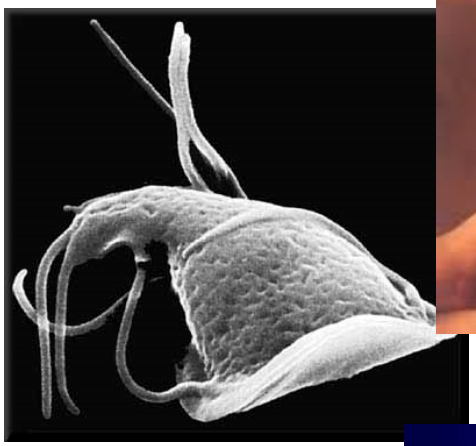
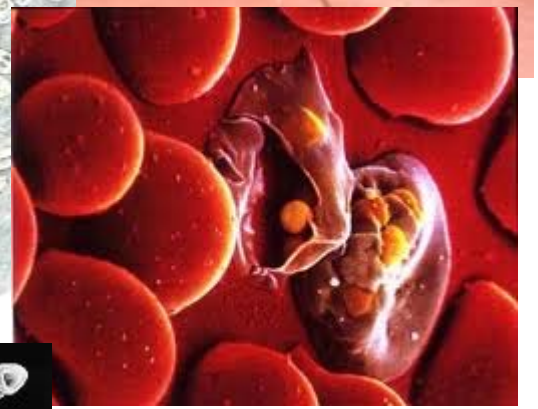
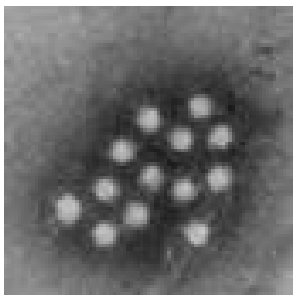
Infectious disease epidemiology: association with water scarcity and agricultural practices







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Principles

1. Food security in disadvantaged regions is highly dependent on the health of farm workers; food importation is a poor alternative to self-sufficiency.

The commitment by the G20 to invest $22 billion in developing-country agriculture is welcome….but labor and water are key components that must be addressed in the drive to local sustainability. In the context of infectious diseases, water and labor are intimately related……

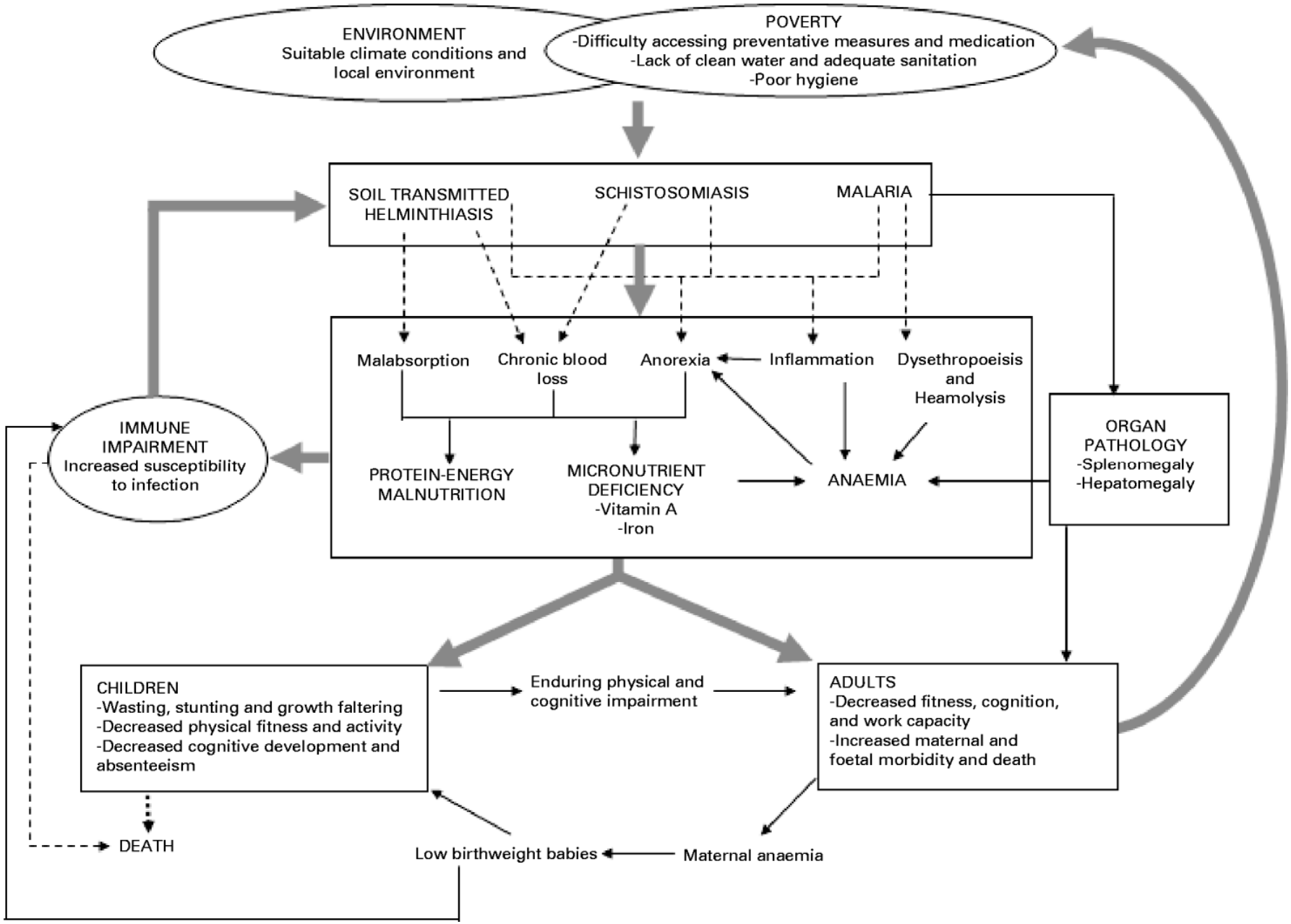
Photo One: Farmer Plowing Dry Soil with Oxen, Senegal
(Photo from Africa Focus, University of Wisconsin)

Principles

2. Water resources are in demand for personal use, sanitation ….and for agriculture (and industry). Population growth places heavy burdens on local water supplies in many developing regions. Inadequate sanitation and limited access to dwindling water supplies intersect dangerously by increasing the risk of infection. Rapidly flowing rivers and dispersed water access sites diminish transmission of water-borne and water-related infections.

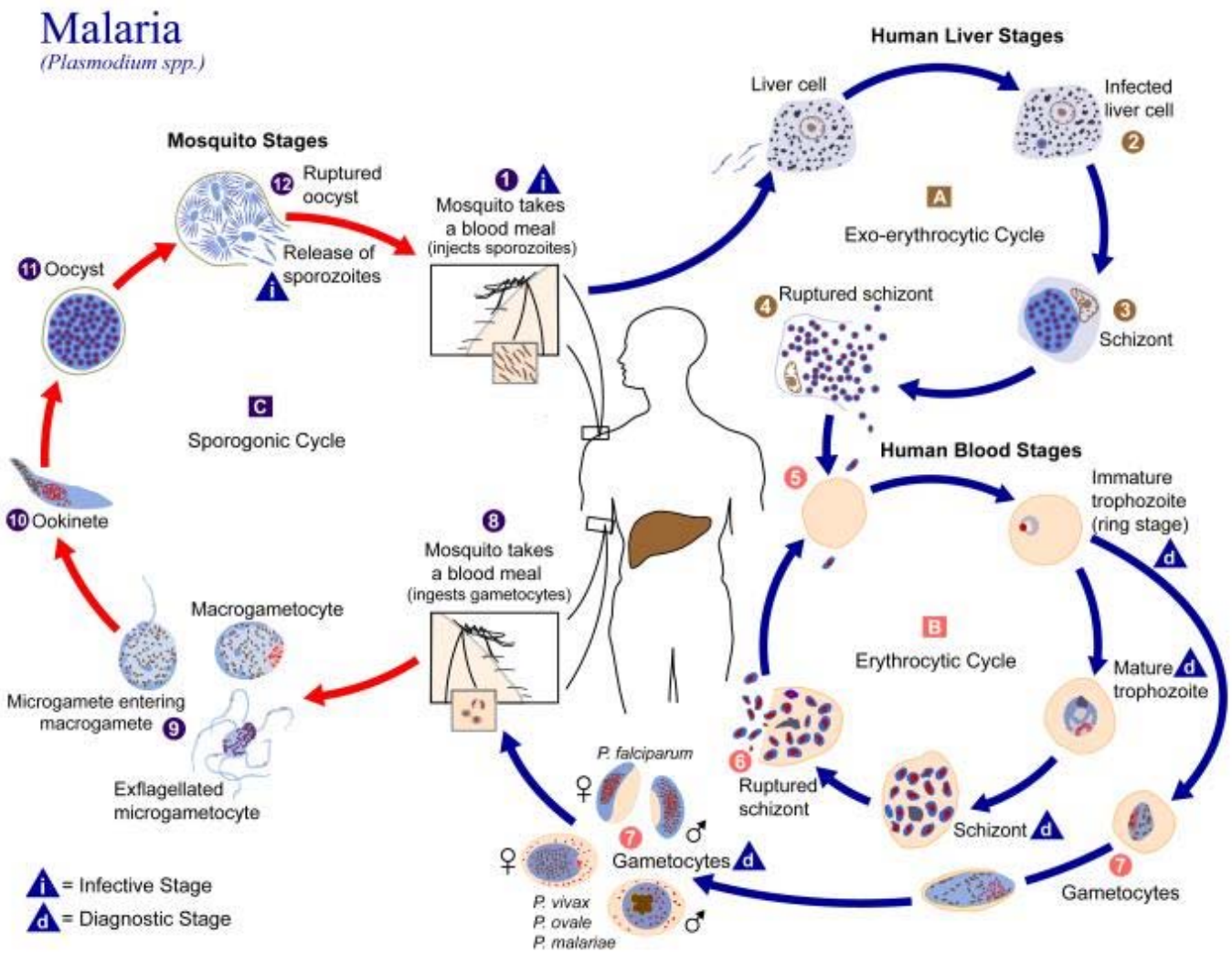
Principles

3. Infectious diseases account for ~50% of mortality in poor regions, including viral, bacterial and parasitic pathogens. Morbidity is an important economic factors: diminished work capacity and productivity; loss of time in field; care for sick family members. Transmission of infectious diseases is dependent on the host population density; water-borne and water-related infections bloom when people congregate around limited water resources. Malaria reduces GDP by 1% in many sub-Saharan African countries.



Pullan & Brooker, *Parasitology* 2008

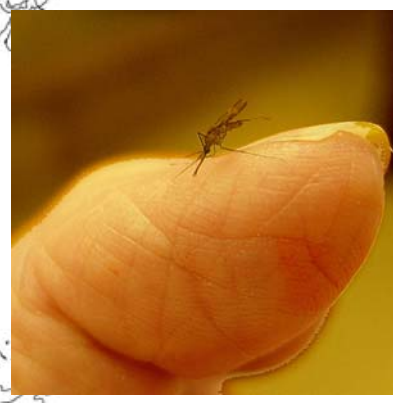
Case Studies



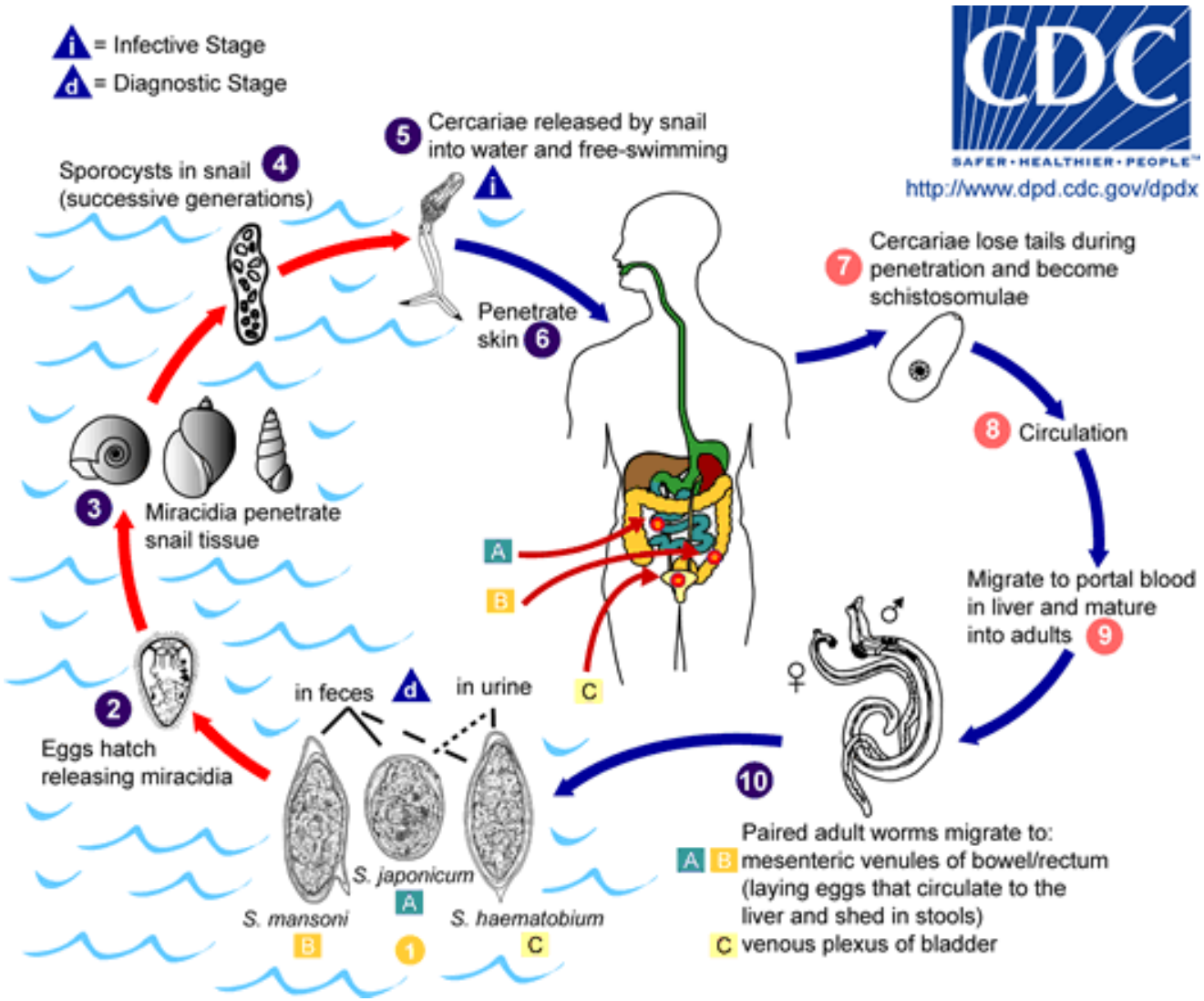
~500,000,000 infections
~1,000,000 deaths

Case Studies

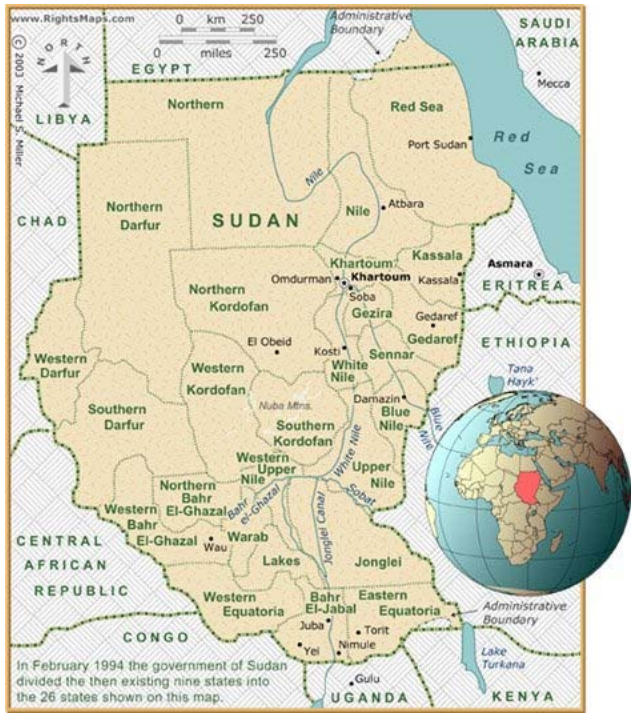
Malaria affected 30 percent of the population in the Tennessee River valley when the TVA was incorporated in 1933. Impoundments in the region provided ideal breeding grounds for Anopheline mosquitoes, and some resulted in serious epidemics of malaria. The TVA project planned a system of reservoirs of ~600,000 acres of water area and > 10,000 miles of shoreline. This programme, in an area where malaria existed to a serious degree, presented an unprecedented control problem. Pre-clearing brush from valleys destined to be flooded, especially in the shallow areas, along with aggressive insecticide/larvicide use (DDT, Paris green, oil), vegetation and water level management, and human population control led eventually to the eradication of malaria in this region….but the problem was greatly exacerbated by the failure to take mosquitoes into account when planning the dams.



Case Studies

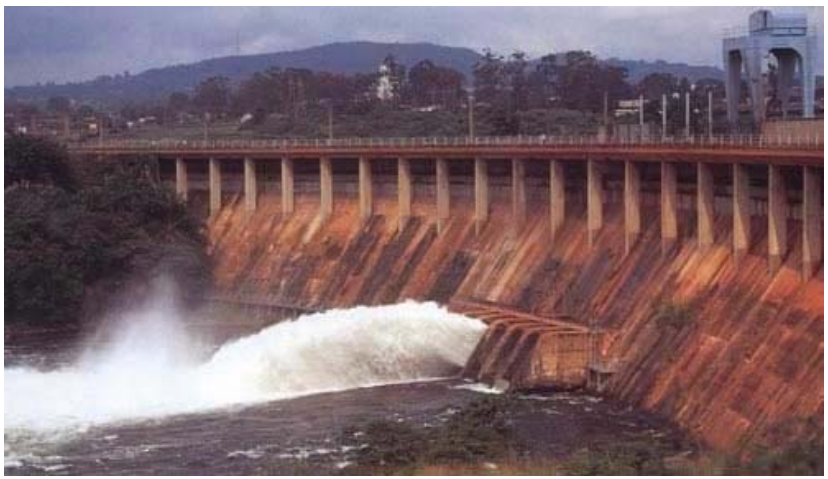


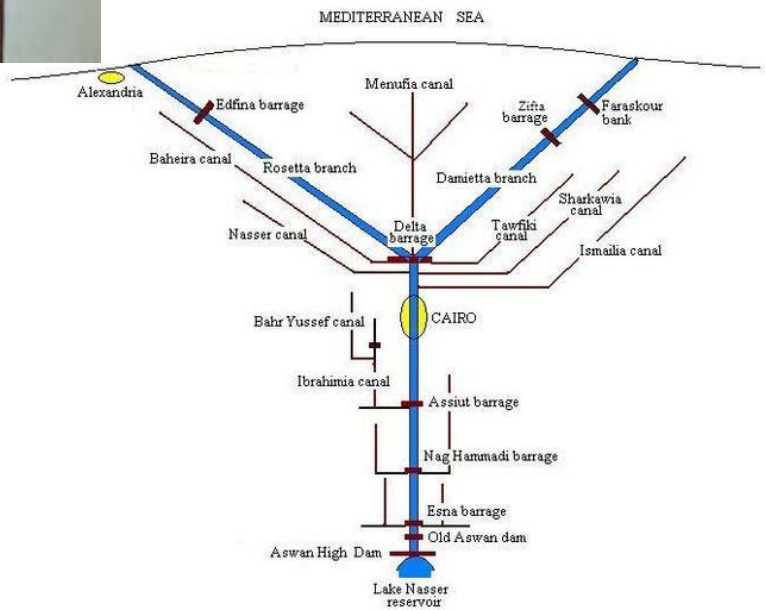
Case Studies



Irrigation canals can provide new and optimal habitat for snails: intermediate hosts for schistosomes. Personal contact with water is required; movement of human populations can spread the infection to new areas.

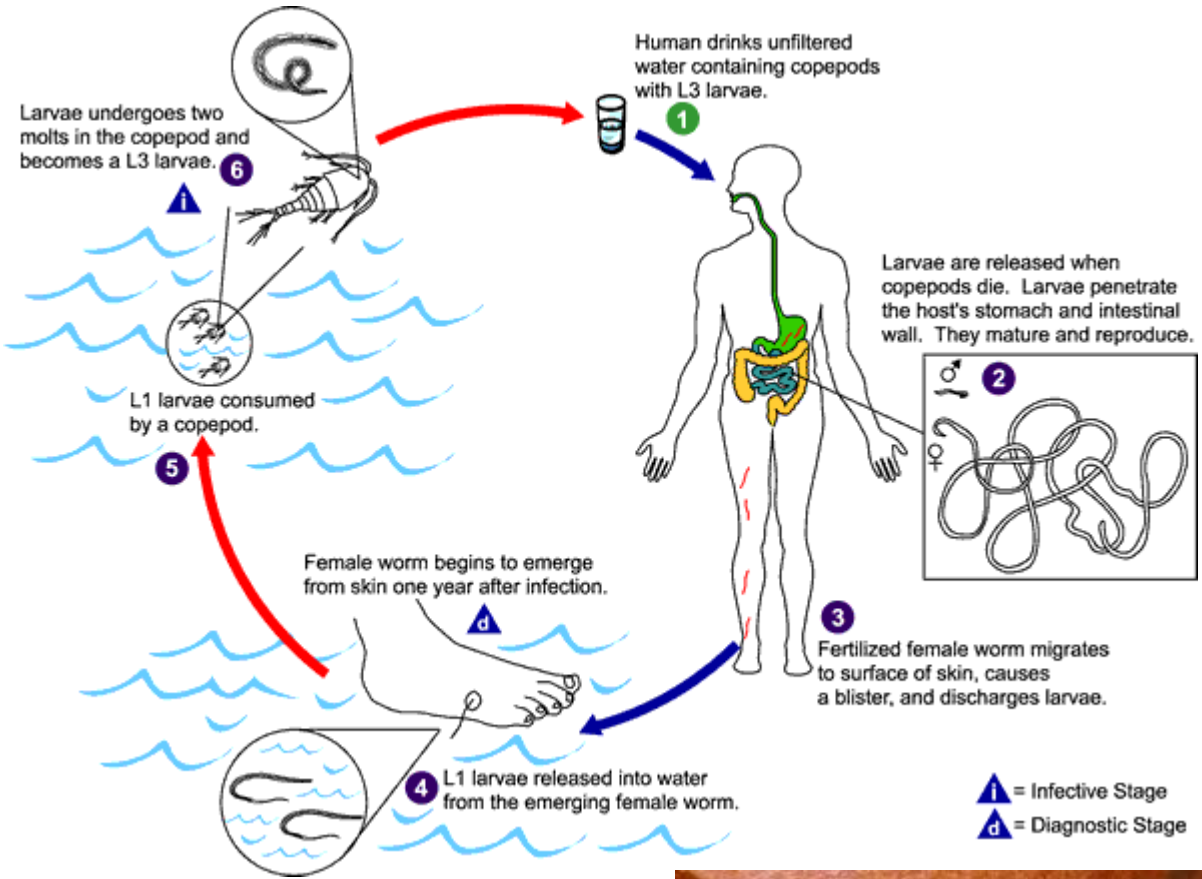
>200,000,000 infections





Sketch of the system of barrages and main canals along the Nile.
Not to scale

Case Studies



***Dracunculus medinensis*: the 'guinea worm'**

~5000 human cases remain (zoonotic)

Eradication based on limiting exposure to water of infected people, physical removal of worms, and filtration of water to remove copepods before drinking

Conclusions

1. **Prevalence of infectious diseases is dependent on host density, allowing for ease of transmission; water scarcity in a local context increases local human density vis-à-vis water-borne and water related infectious diseases.**
2. **Agricultural policies that support production to achieve food security must be sustainable in the context of water demand. Development based on local industry must be similarly based: practices that change access to limited water sources may have unanticipated negative consequences.**
3. **Sanitation alone is not enough; vector control is essential.**

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