Effects of agriculture an vector-borne diseases

Topic E: Land use, vegetation and crops

E.1 View of a varied catchment topography and vegetation in the Philippines
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E.3 Forest clearing and shifting cultivation in Thailand
E.4 Rice cultivation following deforestation
E.5 Shifting cultivation and upland rice in India
E.6 Shifting cultivation and upland rice in Thailand
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E.10 Collecting and transporting wood for the market, Ethiopia
E.11 Resin tapping in a pine forest, Viet Nam
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E.13 Gum tapping in Indonesia
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E.15 Coffee plantation shaded by figtrees, Ethiopia
E.16 Fodder collection in India
The pristine environment of primary forests in tropical areas harbours a great deal of biodiversity. Among the insect species present there may be those of medical importance, but their densities are usually low. Research by Amerasinghe et al. in Sri Lanka (System C of the Mahaweli Development Project) has shown how habitat simplification, occurring when a forest area is developed for irrigated agriculture, can favour important vector species, in the Sri Lanka case *Anopheles culicifacies*.

The current trend to consider the development and management of catchment areas (slide E.1) and river basins in an integral manner, spearheaded by the World Bank, offers new opportunities to incorporate environmental management measures for disease vector control. Where dams are built in a river basin, reservoir fluctuation, downstream artificial floods and salt water intrusion at the estuary may be employed to reduce
vector-borne disease risks. In international river basins, such measures may be hampered by the difficulties of establishing effective institutional arrangements needed for this type of integrated management.

Those involved in forest clearing and shifting cultivation in Thailand are at a great risk of malaria infection. This type of cultivation is often practiced by hill tribes in northern Thailand to grow opium. In Colombia, a similar situation exists in the tropical forest areas where so-called informal agriculture (i.e. the cultivation of coca) occurs, closely associated with intense transmission foci.

The association between deforestation and malaria incidence varies in different parts of the world. Deforestation in West Africa led to a replacement of *Anopheles funestus* populations by *Anopheles gambiae* populations, and to a sharp increase in incidence. In Malaysia, deforestation favoured the principal malaria vector *Anopheles maculatus*, which prefers slow-moving, sunlit stream.

In the forested areas starting west at the Chittagong Hill Tracts in Bangladesh, throughout Myanmar, Thailand, Cambodia and Lao PR, as well as on some of the islands of Indonesia and the Philippines, mosquitoes of the *Anopheles dirus* group are the main malaria vectors. In man-made environments that mimick the forest ecology (rubber plantations) transmission by the same vector occurs.

*Slide E.4*

Populations resettled in recently deforested areas suffer the double risks of the forest fringe. Rice cultivation as shown here in South East Asia carries the risk of Japanese encephalitis outbreaks that occur at intervals when favourable conditions prevail. Such resettled communities often also depend economically on the nearby forest, and will therefore be exposed to malaria transmission by *Anopheles dirus*.

*Slide E.5*

*Slide E.6*

Forest clearing in upland areas of India (E.5) and Thailand (E.6) show the introduction of cultivation on slopes too steep to provide for sustained crop production. As top soil and fertility is lost, farmers will move on to new areas, to clear and destroy new land. A continuing cycle of population movement into potentially hazardous areas is thus propagated, without an opportunity to control either resource degradation and health risk.

Down stream in a catchment area where this cycle takes place, rivers carry excessive amounts of silt, which reduce the lifespan of reservoirs and dams. In floodplains, the silt deposits may change the local ecology to the extent that breeding of mosquito vectors is significantly promoted.

*Slide E.7*

*Slide E.8*
Forest workers often enter the hazardous environment at peak transmission times. The malaria risks of the workers in Thailand (E.7) have already been extensively covered. Their colleagues in Brazil (E.8: a camp of collectors of Brazil nuts in the Amazon region) do not only suffer the risk of malaria but also of muco-cutaneous leishmaniasis, transmitted by sandfly vectors belonging to the genus *Lutzomyia*.

**Slide E.9**

**Slide E.10**

The collection of fuel wood is a daily occupancy for many people in parts of the world where they have no access to or cannot afford other types of fuel. Fuel wood collectors are another vulnerable group when it comes to forest related vector-borne disease risks.

**Slide E.11**

**Slide E.12**

**Slide E.13**

Various types of tree plantations will create the level of relative humidity required by some of the forest breeding malaria vectors. The plantation activities often coincide with peak biting times: gum and resin collection is preferably done at night when yields are highest. Certain perishable fruits (such as the local salak fruit in Indonesia) are collected at night for marketing first thing in the morning.

Oil palm plantations are associated with malaria, scrub typhus and leptospirosis. The distribution of scrub typhus covers the Indian subcontinent, South East Asia and the Western Pacific. The pathogen, *Rickettsia tsutsugamushi*, is transmitted by trombiculid mites belonging to the genus *Leptotrombidium*. Rodents are important reservoirs, but transovarial transmission also keeps the pathogen in the vector population.

**Slide E.14**

**Slide E.15**

Coffee plantations provide an environment which, depending on the local situation, may bring workers into close contact with disease vectors. The choice of the coffee variety and whether or not to have shade trees may have a bearing on the hazards, in particular the sandfly ecology and the epidemiology of leishmaniasis. An additional health hazard, beyond the scope of this slide set but nevertheless worth mentioning, arises from the processing of the berries. The resulting residues with their high organic content can cause serious pollution of local water resources, affecting drinking water supply.

**Slide E.16**

Animal fodder collection in forested zones is another occupation which takes members of rural communities into risk areas for vector-borne diseases.
**Slide E.17**

The Pacific island harbour a form of lymphatic filariasis whose transmission takes place during daytime (as opposed to the nocturnal form transmitted by *Culex quinquefasciatus* elsewhere). The vector is *Aedes polynesiensis*. It breeds in small water collections, with open coconut shells and crab holes contributing significantly to populations densities. Several biological control methods (copepods, fungi) have been tested with initial but not lasting results.

In South India and Sri Lanka, coconut husks undergo a rotting process to release the fibre. Organic material in the coconut husk pits creates a suitable environment for *Culex quinquefasciatus* and this type of cultivation is therefore closely associated with *Wuchereria bancrofti* filariasis.

**Slide E.18**

One way of dealing with water logging is to plant trees with a high water absorption capacity. This method has been used in various field trials of bio-environmental control of malaria by the Malaria Research Centre in Delhi. This integrated approach includes the use of larvivorous fish and physical improvements aimed to reduce seepage and standing water. Community participation is a hallmark of this approach.

**Reference:**

Sharma, V.P. (ed.), 1993. *Community participation in malaria control*. Malaria Research Centre, 22 Sham Nath Marg, Delhi 110 054, India

**Slide E.19**

Settlers moving into the Brazilian rainforests come with many objectives. The health risks they are exposed to go beyond vector borne diseases such as malaria or leishmaniasis. They may range from malnutrition, to sexually transmitted diseases and trauma or death through violence.

Conventional control methods usually have little effect in this pioneer environment, and community based approaches fail in a context where there is frequently very little sense of community to begin with.

**Slide E.20**

**Slide E.21**

**Slide E.22**

Fortunately there are also crops with little or no vector-borne disease risks such as the papaya and cassava plantations shown in these slides.

**Slide E.23**
Farmers’ decisions in crop selection are guided by the marketability of their produce. In this traditionally rice growing area of Tamil Nadu, South India, many farmers switch to sugar cane when the price of rice slumps on world markets. Such changes in the cropping system may have unexpected health repercussions. In this particular case, the longevity of rice field breeding mosquitoes may be extended because of the availability of relatively cool, moist resting places in the cane fields.

Cropping patterns can be influenced by governments through financial incentives (taxation or subsidies) or by imposing import tariffs. In West Africa, for instance, rice consumption by expanding urban populations is rapidly increasing. Governments want to encourage local rice cultivation to save their foreign currency reserves, but to do so they have to instate tariffs on the imports of much cheaper Asian rice to keep local farmers in business. Health implications are seldom considered in such policy decisions; the impact of development policies on health has been the subject of a WHO review (Cooper Weil D.E. et al., see bibliography).

A high level of agricultural skills is needed in Nepal, where only 18% of the total land area is available to support 93% of the population. Vector-borne disease problems, which exist in Nepal, must inevitably be solved within the limitations to feasibility imposed by consideration of cultivation and production. Farming is mainly at subsistence level and per capita income is one of the world’s lowest.

On the positive side of things, transmission risks generally decrease at higher altitudes and the bulk of vector-borne disease problems in Nepal are found in the lowlands of the Terai area.

Lowland irrigated rice production in South Asia (Pakistan, India and Nepal) is associated with malaria and Japanese encephalitis. In the Terai area of Nepal, Anopheles annularis and A. culicifacies are responsible for malaria transmission.

In Pakistan, extensive irrigation in the Punjab suffers from high water tables and waterlogging. A massive water management and drainage programme is underway to correct this. Preliminary analysis, using remotely sensed data, indicated that there is a link between the severity of waterlogging and malaria transmission. The impact on health of the drainage projects is therefore expected to be positive.

In the tropics, irrigated, terraced rice cultivation in small plots is often a continuous process, where at any one time, all different stages of the cropping cycle occur. This creates conditions favourable to perennial malaria transmission. In an historic review of the environmental approaches to malaria control in Indonesia (Takken et al. see bibliography), the case of the Cihea Plains irrigation development on the island of Java is described. After a short period of high productivity, yields went down and many fields remained uncultivated because of high malaria prevalence. After an investigation by malarialogists, improvements in water management and drainage were suggested. In
addition, a less orthodox plan to synchronize the cropping cycle was proposed. Even though this met with initial resistance from both the irrigation authorities and the farmers themselves, it was eventually implemented with great success, reducing the transmission period and intensity substantially.

**Slide E.27**

A diverse rice agro-ecosystem such as this scene from Bali harbours more health hazards than vector-borne diseases alone. Lack of adequate sanitation will promote the prevalence of intestinal helminths, such as *Ascaris*, hookworm and *Trichuris*. Damp conditions inside houses and indoor air pollution from stoves will contribute to respiratory diseases. If communities have no access to safe drinking water, risks of gastro-intestinal infection are high. Zoonoses and rodent-borne diseases may also take their toll and in some irrigated rice areas in Asia and Africa, snakebite as a cause of mortality cannot be neglected.

In a sufficiently balanced ecosystem, however, such disadvantages may gradually disappear as farmers improve their living conditions, invest surplus income partly into community services, and obtain a better access to health services. Health risk reduction and management can greatly accelerate the development process and improve quality of life.