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ANTI-LARVAL OPERATIONS - SOURCE REDUCTION DRAINAGE AND FILLING

by

Mr Z. J. Buzo
Sanitary Engineer
DIS Unit, WHO/HQ

Future land and water use projected

The probable future land and water use of the area in question should be studied, and projects which permanently affect the environment should be designed so as to benefit the local economy. Most large sources could be eliminated or controlled in several ways; analysis should be made to determine for the particular source whether it should be drained so that it could be reclaimed to agriculture or other productive use; whether it should be converted to a reservoir or lagoon; or whether the water should be conserved by diversion to a reservoir at a more suitable source above or below the site of the mosquito source.

Drainage of large areas

Where a decision is reached that drainage should be employed, a number of steps will be necessary:

(i) Determine the depth of the lowest point which must be dewatered; in some instances, the surface elevation of swamps may need to be lowered only a small amount to draw off from the shallow margins the water in which the vector mosquitos occur, leaving the deeper areas as open water which may be stocked with mosquito fish; conversely, in other locations raising the level by installing a low dam at the downstream end may flood the flat shallow margins so that mosquito production is eliminated by wave action and predators. Where only a small change is required the water control works may be more economically constructed.

(ii) Determine by survey the location of a suitable outlet, at an elevation low enough to permit a drainage canal or ditch to be constructed which will have a satisfactory hydraulic gradient. The route the ditch should follow and the cuts and excavation that will be required should be determined at the same time.

(iii) Analyse the effect of the probable maximum and minimum flow on downstream water users, and on downstream vector production.

(iv) Determine what should be done with the spoil; on some large projects it can be used advantageously to fill the lowest points of the area to be drained, thereby lessening the required depth of the outlet channels, or it may be used beneficially for filling small locations which might otherwise require supplementary drains.

(v) Where deep cuts are needed, analyse the desirability of installing pipe or other conduits, or ditch liners to minimize maintenance. Also protect ditch banks where erosion may be expected to occur.

(vi) Where the ditch line will cut regularly travelled trails or roads, crossings should be provided. These should be ample to withstand anticipated maximum flow.

(vii) Where very high flood water conditions occur only occasionally, particularly if this occurs only at off-season when Anopehles vectors are not likely to develop, the principle of by-passing the excess flood flow through its natural route may be followed, so that the vector control flow need only accommodate the normal low flow conditions. Where such a system is installed, the low water flow structures must be separated from the flood overflow and protected by levees so that they will not be damaged by the high water flow. This is common practice in flood water areas. It can be accomplished most easily where the low flow is through enclosed conduits, but can also be provided for by open ditch systems where the low flow ditches are separated from the flood flows, and a control at the entrance limits the volume which can enter to the capacity of the waterway.

(viii) Plans must always be made for regularly scheduled maintenance of large area water control structures, for next to inadequate design, neglected maintenance is probably responsible for the failure of more drainage structures than any other cause. A little maintenance at the right time may prevent very costly maintenance if delayed until a failure has occurred.

Filling

(i) Small fills

In and near communities where people live and where malaria transmission is taking place, a high priority should be accorded to the filling of unused holes or other excavations which hold water serving as a habitat for Anopheles larvae. Included in this category are borrow pits, abandoned ditches, holes where trees have fallen, unused irrigation ditches, adandoned wells, etc. For the very small places no particular engineering skill may be needed; only the intent to eliminate the mosquito source and the necessary input of labour and materials. Waste materials are often available which can be used for the bulk of the fill, but no fills should be left without being topped off with clean earth and the area then graded and left appearing as attractive as may be practicable. Where the area can serve a useful purpose after filling, a double gain will have been made.

The smallest places may be filled with no tools except hand shovels and hand barrow or wheelbarrows, but scrapers and bulldozers lessen the labour load greatly on larger areas. In places where machines are not available but beasts of burden are commonly employed, these may be substituted as motive power for small scrapers ("Fresno scraper") etc.

Fills, whether large or small, should always be graded in the direction of the general land slope so that water will run off in its natural direction and earth from higher land areas may be brought down into the low places to establish the desired grade.

When fills are made where depressions extend below the ground water level so that water stands continuously before filling, the fill should be begun at the "up-slope" end, so that as the filling proceeds, the water will be pushed ahead of it towards the natural outlet.

(ii) <u>Natural fills</u>

A somewhat special case often occurs where there is frequent heavy rainfall so that ditches and streams which debouch on to low, flat areas tend to carry considerable amounts of silt. By appropriate planning, the silt may be trapped to create a "natural fill", in due course eliminating a swamp or intermittent flooded area. The process is much like that employed in hydraulic filling: the incoming silt laden stream is diverted to discharge just above the low point of the area to be filled, and the outlet of the marsh or low area is restricted by temporary gates and levees as may be necessary to cause silt-bearing water coming on to the area to quickly flood over the low points, spreading out to form a "water dam" and immediately losing most of its initial velocity, so that the silt may settle to fill the lower portions. In such an installation, the dam at the lower end should be of a height no greater than the final elevation wanted, it should provide for overflows and it should have provision so that the normal "low-flow" of the ditch or stream can pass through continuously. The silt trap so constructed functions only at times of high flow when the water may be expected to carry more than the normal amount of silt.

The outlet gate may be made in the form of a vee, so that as the inflow increases, the outflow, though continuously restricted, gradually increases when the surface level of the settling basin increases, thereby accommodating the excess while continously allowing

... filled.

... employed when it is desired to desilt ... would otherwise result in unwanted ... waterway further downstream.

(b) Large ... fills

... areas may be filled in this way by means of hydraulic fills ... which large size specially designed centrifugal pumps ... (pipe size) on "suction dredges" suck up silt from the bottom ... waterway, carrying the silt suspended in water which moves ... velocity (usually more than 10ft/sec.) through a pipe ... finally debouch into a silting and settling area at the ... end of the pipe, where the fill is to be made. A hydraulic suction dredge usually moves only about 10% to 15% solids, but the larger ... move such great volumes that this may be the lowest ... to obtain large fills. The smaller sizes are much less efficient, and probably no dredge smaller than the 8" diameter pipe size should be considered.

Projects of this kind are rarely attempted solely for malaria or mosquito control, but when such a project is implemented in connection with the dredging of a river or harbour, arrangements may sometimes be made to have the soil deposited so as to eliminate a large source of Anopheles mosquitos. Many beneficial projects of this type have been accomplished in the industralized countries (an outstanding example is the disposal of dredgings from the Panama Canal, which eliminated thousands of acres of difficult to control vector Anopheles breeding places).

As major land and water use projects are instituted in developing countries, the eliminations of malaria vector sources may be obtained if alert malaria eradication personnel can guide the agencies carrying on the projects in the disposal of the soil.