Environmental and Water Management for Vector Control[1]

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The increased concern about vector population: and disease associated with the development of water management projects, coupled with vector resistance to pesticides and failure to eradicate disease, has revived interest in environmental management methods for the control of vector populations. Environmental management for vector control has been defined as the planning, organizing, carrying out, and monitoring of activities for modifying and/or manipulating environmental factors or their interaction with man, with a view to preventing or minimizing vector propagation and reducing man-vector-pathogen contact.[3] Historically, environmental management methods were a major component of vector control, hut were replaced by the use of pesticides in the **1940's.** Today, many of these methods are lost, along with their documented impact upon vector populations and disease.

Integrated Vector Control

An integrated vector control program is defined as the utilization of all appropriate technological and management techniques to bring about an effective degree of vector suppression in a cost-effective manner4 Such a program should involve a continuous process ***of*** education, re-education, training, and re-training of program directors because of the increased diversity of methods and equipment. Environmental techniques and methods, accompanied by effective educational and training programs, must be based on data from currently successful programs. Organizations and agencies should critically review these techniques and methods before they are accepted and implemented.

A knowledge of the epidemiology of the disease and the ecology and biology of its vector is essential for the implementation of effective environmental management techniques. Today, **as** we discuss malaria in Sri Lanka - and especially how malaria is related to irrigation and the Mahaweli Project - a major consideration must be the implementation of vector control activities and education and training programs for personnel involved in water management. The development of education and training programs is complex because it must take into account the differences in personnel backgrounds, applicable data, and availability of educational and training materials.

For the past four years I have been a member of a team teaching a course on stormwater management facilities for engineers. This is part **of** my responsibility in managing the section on environmental and mosquito problems associated with stormwater facility development. Stormwater management became an issue when mosquito control personnel in New Jersey observed an increase in the number of mosquito problems associated with stormwater facilities. Research showed that problems were created by the design, construction, and

[1] New Jersey Agricultural Experiment Station publication 0-40502-01-85

[2] Mosquito Research and Control. Cook College-Rutgers University, New Brunswick, NJ. USA.

[3] World Health Organization. 1981. Manual *on Environmental* Management for Mosquito Control wirh Special Emphasis on Malaria Vectors. Geneva: WHO Publication No. 66. 283p.

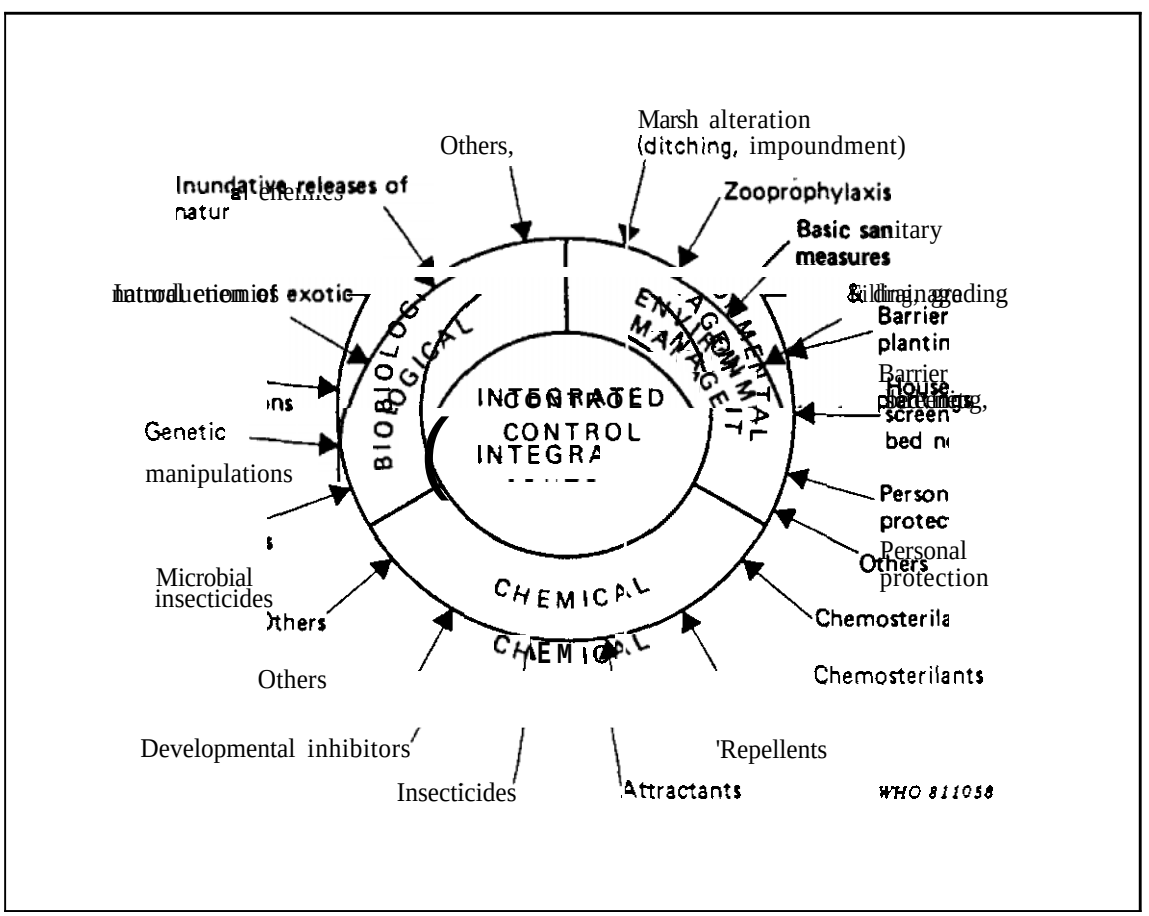
[4] Mather, T.H. and T.T. That. 1984. Environmental *Management for* Vector Control in Rice Fields. Rome: FAO. 152p. World Health Organization. 1983. Integrated Vector Control. Seventh Report of the WHO Expert Committee on Vector Biology and Control, Technical Report Series No. 688, 72.

maintenance of these facilities. The data generated by this research arc the basis for my contribution to the course. The course by objective is to instruct engineers about the potential mosquito problems and their prevention through proper design and construction. The attending engineers have developed, through several years of experience, their own methods of handling problems associated with stormwater management. They are usually involved only in the design phase of projects, while other engineers, perhaps from another **firm,** oversee the construction, hut none of these would he involved in maintaining the project.

A parallel can he drawn with water development projects worldwide, where changes occur in personnel and firms **as** the project moves from conception to operation. Training of all personnel involved in a project must be a major component in the implementation of integrated vector control programs. **A** major constraint on the development of education and training programs is the lack of avn ilable data, particularly in environmental management. These programs must he based on case stu dies and "hard data to **support** the selection of environmental management techniques. The educational and training materials should he group-specific, including publication in the appropriate language.

4n examination of Figure 1 reveals that education is not included. Note should be taken of the

Figure 1. Diagram of the components (environmental manrgement, chemical, biological) and their potential constituent methods to he considered in an "integrated control" approach to mosquito control[5]



[5] Axtell, R.C. 1979. Principles **of** integrated *pest management* (IPM) in relation to mosquito **Control, *Mosquito News*** 39:709-718.

research carried out on the various components of this diagram. Recent literature includes very few studies which deal with environmental management methods, Most research on environmental management is mrried out in the United States and is done by the individual mosquito abatement districts or states involved in mosquito control. There appears to be no federally-funded research projects or positions in environmental management for mosquito control. Several short-term and relatively small projects have been funded through Coastal Zone Management funds or with grants from individual federal departments. Even the well-planned and classic multidisciplinary Riceland Mosquito Management Program in the southern USA[6] did not include a significant environmental manage.. ment component.

Since research on environmental managemeni methods cannot be carried out over the short term it is difficult to obtain information appropriate for publication. A year's research on a pesticide can generate a number of publications; in environmental management one year of research will produce only a preliminary study which must be followed by the application of the environmental management method. Several additional years will be required to determine the effects of the application. This lengthy process creates problems of funding and professional advancement for researchers in this discipline.

Evidence of increasing interest in environmental management and vector control is the formation of the WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control (PEEM).

The 1984 paper on vector control in rice fields by Mather and That (see footnote 4) proposed five criteria for environmental management methods which should be applicable to any type of water management project. Methods must be:

1. known to be effective against the identified problem vector(s);

2. he socially acceptable;

3. cost effective when compared with other feasible methods;

4. economically sustainable by the community at some agreed level of responsibility; and,

5. compatible with local crop production techniques.

In using these criteria, it is important that databases be developed, through literature review and research, to implement effective integrated vector control programs in water development projects.

The International Irrigation Management Institute (IIMI)

IIMI's objectives offer ideal opportunities to implement irrigation schemes which could serve as models, and to develop the database and educational strategies so urgently needed. IIMI has three research programs:

Rehabilitation of irrigation projects. A major objective in future irrigation development will be the rehabilitation of older irrigation systems. The opportunity to study the disease and its vectors in a functioning system make these old systems ideal research environments. Their rehabilitation will provide the opportunity to implement vector control methods. This kind of work has been done at various locations around the world but it appears that a collaborative study by vector control specialists and engineers has occurred only once, at the Tennessee Valley Authority (TVA).

Vector habitats do not occur throughout the entire irrigation system nor are vectors found during all seasons. Therefore, detailed studies on where and when the vectors appear, and why they are not present in some areas of the system, will develop a database that will allow the rehabilitation engineers to eliminate vector habitats. Thus, a close working relationship between vector control specialists and engineers should be required on all projects.

[6] Olson, J.K. et al. 1981-1983. Project Summaries. Washington. DC: Riceland Mosquito Management Program, Office of Research and Development. US Environmenta Protection Agency.

Main system management. Main system management usually deals with water control throughout the system. Here, the application of environmental management methods for vector control becomes more of an administrative duty. The most common of these administrative duties would be selecting fields for intermittent irrigation, selecting crops and determining rotations, and assigning committees and personnel duties. An awareness by the administration personnel of the impact of certain management programs upon vector populations and disease transmission could eliminate future problems. Again, the need is for a working relationship between vector control specialists and administration personnel to determine the selection and timing of environmental management programs which can be implemented without changing the objectives or the general management of the irrigation scheme.

Small-scale village-operated irrigation systems. The small-scale or community-run irrigation system offers an excellent opportunity to implement certain environmental management programs in conjunction with education and training. Because of the diversity of systems, locations, and crops, it will be difficult to develop comprehensive techniques, but certain generalizations can be applied and details concerning the vector biology of individual species or selected areas can be obtained from a database.

The education of farmers concerning integrating environmental management techniques into their work scheme must be related to the objectives of their irrigation system. If significant changes in these objectives are required in order to implement environmental management methods, the control program will fail. The major challenge is to incorporate integrated vector control strategies into farmer education programs worldwide.

The importance of an integrated approach was demonstrated recently in an anti-malaria program in Zaire. Field inspections showed that fish ponds played a predominant role in the propagation of vector species.[7] These have been constructed throughout the area by various organizations for developing protein resources. Apparently it was assumed that the fish would eat the mosquito larvae. However, not all species of fish eat mosquitoes, nor do all fish species penetrate the surface vegetation to feed upon mosquito larvae. A simple component of vector control in the education system for developing aquaculture could have prevented this problem.

Conclusion

Important initial steps are being taken by PEEM to develop collaborative centers in the fields of irrigation and rice culture research. This should be followed by establishing a working relationship between the vector control and irrigation specialists to cevelop both the databases and the educational and training materials needed in developing and operating future irrigation schemes.

Research should address the major problems associated with the design, construction, management, and maintenance of irrigation systems. The data and results, translated into the appropriate language, must be made available to the various organizations and personnel involved with irrigation systems.

'Brooks. G.D. *and* J.K. *Shisler.* 1980. *The feasibility of. and recommendations for, anti-larval measures against vector Anophelines in Zaire. Washington.* DC: *American Public Health Association.* 28p. *Shisler,* J.K. *and* G.D. Brooks. 1981. *The application* of *water management methods* for *controlling* vector-mosquito *populations in Tropical Africa, Proceedings of New Jersey Mosquito Control Association* 68:32-36.