MALARIA VECTOR BREEDING AND IRRIGATION: AN EXPERIENCE FROM PAKISTAN

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Malaria is the most prevalent and devastating parasitic disease in tropical countries and has compelled the attention of the public health workers and policy makers. It kills more people than any other communicable disease except tuberculosis. Besides, a major threat to health of millions of people, it also causes a severe hurdle to the economic development of tropical and subtropical countries of the world. Malaria is endemic in a total 101 countries, 45 are WHO's African Region, particularly sub-Saharan Africa, with 41% malaria cases, 20 in WHO's Americas Region with 3% cases, 14 in Eastern Mediterranean Region with6 % cases, 4 in Europe with 3% cases, 8 in South Asia Region with 23% cases and 9 in WHO's Western Pan Pacific region, with 24% cases. Now malaria also returning to Central Asia due to poor scio-economic conditions and civil war.

Malaria prevalence in Africa:

Of total world population about 5.4 billions, 2200 millions (40%) are exposed to malaria infection in some 90 countries and globally there are 300-500 million clinical cases of this disease annually. Malaria is also the cause of an estimated 1.4 – 2.6 million death or 5000 – 6000 deaths per day in the countries of third world (WHO, 1995). Malaria is the most serious health problem facing in the countries of Africa and the most recent estimate indicates that 93% of 550 million people living in this region are at the risk of malaria. The areas of highly endemic with stable malaria transmission are Angola, Benin, Burkina Faso, Cote d'lvoire, Congo, Eritrea, Ethiopia, Ghana, Kenya, Mali, Mauritania, Mozambique, Niger, Nigeria, Senegal, Tanzania, Uganda, and Zambia and more than 75% population of African Region is in these countries. Of total 1.4-2.6 million deaths, more than 90% occur in Africa, south of the Sahara**.** Here, children particularly below the age of 5 year are chronic victim of malaria and this disease cause 2 deaths per minute and 600 more children start a loosing fighting for their lives in each minute. Very severely affected children often die within 24 hours**.** This disease is also one of the main reason of absenteeism from their schools**.** In human, the malarial parasite spread from one human to another one by some species of *Anopheles* mosquitoes. There are total 522 species of this genus, of which 74 have been recognized as malaria vector, of which 25 are most important and considered as primary vectors. In each geographical condition there are usually four to five *Anopheles* species which are considered the vectors of the malaria. In West Africa the main vector is *An. funestus*. However, the main vector in sub Saharan Africa is *An*. *gambiae*.

Malaria Vector Breeding and Irrigation development:

No doubt, irrigation development has brought a green revolution in world, but on other side this development has also been associated with some negative effects on human health. particularly with respect to vector-borne diseases. However, the worldwide the role of irrigation in malaria transmission has received much attention and studies have yielded a complex picture. In areas with stable malaria transmission where populations have developed immunity to malaria, the introduction of irrigation does not significantly worsen transmission. However, in areas where malaria is unstable, the increased densities of vectors resulting from irrigation can lead to increased malaria. There is conclusive evidence in more recently constructed schemes in neighboring India just across the border from our study area (in Rajasthan, India) for increased malaria transmission as a direct result of the introduction of canal-irrigation. Here after this canal irrigation system development, malaria scenario has worsened remarkably. This prompted us to look into the situation for the Pakistani Punjab where more than 70% area is under surface irrigation but the possible linkages with malaria have not been studied. (ALL ATUDIES ABSTRACTS AT AT THE END). We carried out our investigations to better understand whether irrigation-related water bodies within and around villages in Punjab indeed support anopheline breeding and whether this translated into high vector densities and significant malaria transmission. Our observations indicate that irrigation structures offer ideal habitats for the proliferation of anophelines, including vectors of malaria. In South Punjab, Pakistan where rainfall is low, it appears that most breeding sites are, in one way or another, linked to the irrigation system. Because in such arid areas anophelines appear to be restricted to irrigation-related sites.

Irrigation Development in Sub Sahara Africa:

Definitely, development of irrigation projects in Africa will improve the living standard of people. But on the other side we should also consider their impacts on human health from vector borne disease point of view. Such development always result in creation of new breeding sites of malaria vector. It is quite clear from studies we conducted here in Pakistan as well as some others some others like from India. In africa malaria prevalence review shows that malaria is not only major killer of our African people, but also major hurdle to overall economic development of African region. Therefore, there is burning need in africa NOT only to increase the irrigation development but ALSO the proper management of such existing and new develping system. We should consider this aspect of irrigation development in realastic way and also to find some environmental and water management strategies to reduce the breeding of malaria vector and ultimately malaria transmission in Africa.

Abstracts of studies carried out in Pakistan:

A). The decreasing effectiveness of conventional malaria vector control methods has led to the re-emergence of environmental management as a possible alternate strategy for the reduction of mosquito vector breeding sites and health risks associated with them. The design and operation of irrigation systems can be modified to prevent the proliferation of malaria vectors and reduce malaria transmission. The objectives of the study were to assess the importance of irrigation system components in the generation of

malaria vectors, as a first step to identifying and designing environmental management interventions for the control of disease vectors. All surface water bodies in and around three selected villages along an irrigational distributary in Haroonabad, Southern Punjab, Pakistan, were surveyed on fortnightly basis for anophelines mosquito larvae (Diptera: Homoptera) from April 1999 to March 2000 as a part of an investigation into the potential linkage between irrigation and malaria transmission in Pakistan. The selected villages reflected a continuum of habitats from severely waterlogged to desert conditions. The samples were characterised according to exposure to sunlight, substratum, presence of vegetation, fauna, physical water condition (clear/turbid/foul). Also water temperature, dissolve oxygen (DO), electro-conductivity (EC) and pH were noted in situ. The species composition differed among the villages. The predominant species were *An. culicifacies* followed by *An. stephensi* in the waterlogged village and *An. subpictus* in the desert village. Overall, our results indicated that irrigation related sites in South Punjab do support the breeding of anophelines mosquitoes, including malaria vectors. The major malaria vector in Pakistan, *An. culicifacies* and *An. stephensi* occurred at relatively low densities, mainly in irrigated and waterlogged fields. Important parameters determining the occurrence of anophelines included physical water condition and presence/absence of predators. No relationship could be detected between mosquito larvae and water temperature, DO, EC, and pH. In south Punjab the rainfall is low which make possible the reduction of vectors' breeding through water management, as anophelines breeding sites are directly or indirectly linked with intensive canal irrigation system.

B). Wastewater agriculture has become a widespread practice in arid and semi-arid countries. Despite its health hazards, partially treated or untreated wastewater provides dual benefits of water and nutrients for crops. However, the potential role of wastewater treatment system to serve as a breeding ground of mosquito vectors of human diseases has been neglected remarkably. The objective of this study was to investigate the health risks associated with mosquito breeding in a wastewater treatment and irrigation system at a site on the outskirts of Faisalabad city, Pakistan. Fortnightly mosquito larval collections were made from July 2001 June 2002. Wastewater treatment ponds were classified as anaerobic and facultative depending upon the degree of treatment and their surrounding area was divided into three zones with respect to patterns of irrigation. A total 3110 collected samples yielded 682,731 *Culex* larvae of six species, viz., *Cx. quinquefasciatus* Say (61.70%, vector of Bancroftian filariasis and West Nile fever), *Cx. tritaeniorhynchus* Giles (30.22%, vector of West Nile fever and Japanese encephalitis), *Cx. pipiens* Linnaeus (7.68%), *Cx. bitaeniorhynchus* Giles (0.08%), *Cx. pseudovishnui* Colless (0.32%) were collected. Also 125,142 anophelines were collected representing eight species viz., *An. subpictus* Grassi (55.95%), *An. stephensi* Liston (36%, vector of malaria), *An. culicifacies* Giles (5.5%, vector of malaria), *An. peditaeniatus* Leicester (1.5%), *An. nigerrimus* Giles (1.5%), *An. pulcherrimus* Theobald (1%). Irrigation sites also significantly supported the breeding of above mentioned vectors. Present study shows that wastewater treatment and irrigation systems have a significant role in the generation of potential vectors of human diseases, and emphasizes the need for more

research on this neglected issue, finally to develop appropriate environmental and water management strategies for disease vector control.

C). Mosquito breeding within the wastewater irrigation system around the town of Haroonabad in the southern Punjab, Pakistan was studied from July to September 2000 as part of a wider study of the costs and benefits of wastewater use in agriculture. The objective of this study was to assess the vector-borne human disease risks associated with mosquito species utilizing wastewater for breeding. Mosquito larvae were collected on a fortnightly basis from components of the wastewater disposal system and irrigated sites. A total of 133 samples were collected, about equally divided between agricultural sites and the wastewater disposal system. Overall, 17.3% of samples were positive for *Anopheles*, 12.0% for *Culex* and 15.0% for *Aedes*. Four anopheline species, viz., *Anopheles stephensi* (84.3% of total anophelines), *An. subpictus* (11.8%), *An. culicifacies* (2.0%) and *An. pulcherrimus* (0.2%) were present, as were two species of *Culex*, viz., *Cx. quinquefasciatus* (66.5% of culicines) and *Cx. tritaeniorhynchus* (20.1%). *Aedes* were not identified to species level. The occurrence of different species was linked to particular habitats and habitat characteristics such as physical water condition, chemical water quality and presence of fauna and flora. Anophelines and *Aedes* mosquitoes were mainly collected during the month of July while *Culex* were collected in September The prevalence of established vectors of human diseases such as *An. stephensi* (malaria), *Cx. tritaeniorhynchus* (West Nile fever, Japanese encephalitis) and *Cx. quinquefasciatus* (Bancroftian filariasis, West Nile fever) in the wastewater system indicated that such habitats could contribute to vector-borne disease risks for human communities that are dependent upon wastewater use for their livelihoods. Wastewater disposal and irrigation systems provide a perennial source of water for vector mosquitoes in semi-arid countries like Pakistan. Vector mosquitoes exploit these sites if alternative breeding sites with better biological, physical, and chemical conditions are not abundant.

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