

Use of Mosquitofish for Dengue Vectors Control in Pakistan.

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In Pakistan, dengue is the most rapidly spreading vector-borne viral disease since 2005 and outbreaks have been attributed by weather and environmental changes, vector species composition, behavior, population dynamics and immunity level in local population. *Aedes aegypti* and *A. albopictus* have been considered major vectors of dengue in Southeast Asia including Pakistan. Both species have been specifically associated with human dwellings due to their breeding preference for clean water domestic habitats. In the absence of a vaccine, vector control strategies that include chemical, biological and environmental management is the foundation for dengue prevention and control. However, the use of insecticides has always given the top most priority. Since the existing vector control tools have some limitations in terms of cost, delivery and long-term sustainability, therefore it is compulsory to select “*time and target specific*” vector control intervention(s) based appropriate entomological and epidemiological evidences and must be carried out in both inter-epidemic and epidemic periods involving local communities.

The use of mosquitofish is considered a cost-effective and environment friendly biological method of mosquito control. These fishes are small with size range of 0.5-3.0 inches, which can eat upto 200 mosquito larvae in a day *when used properly or correctly*. Currently many mosquito control programs are using this intervention as one of the main defense-line against mosquito breeding without harming the ecology of area or the fauna of indigenous fish and amphibians. Worldwide Gambusia (*Gambusia affinis*) and Guppy (*Poecilia reticulata*) are being used extensively in many mosquito control program after careful and intensive mosquito breeding sits assessment surveys. *Gambusia* is a large group of fish having 43 species, most of which are found in freshwater habitats. Other important species are Goldenfish (*G. aurata*) and koi however these mosquitofish species are not as effective as *G. affinis*.

Globally, there is always a big debate over the efficacy of mosquitofish and it is strongly recommended not to release mosquitofish in wider habitats like ponds, lakes etc. However, these mosquitofish are effective and successful when use in small clean water habitats like small public ponds, ornamental ponds, animal water troughs, bird bath fountains, big money plants vassals, unused and broken swimming pools which are free from excessive organic and non organic materials.

Large ponds always have *excessive organic materials* that include leaves, grasses, fruit, dropped branches and flowers etc. Such habitats also have green plant algae which maintain the oxygen balance in pond and also serve as a good source of food for fish. However the heavy accumulations of these organic materials which are the general characteristics of open large ponds consume more oxygen through excessive and rapid decomposition making these ponds unfit for mosquitofish and adversely affecting their efficacy to consume larvae, pupae and eggs of mosquitoes. Among non-organic characteristics, Biochemical Oxygen Demand (BOD), Electro-conductivity (EC), Total Dissolve Salts (TDS), and ammonia (NH₃) level etc which further compound the situation and subsequently results in a rapid death of mosquitofish.

In Pakistan surface water bodies like open ponds have extremely higher concentration of organic and non-organic pollutants due to these physio-chemical and biotic characteristics favor the breeding of only those mosquito species which have a wide range of tolerance against above mentioned physio-chemical characteristics of habitats. *Culex quinquefasciatus*, *Cx. pipens fatigans* and also *Anopheles subpictus* are the major species which prefer such polluted breeding sites while these characteristics of habitats also completely prevent the breeding of both dengue vector species *A. aegypti* and *A. albopictus*. On the other hand, open and large habitats having *clean water* like rice field, commercial fish ponds, and irrigation channels provide attractive breeding sites for *Cx. tritaeniorhynchus*, *Cx. bitaeniorhynchus*, *Cx. pseudovishnui*, *Cx. vishnui*, *Anopheles culicifacies*, *A. stephensi*, *A. pulcherrimus*, *A. nigerrimus*, *A. peditaeniatus*, and *A. barbirostris* in Pakistan but no breeding of both dengue vectors particularly *A. aegypti*.

Similarly, these organically pollutant habitats also provide an excellent attraction for many *natural pond residents* which include; giant water bugs, water beetles, diving beetle, damselfly larvae, dragonfly larvae, water scorpions, water boatman, and backswimmers, water strider, tadpole (frog or toad), and midge etc. The natural presence of these native mosquito-larvae eating insects particularly water beetle, diving beetle, backswimmer, and dragonflies in such habitats have shown considerably more effective control on mosquito breeding than introduced *Gambusia*. On the other hand when mosquitofish will be released in such habitats they will eat other insect youngones instead of mosquito larvae. Therefore mosquitofish will not drastically reduce mosquito larvae populations in large water bodies rather these mosquitofish in these natural habitats has a detrimental affect on other mosquito-eating insect and native fish populations. Many studies in world proved that mosquitofish are only effective when used in small ponds where other aquatic fauna is limited and mosquitofish have no choice other than mosquito larvae and pupae.

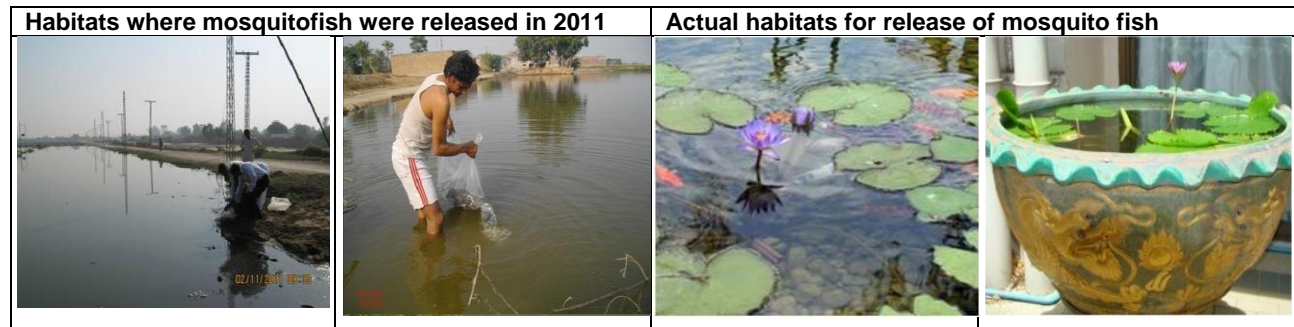
Similarly in Pakistan, during 2005-2010, a comprehensive series of field investigations on vector mosquitoes have been conducted across the country and there was no notable record of breeding of *A. aegypti* in open habitats like such ponds. However, a limited breeding of *A. albopictus* was reported from some open habitats having fresh and clean water. These entomological finding have been strongly supported by international findings which revealed that both vectors of dengue and DHF *A. aegypti* particularly and *A. albopictus* generally have no association with open and organically polluted breeding sites, rather these have statistically significant association with man-made artificial habitats which are placed at shaded places in human dwellings in Pakistan. Again it is very important to note that in Pakistan organically polluted water habitats particularly large and open ponds have huge populations of above mentioned predators of mosquitoes which have naturally predatory potential on mosquito youngones. Therefore again the release of fish in such habitats in Pakistan will not show any impact on mosquitoes rather this will disturb the ecology of local area and local aquatic fauna.

Tilapia fish which is well established in our eco-system has a wide range of feeding preference on both animal and plants (omnivorous) and habitats in which it will be released if has heavy accumulation of vegetations and other insects' larvae which ultimately reduce the predatory potential *Tilapia* fish on mosquito larvae. Other two kinds of mosquitofish *Gambusia* and *Guppy* were also used which are mainly carnivorous (eat animals). However it is well documented that their food preference, particularly of *Gambusia* depends on the availability of food items rather than choice which also compromised the efficacy of these mosquitofish in big organically polluted water habitats.

OPERATIONAL GUIDLINES FOR USE OF MOSQUITOFISH

To make this intervention cost-effective, community-friendly and sustainable against dengue vectors following extremely important technical points must be followed;

- Mosquitofish must be released after very careful and intensive mosquito breeding sites assessment surveys.
- Physio-chemical (BOD), EC, pH, TDS, and NH₃ concentration and biological parameters must be thoroughly studied before the release of mosquitofish.
- Mosquitofish should only be use in small clean water habitats like small public ponds, ornamental ponds, animal water troughs, bird bath fountains, big money plants vassals, unused and broken swimming pools which are free from excessive organic materials like grasses, fruit, dropped branches and flowers etc.
- Mosquitofish should not be released in wider habitats like open big ponds, lakes etc. having heavy accumulation of organic pollutants.
- *Gambusia* and *Guppy* which are carnivorous (eat animals) should be preferred on *Tilapia* fish (omnivorous)



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