

Guidelines on Source Reduction

Long before the discovery of synthetic insecticide and its introduction as adulticide, anti-larval measures were the only method of control of mosquito borne diseases and as well as mosquito abatement.

Anti-larval measures are broadly categorized into

1. Source reduction
2. Biological
3. Chemical

Source reduction

Definition:

Anti-larval operations causing the reduction or permanent elimination of mosquito breeding places or sites are defined as source reduction methods. Source reduction primarily aims to prevent development of aquatic stages of mosquito larvae reducing breeding source. These methods are environment friendly, economical in the long run with minimum maintenance and surveillance.

Source reduction measures undertaken would not only solve the problem of malaria and other vector borne diseases in an area but also would bring socio-economic & financial benefits, general well being of communities and overall environmental up-gradation.

Source reduction methods are further classified into

1. Elimination or reduction of breeding sites primarily involving engineering methods.
2. Environmental manipulation.

Elimination or reduction of breeding sites

This aspect of source reduction are divided into

- a) Filling
- b) Drainage
- c) Drains
- d) Drainage in irrigation schemes

a) Filling

Filling can be on minor scale for elimination of burrow pits, ditches, small unused irrigation canals unused/abandoned wells, in and around human habitations/villages for prevention of

mosquitogenic habitats. These activities require minimum or no engineering skill and can be undertaken by field workers employed for routing activities.

Filling operations should be undertaken only after evaluation of malaria endemicity prevailing vector mosquitoes and their breeding behavior.

Garbage sometime may be used to advantage into a place that requires filling provided adequate measures are taken keeping in view hygiene and fly nuisance and offensive smell. Compost can be made from garbage.

Sanitary land fill method is also recommended for land reclamation. This is achieved by dumping a layer of refuse/garbage in a selected area followed by earth cover daily after compaction. Land thus reclaimed can be for recreational park, playing ground and storage.

Natural fills in an area with high rainfall for a considerable period during monsoon months, runoff streams, carrying very high sediments with suitable engineering methods, sediments are trapped and allowed to settle. This sedimentation can be used as natural filling material for permanent elimination of intermittently flooded areas or swamps. This source reduction method requires geographical reconnaissance, vector prevalence, feeding behavior of vector mosquitoes in relation to malaria endemicity and seasonal malaria transmission.

b) **Drainage**

Drainage is used in (1) eliminating breeding sites by draining away the water collections or (2) reducing vector breeding by channeling water to a few places which can be easily controlled. Construction of surface ditches, sub-surface drains, vertical drains, pumps and tide gates are some of the methods used in drainage. Type of ditch or drain, best suited for a particular situation, will depend upon topography, source of water and soil properties, further, the availability of funds for the works will be an important factor. Drainage can be of the following types.

c) **Drains**

✍ **Surface ditches:** Ditching is the most widely used method of drainage in source reduction programmes. The cost of construction is modest and benefits are considerable. Proper choice of side slopes and grades can reduce maintenance. However, regular maintenance is necessary to ensure adequate flow capacity. This also includes channel improvements, so that mosquito breeding pockets will not be created.

✍ **Sub-surface drains:** Well designed sub-soil drainage requires a minimum of maintenance and can function satisfactorily for many years. For small installations, either concrete or clay pipes may be used. But for large installations concrete pipes are commonly used. This method has the advantage of converting water logged areas into suitable land for farming or other purposes.

✍ **Vertical drains:** When water is held on the surface by an impervious stratum which is known to overlie one that is previous, it may be economical and effective to utilize vertical drainage which is simply boring a hole through the impervious layer so that the water will drop to pervious layer and be taken off. When installing vertical drainage, local sanitary authorities must be consulted, regarding the danger of contaminating sub-surface water supplying wells from which the drinking water may be drawn.

d) Drainage in irrigation schemes

✍ **Drainage in irrigation schemes:** Source reduction measures required in irrigated areas are water management. This may be diversion of water, effective distribution system, drainage of excess water, or regulation in such a way that a dry day is kept in a week's irrigation. Such control or water has to be from the head gates to the field turn out.

✍ **Coastal drainage:** Drainage of coastal swamps and lagoons requires care in design and construction of sea outlets.

✍ **Drainage by tide gates:** The gates are used for drainage of salt marshes along the sea. The gates are opened at low tide to allow water to flow out and closed at high tide to prevent sea water from flowing in. The construction of the gates is a specialized job and should include construction of ditches and dykes to control tidal waters.

✍ **Drainage by pumps:** When water accumulates in low lying areas and cannot be drained it may be pumped out by installation of temporary diesel or electric pumps.

It is important that in all water development projects, in the towns under the urban malaria scheme, measures should be undertaken to reduce or prevent the creation of mosquito breeding sites and for this the Biologist/Anti-Malaria Officer should be associated at the planning and at execution levels.

Government of India, Ministry of Health has advised that the States/Union Territories to constitute committees for carrying out survey of the mosquito breeding sources and prepare a plan/blue print for their elimination by minor engineering works. The States/Local bodies should give the required importance to the committees and make provision in their budgets for implementation of the recommendations of the committees.

✍ **Environmental manipulation:** Under this heading the measures are included by which changes are effected in the natural conditions under which mosquitoes exist, rendering them unfavourable to the life and activities of these insects either in their aquatic or adult stages. These measures are conveniently classed as chemical, physical or biological measures. The examples are pollution of water, changing the salt content of water, silting, flooding, fluctuating water levels, agitating of the water surface, mudding, shading, etc.

Prevention of Egg Laying

Egg laying in suitable breeding habitats preferred by different disease vector mosquitoes, is the first step in the life cycle of mosquitoes.

Prevention of clean water collections or removal/elimination of clean water collections is the environment friendly cost effective and easy to implement.

Throwing of disposable/used tea cups, glasses, buckets, tyres utensils is a very common habit of the community particularly in residential settlements, irrespective of slums or organized localities. During monsoon and post monsoon months these small thrown away containers become enormous potential breeding sources for both *Anopheles* and *Aedes* vector mosquitoes. Open tanks, overhead and underground tanks unused wells in urban, peri-urban or semi-urban locality are also potential breeding source for vectors of malaria, dengue and chikungunya. Storage of potable water has been a common practice both urban & rural areas. Shortage of potable water to slums dwellers forced to store water in containers. Construction sites were with high breeding potentials. Labourers engaged in construction activities were often from malaria endemic areas harbouring malaria parasites. High breeding potentials in construction sites with asymptomatic carriers of malaria parasites caused severe malaria outbreaks in New Delhi, Greater Mumbai Municipal Corporation and elsewhere.

Concrete roof and terrace without proper drainage may lead to water collections, during monsoon months forming breeding sites.

The above described breeding sources in urban, semi or peri urban, in and around human settlements in villages, should be taken into surveillance for comprehensive source reduction involving communities, residential welfare associations, various religious groups/organizations schools, hospitals, gram panchyats, office building, local PWD or CPWD, Railways and municipal bodies/corporations.

The following steps are suggested for implementation of source reduction methods.

- ✍ Never to throw any containers in open capable of holding water for more than a week.
- ✍ Lids of overhead tanks must be checked and maintained monthly basis. Any leakage should be repaired immediately. Cover-up of underground and open tanks. Open tanks used for animals should be dead dried once in week.
- ✍ Construction sites require special attention. Building bye-laws, must be implemented to prevent fault in designs, water flow on roof, gully traps open tanks for curing should be treated with larvicides on weekly basis.
- ✍ Unused wells either be closed or treated with larvicides.
- ✍ Ornamental tanks, fountains should be checked periodically and larvivorous fish be introduced.
- ✍ Wells in use may be cover with mosquito proof nets and village panchayats be involved.

✍ Public health engineers should be involved for proper drainage, building designs, periodic flushing of water logged areas and drainage.

In urban, semi urban or peri-urban localities, slums, *Culex* mosquito breeds in high density. *Culex* in urban situation is highly anthropophagic. Also *Armigeres* in urban situation bites throughout day and night in high biting density. Both these mosquitoes were highly irritating. Both these mosquitoes breed in high density mainly in drains, septic tanks with organic pollution.

Municipal Corporations or local civic bodies should take up this challenge with public health engineers for permanent solutions of breeding problem. Weekly cleaning of drains, netting of vents of septic tanks and larvicidal treatment may be considered.

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Advisory / Guidelines on source reduction for preventive measures against proliferation of mosquitoes / anti- larval measures for the control of incidence of Malaria, Dengue and Chikungunya

1. Malaria and Dengue are two important vector borne diseases in metropolitan cities, towns urban and peri-urban areas.
2. The mosquito vector breeds in Cement tanks , desert cooler, overhead tank, under ground tanks, tyres, pitchers, discarded containers, flower Pot and discarded junk yards.
3. In recent years there is growth of construction activities and rapid urbanization creating mosquito-genic conditions.
4. Engineering aspects are one of the important issues under environmental and integrated vector control measures.
5. For long term environmental operations as basic vector control measures for prevention of vector borne disease are:
 - (a) Management of water bodies, drainage to discourage the breeding of disease vector.
 - (b) Urban Legislative Body, all Municipal Corporations are to develop and implement Programme for water supply, sewerage, drainage and solid waste management to keep the environment free from vector breeding. Cover storm water drainage system and maintain them periodically and properly by way of regular cleaning, desilting and maintain adequate velocity for flow of water.
 - (c) Water stagnation in construction areas must be prevented
 - (d) Over flow from overhead water tanks must be controlled through proper floating valves.
 - (e) Proper sanitation in community Toilets and drainage facility must be provided for slum areas with proper supply of potable water.
 - (f) Leakage of water tanks, water supply pipes and fountains must be repaired and reinstalled to prevent water stagnation and mosquito breeding.
 - (g) A MOU between Municipal Corporations and contractors be formulated and incorporated as a Clause in the line of as per civic bye-laws, Mumbai Municipal Corporation Act 1928 for prevention of breeding during construction of developmental projects. Anti larval measures must be taken by construction authorities and completion certificate only to be issued after proper disposal of storage tanks or dismantling such structures so that no rain water can accumulate.
 - (h) Vegetation in and around ornamental tanks and swimming pools should be removed to limit the breeding potential.
 - (i) Stagnated water in buckets, discarded tyres dumps, junk yard should be drained out or disposed before monsoon to discourage mosquito breeding.
 - (j) Lids of overhead tank are to be mended to prevent entry of mosquitoes.
 - (k) Orientation training of Junior Engineers, Public Health Engineering departments and other engineering staff about vector control measures and preventive measures on water stagnation.
 - (l) Urban planners and engineer should assume responsibility for creating master plan with comprehensive vector control activities. The construction of buildings and

building codes designed to minimize site of mosquitoes breeding, the registration and regulation of construction sites to prevent mosquito breeding and coordination are to crucial elements for prevention of mosquitogenic potential.

- (m) Flower pots and cooler require special attention as potential breeding spots in domestic situation like government buildings, hospitals, schools, religious places, public places, cinema halls, theatres, malls, entertainment venues. Anti larval measures with Temephos granules may be applied fortnightly. Wherever possible these potential breeding spots be dried up once in a week. Special attention be given for mosquito free environment in hospitals.
- 9. Development of inter-sectoral linkages by roping all government and non-government agencies, institutions for behaviour change and adoption of COMBI approach
- 10. Health educational messages to the community on weekly cleaning of containers or covering of such containers holding water for more than seven days and disposal of solid waster material and tyre dumps.
- 11. All developmental projects in urban and semi-urban / peri-urban areas should have clearance on anti-mosquito preventive measures after assessment by National Vector Borne Disease Control Programme.
- 12. Development of skilled manpower for the control of breeding of vector mosquitoes and regular surveillance on potential breeding sources and their reduction in metro cities, urban, peri-urban, semi-urban areas.

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**Advisory for Control of *Anopheles stephensi* and *Aedes aegypti* -
Vectors of malaria, dengue and chikungunya**

1. Source Reduction.

- ✍ Elimination of breeding sites by removing potential breeding places like water bottles, solid waste, coconut shells, tyres, etc.
- ✍ Weekly cleaning/Drying of water containers, Room coolers.
- ✍ Extensive IEC activities for social mobilization of the community on preventive measures and destroying breeding habitats.
- ✍ Minor Engineering measures like proper placing of lids of overhead tanks, underground tanks, repairing of leakage from pipeline and preventions of over flowing tanks, channelizing of water collections in roof and cleaning of gutters/water outlets.
- ✍ Overall general sanitation in and around domestic environment.

2. Anti larval Measures:

- ✍ Application of weekly anti-larval (Temephos, Bti, etc.) in water collections in and around domestic environments.
- ✍ Release of larvivorous fish in permanent water bodies, ornamental tanks etc.

3. Adult Control Measures:

- ✍ Indoor Space spray with pyrethrum.
- ✍ Outdoor fogging with malathion

Breeding sites of *Culex quinquefasciatus* with high organic pollution



Preferred breeding sites of both *Anopheles stephensi* and *Aedes aegypti*



Ornamental tank and fountain

Containers with high breeding potential for both malaria and dengue vectors in construction sites with settlements of labourers



High breeding potentials in residential areas with broken lids or cover of overhead tanks



Construction sites with varieties of breeding sites / spots

