Urban malaria & vector control

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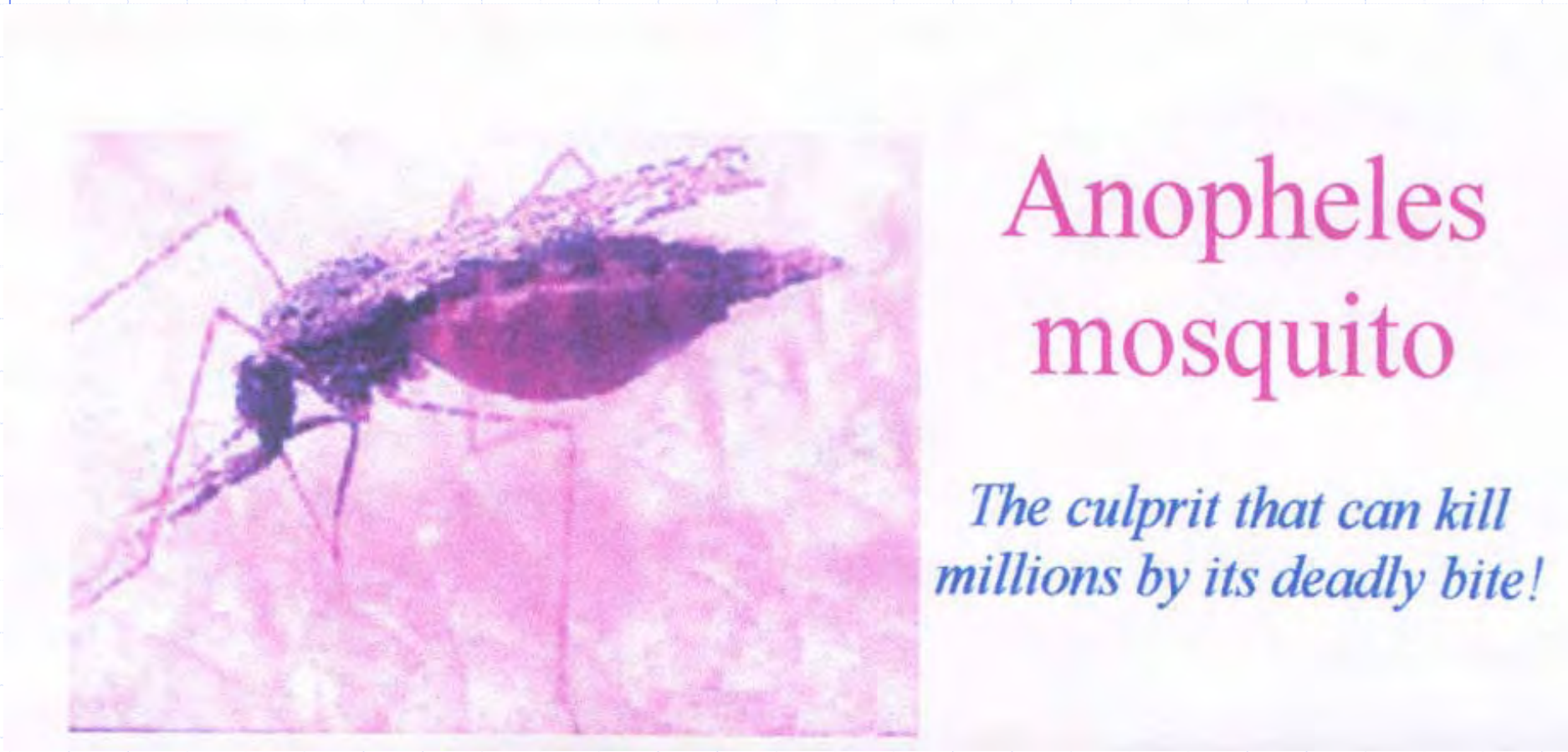


Introduction

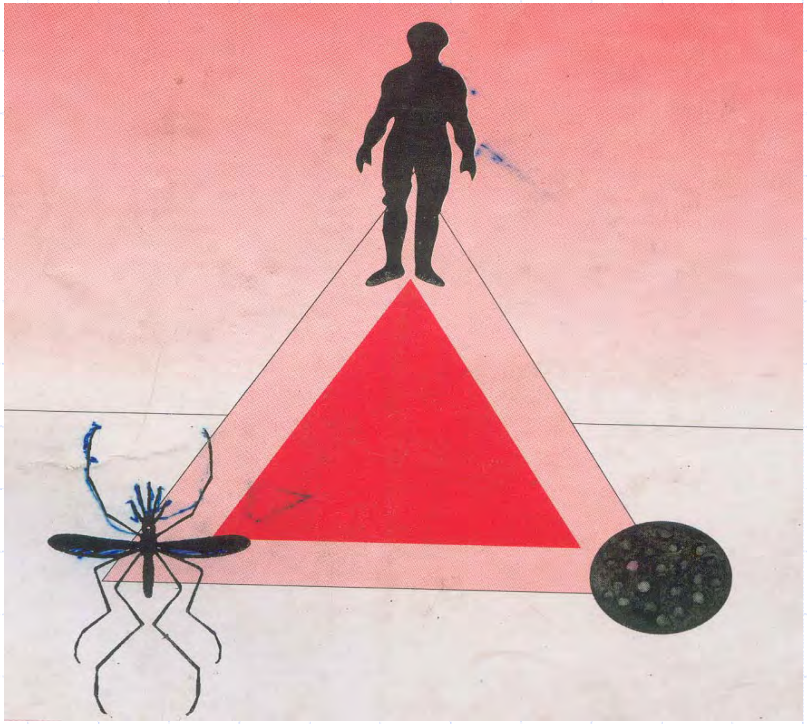
- Rapid and uncontrolled growth of Mumbai with unabated proliferation of slums have brought in their wake several public health problems among which mosquito rodent and other pest menace and the threat of diseases transmitted by them is most reckonable. Rising incidence of malaria the recent traumatic of dengue and leptospirosis the all pervading mosquito rat and fly nuisance are the clear manifestations of the problem

Misconceptions about malaria

- Some of the usual misconceptions about the causation of malaria are that it is caused by bad air, drinking contaminated water,garbage accumulation or even wetting in the rain No doubt, that these beliefs are wholly erroneous and have no scientific basis

WHAT IS MALARIA?

- Malaria is communicable disease caused by certain parasite of the genus-plasmodium. It is caused by the bite of an infected female Anopheles mosquito



MALARIA AND DENGUE MOSQUITO

- Malaria and Dengue these diseases are caused by mosquitoes which are breed only in clean stagnant water. These mosquitoes do not breed in dirty places or in garbage.

Scale of Malaria

- Around 2.5 billion people (at least 40% of the world's population) are at risk in over 90 countries
- Malaria causes or contributes to 3 million deaths and up to 500 million acute clinical cases each year. In other words:
- Almost as many deaths per annum as the AIDS death total in the last 15 years

- Malaria is one of leading causes of morbidity and mortality in the developing world (along with TB, acute respiratory syndrome, diarrhoea and HIV) but still not recognised in developed countries as a disaster like AIDS or EBOLA.
- The main areas affected are Africa, South East Asia, India and South America but surveillance and records are too poor to know the real distribution and case numbers.

SPREAD

- Malaria kills more people today than three decades ago. Reasons for the spread include
  - Increasing drug resistance
  - Increased migration and immigration
    Increase in size of endemic territories (e.g. people moving from countryside to cities)

Spread (contd)

- **Tourist and business travel (increased air travel since 1950s/60s)**
- **Decreased mosquito control efforts (insecticide spraying)**
- **Deforestation and mining (development activities)**

- Malaria is spreading to new territories for example, India, Brazil, Sri Lanka, Turkey, and the Middle East
- Malaria is spreading from the countryside into cities (e.g. Mumbai), increasing the risk for city dwellers and tourists in these ‘safe’ zones of endemic countries.

40 years ago malaria had been eradicated or dramatically reduced in 37 countries (WHO insecticide spraying programme 1956-69) but this situation has been rapidly reversing, especially over the last decade. The reversal is largely due to the cost of sustaining programmes, loss of motivation in the face of a seemingly declining threat, and the development of insecticide and drug resistance.

- Malaria exacts an enormous toll in lives, medical costs and days of labour lost
- Educational system also suffer as large no of children miss several weeks of school each year in endemic regions.
- The direct annual commercial loss in Africa due to malaria was estimated to be US $3.6 billion by 2000 (US $10 million a day).
- A single bout of malaria is estimated to cost a sum equivalent to 10-20 working days in India and Africa.

Obstacle & Remedial action

Political commitment

Insufficient political commitment for improved health services

Inadequate surveillance and control programmes

Insufficient international public funding

Inadequate training/career opportunities for local malaria scientists/health professionals

Resistance

- Drug resistance is increasing rapidly, largely due to widespread uncontrolled and unregulated drug distribution.
- Another underlying factor contributing to the development of resistance is the improper usage of the drugs; for example, sub curative doses - people feel better, so stop taking their medicine, and some resistant parasites may be given the chance to survive and be transmitted by mosquitoes.

There is insufficient research into novel drug targets. Current new options are based on the same three families of compounds (the quinolines, antifolates, and artemesinin derivatives) all of which have records of resistance and/or ineffectiveness.

Insecticide programmes have also been hampered by the emergence of resistance to DDT and other insecticides.

Problem in vaccine development

- Parasites have a more complex structure than viruses and bacteria and change appearance over the course of an infection.
- Finding the best way to attack them via vaccination is not easy - further research on their composition and biology is needed even before addressing major issues such as how to produce and administer a vaccine.
- The two main malaria parasite species are sufficiently different from each other that a vaccine based on one will probably not prevent malaria by the other.

Gaps in malaria research

- Biochemistry of the parasite
- Basis of parasite drug resistance
- How people build up immunity to malaria
- Transmission characteristics and epidemiology (differs throughout the world)
- Pathogenesis (i.e. development characteristics of malaria)
- Mosquito biology, infection, genetics,insecticide resistance
- Effect of malaria on other diseases and vice versa
- Environmental factors

Investment in Research

Global expenditure on research per associated death for various diseases

Diseases	**Annual global research ($ million)**	**Global mortality (1990: Thousands)**	**Estimated global research expenditure per fatal case worldwide (1990)**
HIV/AIDS	952	290.8	3274
Malaria	**60**	**926.4**	**65**

Malaria control is everybody's business and everyone should contribute to it, including community members and people working in education, environment, water supply, sanitation, and community development. It must be an integral part of national health development and community action for control must be sustained and supported by intersectoral collaboration at all levels and by monitoring, training and evaluation, and operational and basic research

Types of mosquitoes

- In the world there are more than 3000 species of mosquitoes belonging to 37 genera. Out of these only 15 genera are recorded from India which are

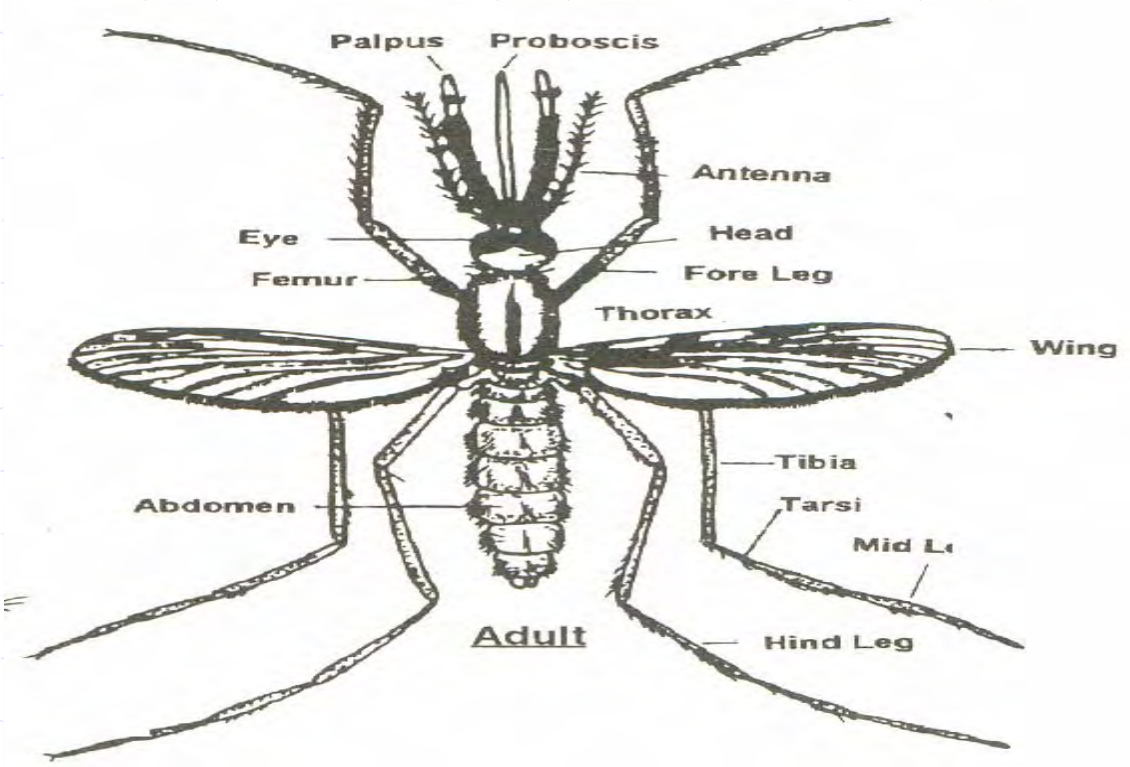
- 1.Anopheles
- 2.Aedeomia
- 3.Aedes
- 4. Armigeres
- 5.Heizmania
- 6. Culex
- 7. Culiseta
- 8. Ficalbia
- 9. Mimomyia
- 10. Mansonia
- 11. Orthopodomyia
- 12. Malaya
- 13. Tripteroides
- 14. Uranotaenia
- 15. Toxorhynchitis

Malaria vector in India/Mumbai

- Malaria in India is transmitted by 9 well known Anopheles species,
- A. culicifacies
- A. philippinensis
- A. fluviatilis
- A. annularis
- A. minimus
- A. varuna
- A. stephensi
  A. sundaicus
- A. balabacensis
- Malaria vector in Mumbai is A.Stephensi

Mosquito morphology

- The body of the adult mosquito consist of three regions; head , thorax and abdomen



Life cycle of mosquito

- The cycle completed in water & part in terrestrial environment
- Cycle consist of four stages egg,larva,pupa & adult
- Egg: The eggs are tiny approx.half a millimeter in length and are laid on the surface of water
- Anopheles & Aedes lay eggs singly, whereas Culex mosquitoes lay them in rafts
- Anopheles female lays 130 eggs on every alternate day, whereas culex lays 150 eggs.
- Within 24-48 hrs a tiny Ist stage larva hatches from the egg

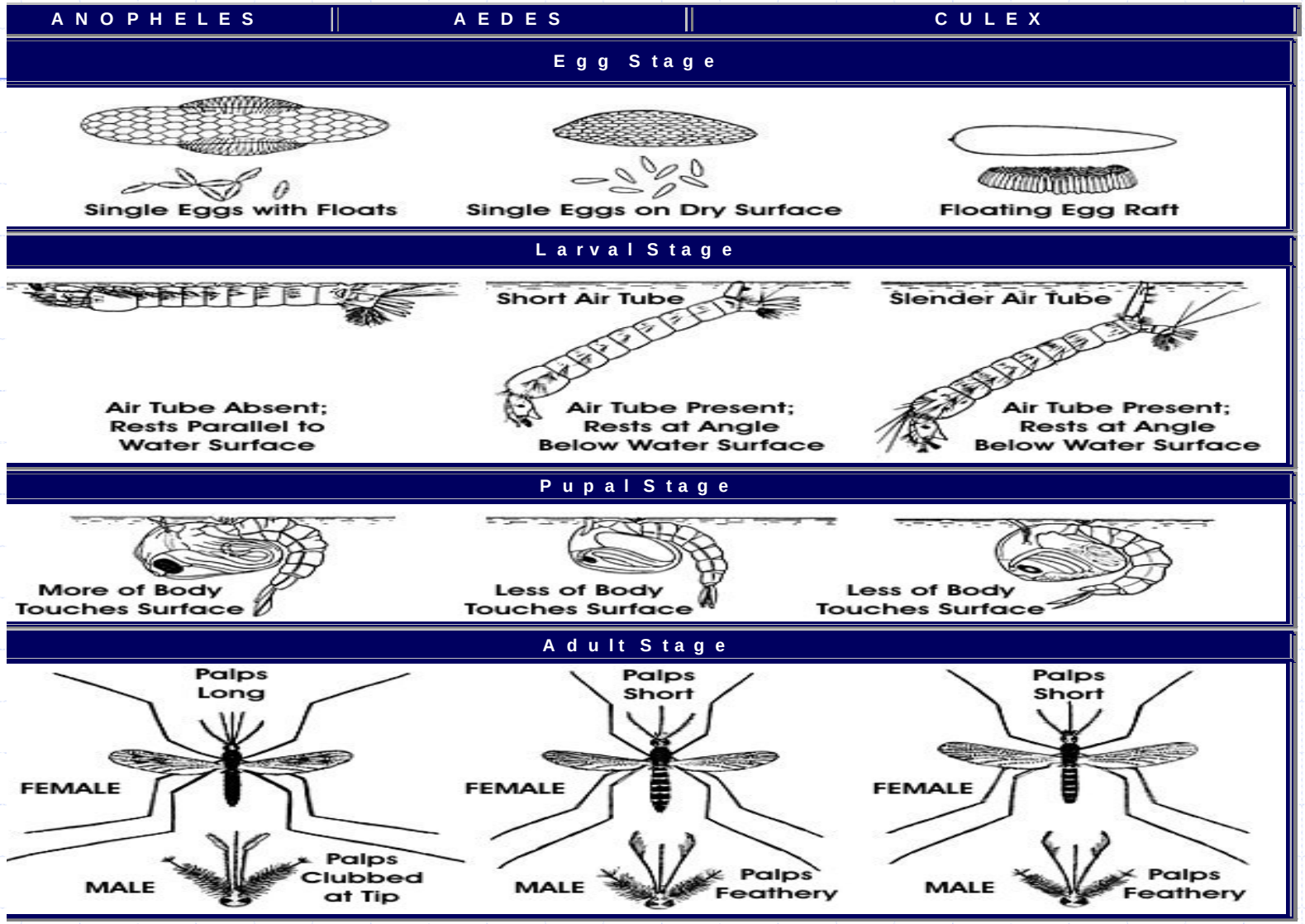
Larva

- The Ist stage larva is tiny & upon hatching begins to feed on microorganisms & organic particles.
- Larvae are active swimmer
- Respire with the help of respiratory siphon in the case of culex & Aedes & through spiracles in the case of Anopheles larvae.
- The larvae grow by shedding their skin thrice in there life span of approx. 7-10 days from first to second, second to third & third to fourth stage.
- Shedding called moulting. Fully grown larva moults and form pupa.

Pupa

- The pupa are ‘comma shaped’ with flexible abdomen for swimming.
- They have a pair of trumpet like structure on the dorsal surface for breathing.
- The pupa does not feed &being lighter than water floats on the surface of water
- The stage lasts for 2-3 days and the adult mosquito develop within pupa emerges.

Differentiation of life stages



Adult

- From pupae male & female mosquitoes emerge in almost equal proportion.
- On the third day of their emergence the adults start feeding and subsequently on every alternate day the female feed on blood of human being or animals whereas male feeds on the plant sap &juices.
- Male have shorter life span (about week)
- The adult female mosquito survive for 15 to 30 days in warm & humid climate.

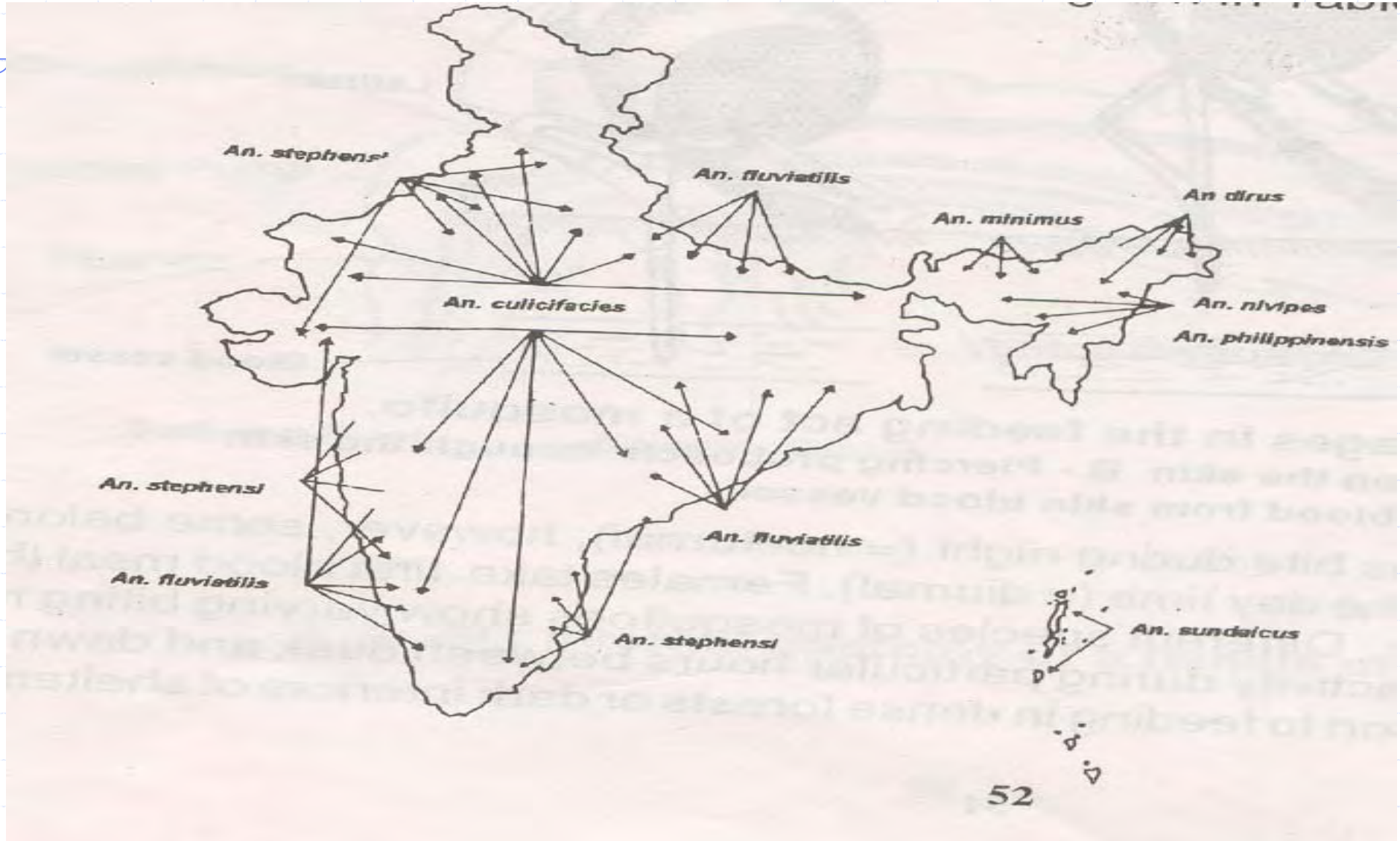
EMERGENCE OF PUPA FROM LARVA

Culex quiquefaciatus

Anopheles stephensi (Adult female)

Aedes aegypti (Dengue vector)

General distribution of malaria vectors in India



Genesis of Vector control

- All attempts at the control/eradication of the vector borne diseases have been based upon
- (a) removing the conditions which make possible the breeding of vector(mosquito)
- (b) destroying vector at some period of its life I.e. during the adult or larval

Genesis of vector control continued

- (c) Preventing the mosquito from biting the man
- (d) Attacking parasite as and when it circulate in the blood of man i.e. adoption of antimalarial drugs.

Vector control methods

- (a) Environmental sanitation
- (b) Public education
- (c) Protective and preventive measures
- (d) Legislation
- (e) Ecological control
- (f) Biological control
- (g)Chemical control
- (h) Genetic control

PEST CONTROL ACTIVITIES

MALARIA MOSQUITO CONTROL	DENGUE VECTOR CONTROL	NUISANCE MOSQUITO CONTROL	FLY CONTROL	RAT CONTROL
1)Source reduction I) identification &record of breeding places 2)Biological control 3)chemical control Larviciding work I)M.L.O ii)Fenthion iii)Temephos 4)Thermal fumigation for adult mosquito control 5) Legal actions	Aedes larvae survey destruction of larvae thermal fumigation public education	source reduction biological control chemical control weekly larvicidal treatment thermal fumigation legal actions	regular anti fly treatment intensified during monsoon places covered I)dust bins ii)trailers iii) Refuse shades iv) Refuse heaps v)markets vi) Hospitals vii) dispensaries	**Regular trapping** **Complaints** **Indoor** **setting traps** **Outdoor** **Poison baiting** **Night rat killing** **Burrow fumigation**

LIST OF POSSIBLE BREEDING SOURCES OF MALARIA, DENGUE AND FILARIA VECTOR MOSQUITOES

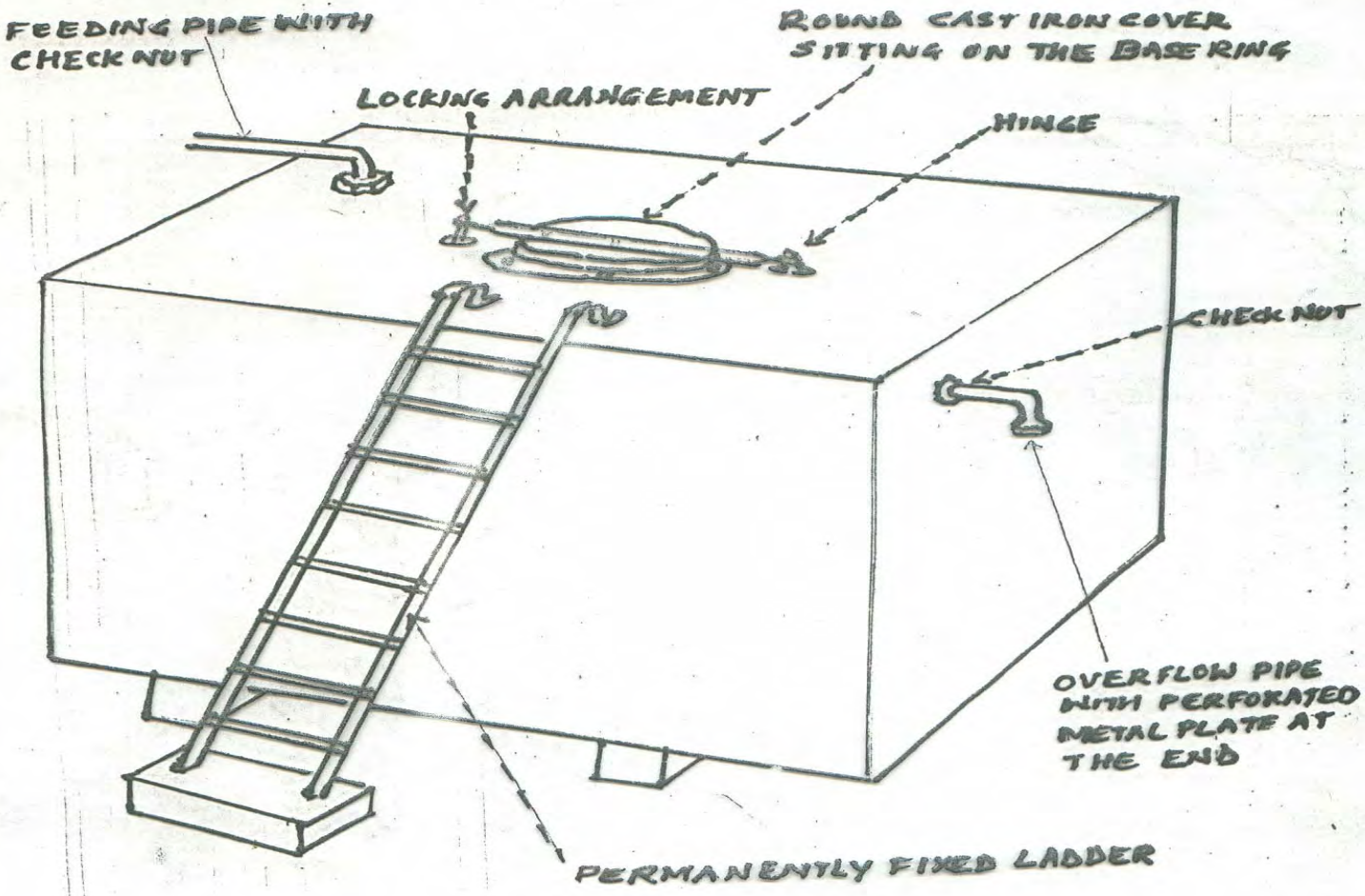
malaria vector	dengue vector (Aedes)	Filaria vector (culex)
A)**Permanent sources**		All sources mentioned in
1) Wells	Drums	column no 1&2 and
I)Open wells	Tyres	Nullah
ii)Trap door wells	Odd articles & receptacle	Open channel drains
iii) H.C.C. wells	Garden tanks	Storm water entrances
iv) Tube wells	Fountains	septic tanks
v) Ring wells		aquaprivies
		creek lands
2) Cisterns (tanks)		Low lands
I) R.C.C.		grass plots
ii) Mild steel		Ditches
iii) Hume pipe		
iv) H.D.P.E.		
v) L.D.P.E.		
3) Elevated overhead tanks		
4) Mill tanks		
5) Masonary tanks		
6) Garden tanks		
7) Static tanks		
8) Mill ponds		
9) Village ponds		
10) Fountains		
11) Swimming pools		
12) Cooling tanks		
13) Cooling towers		
14) Building constructions		
B) Temporary Sources		
I) Cellars		
ii) Roof gutters		
iii) Odd articles & receptacles		
iv) Building constructions		

Detection of Anopheles mosquito larvae

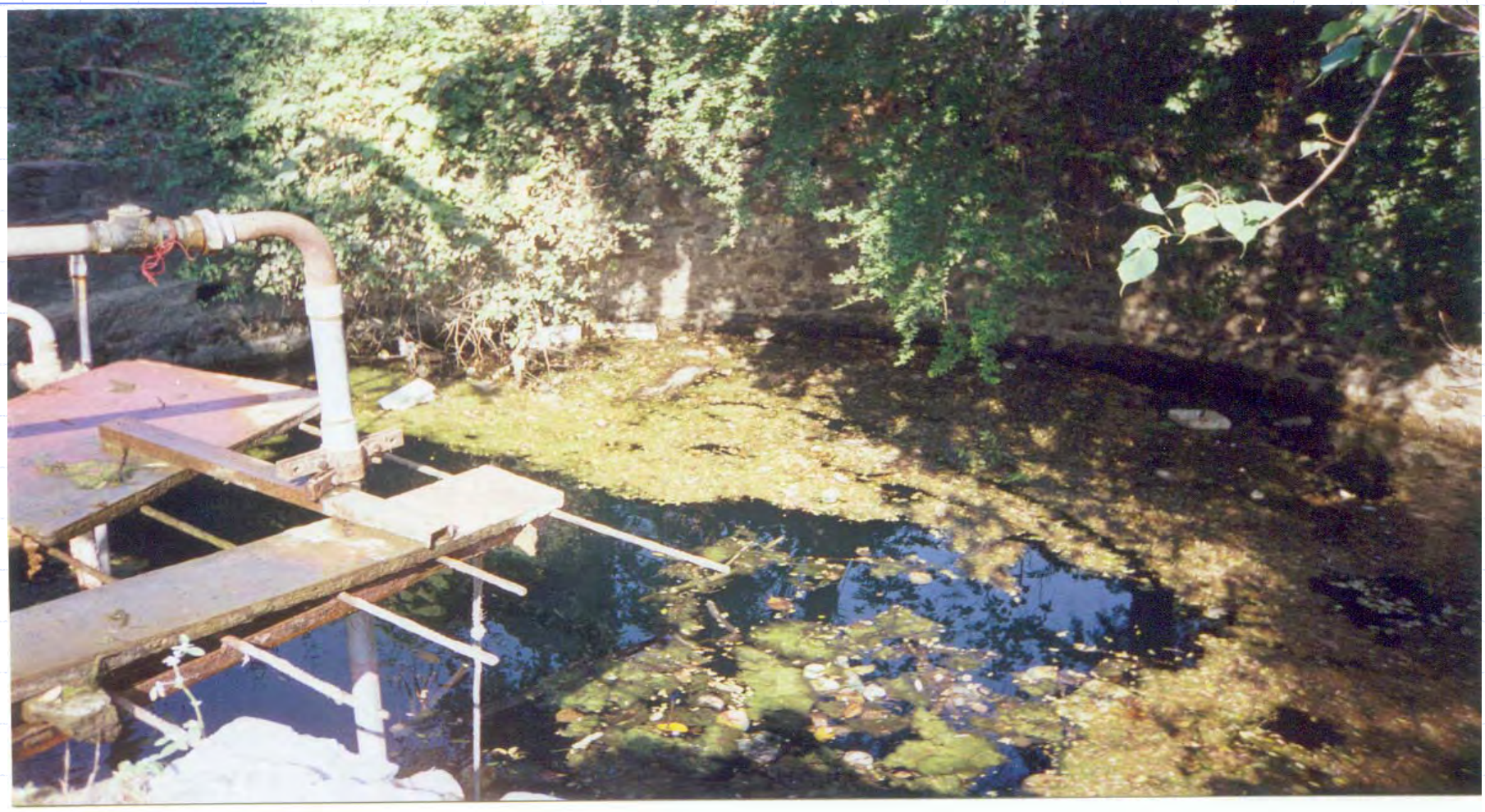
Tank inspection & noting of defects

FOGGING OPERATION

STANDARD PATTERN MOSQUITO PROOF CISTERN



Surface well



Open well covered with R.C.C. slab

CONSTRUCTION SITE

Masonry tank

Garden tank

COOLING TOWER

H.D.P.E. water tank

R.C.C. Overhead tank

Mill Overhead tank

Mild steel overhead tank

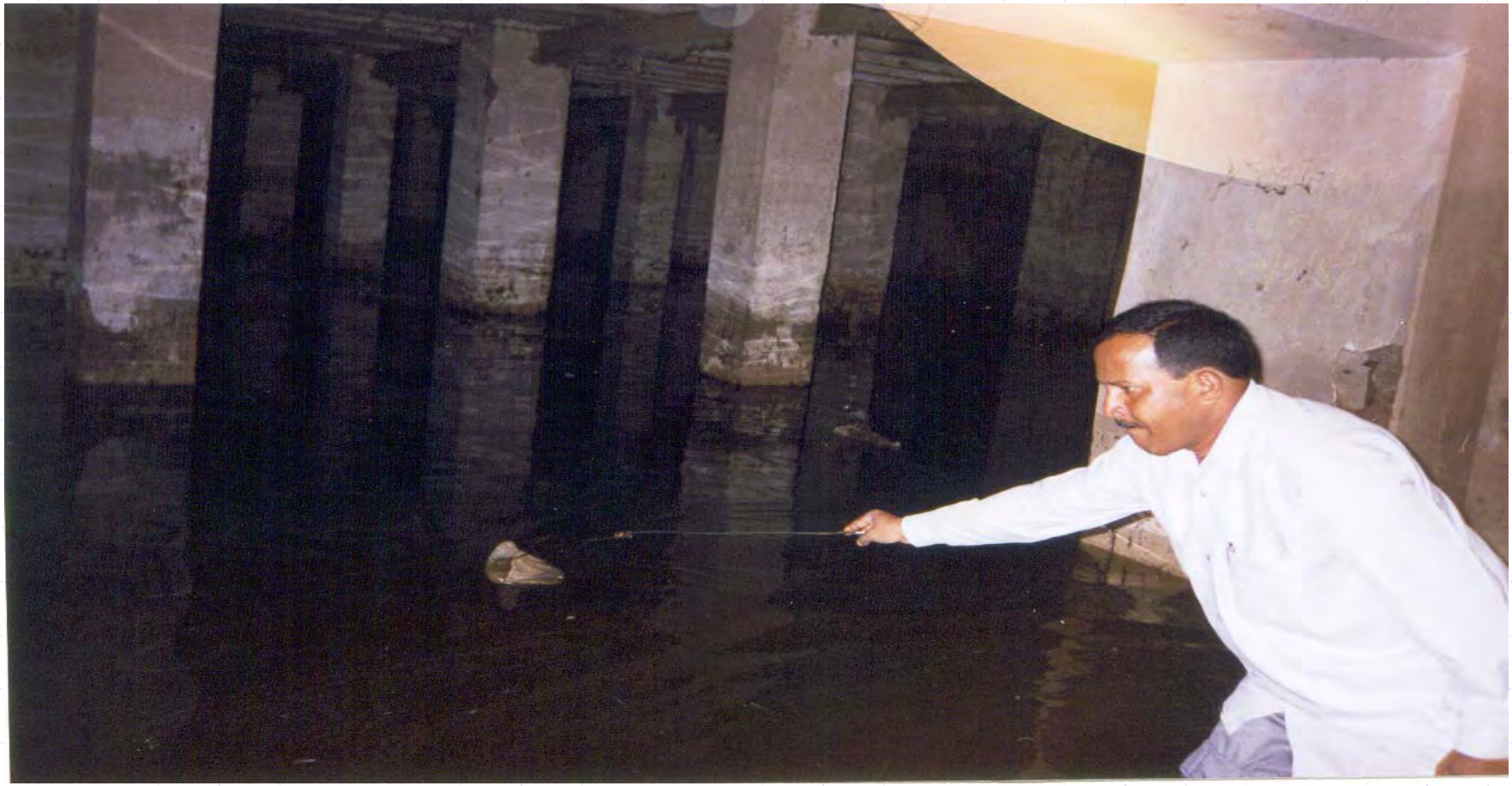
Elevated R.C.C.tank

Fountain (Dry & with water)

Swimming pool

ROOF GUTTER HOLDING RAIN WATER

BLOW ROOM CELLAR IN MILL



Modern designs creating new mosquitogenic situations

Masonry tank under kitchen platform

Loft tank

INTER DOMESTIC BREEDING OF MOSQUITO

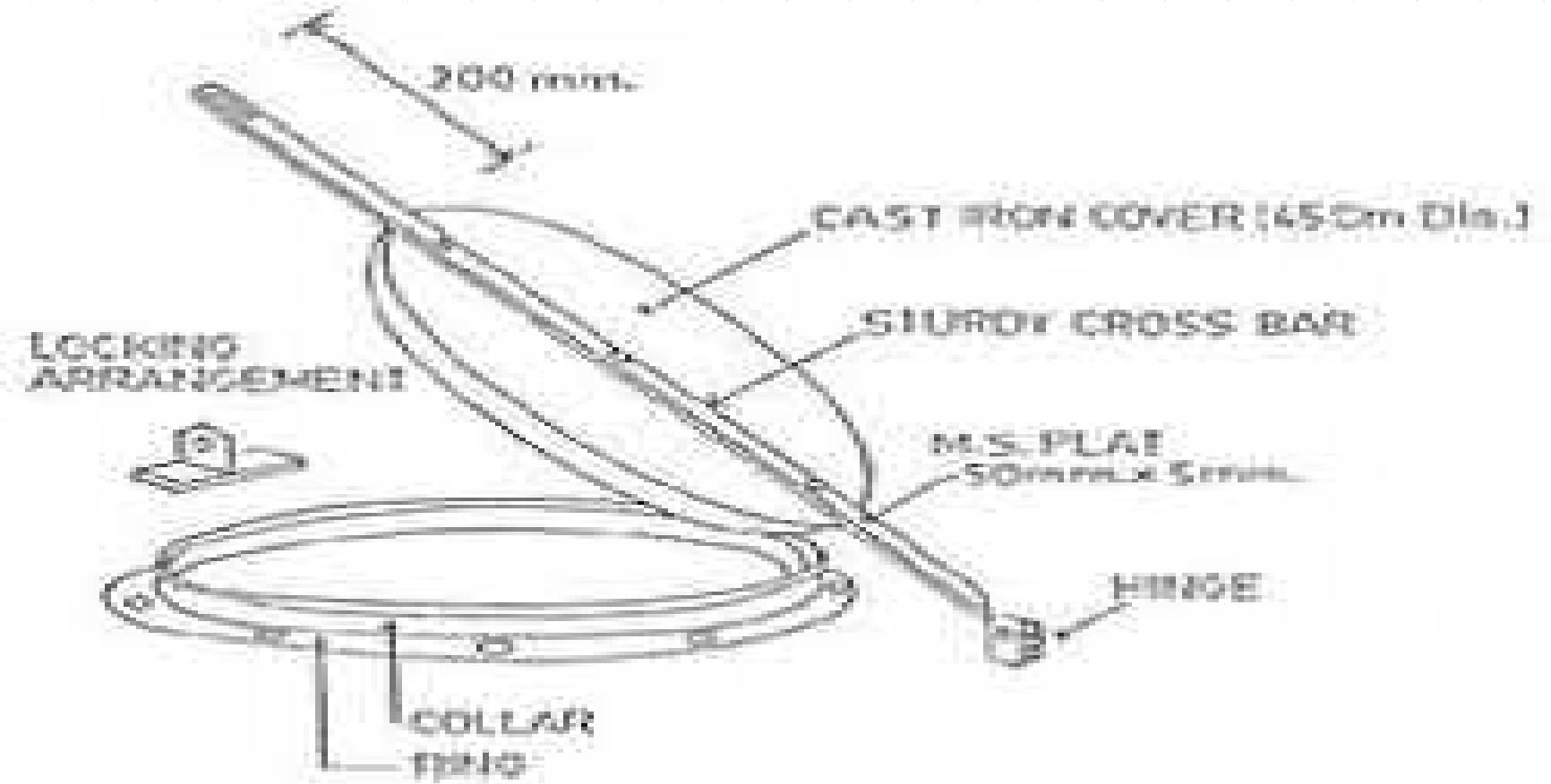
Odd articles and Receptacles

Different types of odd articles

- 1) Tyres
- 2) Drums
- 3) Machinery & its part
- 4) Tins
- 5) Earthen pots
- 6) China-clay pots
- 7) Tarpaulin
- 9) Coconut shells
- 10) Empty bottles
- 11) Plastic crates & trays
- 12)Vases/Flower pots
- 13)Buckets
- 14)Tree holes
- 15) Wooden tray
- 16) Pipe bents
- 17) Glass aquaria
- 18)Disused bath tubs
- 19)Disused wash basins
- 20)Stone ragda
- 21)Unused utensils
- 22)Thermo coal Packing material
- 23)Metal sheets with depression
- 24)Bird bath

Standard pattern cast iron cover

dimensions of standard pattern cover



Culex breeding place & its detection

Open drain with Dhapa & katchara breeding place for culex mosquito

NULLAH HAVING WATER HYCINTH (1) & GARBAGE (2) SUPPORTING CULEX MOSQUITO BREEDING

Insecticides in use

- LARVICIDES

1)Mosquito larvicide oil
2)Pyrosene oil
3)Fenthion (Baytex E.C.)
4)Fenthion granules
5)Temephos (Abate)

- Fumigation for adult mosquito control

1)Pyrethrum extract
3)Deltamethrin ULV

FLY CONTROL

1)D.D.V.P.
2)Propoxure bait

INDOOR SPAY

1)Cyfluthrin (Solfac)
2)Deltamethrin

RODENTICIDES

1)Zinc Phosphide
2)Couma tetraryl (Racumin)
3)Aluminium Phosphide (celphos)

Legal sections used by MMC for vector contro

- Sec.253:- All drains ventilation shafts,pipes,house gutters,water closets,privies,latrines & urinals which do not belongs to Corporation shall be open for inspection & examination
- Sec.274:- Provision of access(ladder) to cisterns invokes
- Sec.274A:- Provision for keeping cisterns locked.
- Sec.381(i):- Rectification of existing defects are carried out.
- Sec.381A:- Prevention of formation of new breeding places

Legal sections continued

- Sec 375A:- Removal of building materials from any premises which could be harborage or breeding place for rats.
- Sec.488:- The Commissioner etc. may enter any premises for the purpose of inspection,survey or examination & necessary work.

Rat control

Economic importance of Rats

- Rodents are competitors to human beings and other animals for food & feed. The damage they do is both qualitative and quantitative.
- The World Health Organisation has estimated that rats cause losses amounting to approx. 33 million tones of food each year,enough to feed 130 million people.
- It is estimated that 16% of the food is destroyed by rats.
- Rat contaminate & destroy three times more food than they eat

- One pair of Rat can produce 3000-4000 rats/year
- Rats are responsible for both direct and indirect transmission of diseases to man & animals.(Plague, Salmonellosis,Rat bite fever &Leptospirosis
- Rats have a very complex behaviour. Due to their instinctive fear of unfamiliar objects (neo phobia),the acute sense of smell & highly developed sense of taste,it is difficult to find and successfully employ measures for their control.

Formula of 4D's

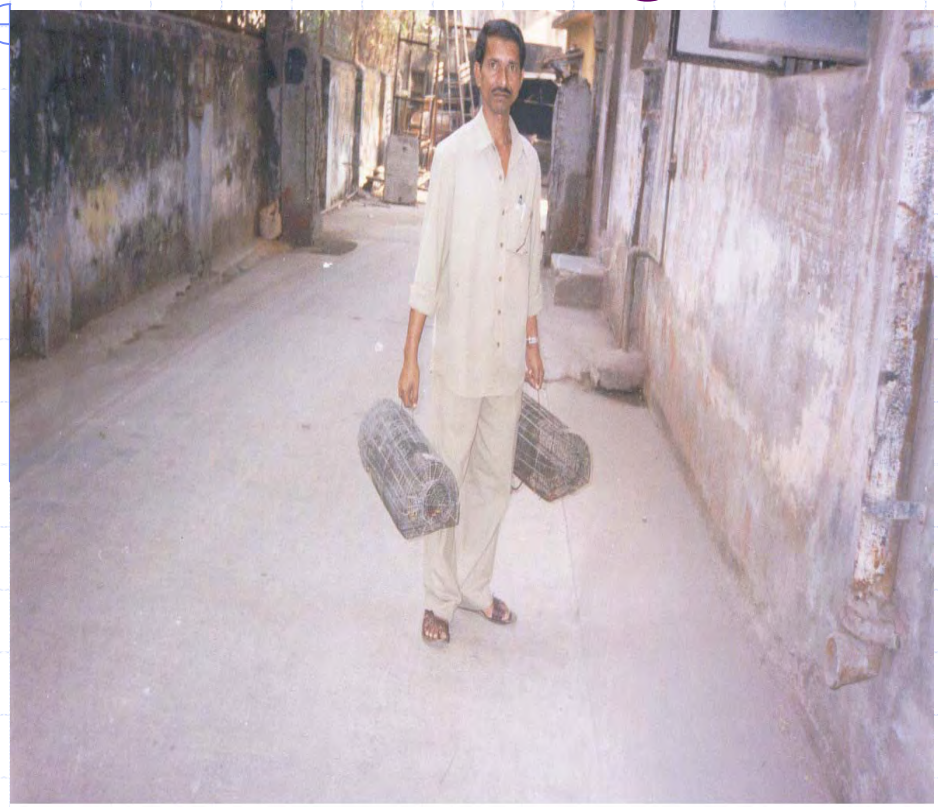
- The formula of 4D's is useful in rat control
- 1)D-deny entry
- 2)D-deny shelter
- 3)D-deny food
- 4)D-destroy

Broadly the control measures fall into four categories 1)Mechanical 2)Biological 3)Ecological 4) Chemical

Mechanical control

- Use of traps 1) mass trapping 2) complaint basis
- Rat proofing 1) providing physical barriers to houses to deny entry for the rats (e.g. Rat guards to drain pipes.
- Night rat killing is carried out only city wards

Rat labourer with rat collection &while killing



NIGHT RAT KILLING

Biological control of rats

- This method on large scale is not feasible in the long run.
- It includes employing predators like the Monitor Lizard,Mongoose,Cat & Weasel.

Ecological control

- In this method, sanitation plays a very important role.
- Proper disposal of garbage will help to reduce rat infestation.
- Intersectoral co-ordination will help in a broader rodent control programme.
- Results can be achieved only after sustained implementation and monitoring.

Chemical control

- The chemicals use in killing of rats are called as Rodenticide. These are classified into two categories
- A) Acute:-These are single dose poison and are fast acting and effective against types of rats.The risk to man and non-target animals is however great e.g.Zinc Phosphide.
- Chronic:- These are multiple dose anti coagulant poison and are slow acting e.g.Bromodiolone,Racumin etc.
- Fumigation of burrows with chemicals is also carried out. These are fast acting e.g. Aluminium Phosphide.

FLY CONTROL

- Houseflies should be regarded as a sign of insanitation
- Single female fly produce 2387 flies/month
- Flies breed mainly in places such as horse manure,human excreta,manure of other animals,garbage,decaying foods and vegetables, damp rubbish containing organic matter
- They are prevalent near dwelling houses, restaurants hospitals,cattle sheds,slaughter houses and dumping grounds.

- Flies transmit diseases by mechanical transmission with its body parts, vomit drops and defecation.
- Diseases are typhoid and Para-typhoid fever, diarrhoea,cholera,gastro enteritis,amoebiasis,Poliomyelitis, conjunctivitis, anthrax etc.

Control measures

- The best way to control houseflies is to eliminate their breeding places and to bring about an overall in the environmental sanitation on a community wide basis. This effect implies the following:-
- 1) Storing garbage, kitchen wastes and other refuse in the bins with tight lids,pending disposal
- 2) Efficient collection,removal and disposal of refuse by incineration, composting or sanitary land fill

- 3) Provision of sufficient sanitary facilities. e.g. pot privies, septic tanks, water seal, latrines and sanitary sewerage system.
- 4) Stopping open air defecation
- 5) Sanitary disposal of animal excreta
- 6) Stepping up general sanitation. A clean house with clean surrounding is the best answer to the fly problem.

Insecticidal control

- Fly control can also be achieved by using various insecticides like DDVP, baigon baits etc.
- Space sprays in general have little or no residual action. They produce only a temporary effect on adult fly.
- In summary,insecticides at best, are only a supplement,but not a substitute for sanitation.
- Protection against flies:- Screens with 14 meshes per inch will keep out the flies from houses,hospitals,markets,restaurants and and other places.

- Willing co-operation and ‘Fly Consciousness’ should be created among the people through health education.
- Fly control campaigns require organised individual community efforts which is the basis of successful Public Health Programme.
- Special attention is given by intensifying antifly measures at dumping grounds, municipal and private markets and hospitals by spraying insecticides for adult flies to avoid any type of disease spread.

Requirements for successful mosquito control

- Whole-hearted adoption of radical and systematic vector control measures.
- Chief officers of the different bodies should realise –

1) That malaria is a very serious source of loss of lives and revenue
2) That an unprotected source of breeding of this mosquito is an immediate danger and that every day's delay in dealing with it means that the health of this person living in the vicinity is menaced

- Information, Education and Communication
- Individual Responsibility
- Community Action
- Government Support