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IMPACT OF ENVIRONMENTAL CHANGES ON VECTOR POPULATION IN AN URBAN SITUATION

The activities of the growing population in Pondicherry urban agglomeration, with increasing industries have exerted an enormous pressure on its fragile environment. The lack of proper drainage and improper liquid and solid waste management has led to the breakdown of sanitary facilities. This has created conditions conducive to the proliferation of many disease vectors. The risk of infection with vector-borne diseases has increased due to exponential population growth, industrialization, urbanization and large-scale population movement¹. Developmental activities based on certain aggregate planning models that have promoted unplanned growth and breakdown of sanitation are the major cause of increase in the occurrence of vector-borne diseases. Developmental activities like irrigation projects, construction of roads, housing colonies, dams and railways are some of the other causes that affect the environment to create an imbalance in the natural ecosystem.

Improper waste management and disposal system, lack of health education of the people, poverty and unaffordability are some of the other causes that make the man's living conditions unhygienic and unhealthy. Our urban landscapes are littered with garbage, plastic bottles, disposable cups, discarded tyres, *etc.*, which serve as ideal breeding grounds for biological vectors. Urbanization is a continuous process in a developing country like India and this has naturally led to the

aggregation of population². Further, due to rapid industrialization large number of labourers migrate from rural to urban areas in search of job opportunities. This has resulted in the development of many slums with no proper sanitary and waste disposal arrangements. Owing to unplanned town expansion, the villages in the peripheral areas of towns are becoming semi-urbanized and this process continues unchecked. The setting up of an industry either in an endemic (disease prevalent) or non-endemic (disease-free) area leads to certain common characteristics connected with environmental health. Two main problems arise out of this crisis, the first being the creation of mosquitogenic conditions which will increase the receptivity of the area for the disease transmission, and the second is an aggregation of labourers which results in the increased vulnerability of the area.

Pondicherry had set an example as a model town in India in the first half of the 20th century. There were no known vector-borne diseases as major public health problems. After 1947, due to the overall development of the region, people from the neighbouring states/areas immigrated to this town, especially in the field of industry and commerce. The fast growth in industry, trade and tourism has resulted in a quantum leap in the immigrant and floating population. This write up focuses on the impact of environmental changes in Pondicherry contributing to the proliferation of vector population.

Industrial Growth and Urban Agglomeration

The number of industrial units in Pondicherry has increased from 3953 during 1961 to over 6000 in 2001. The industries continue to attract a large labour force. At present, there are over 70,000 people working in the small and medium scale industries. Numerous slum colonies have sprung up around these industries. The effluents from these industries, discharged without proper treatment and, improperly disposed have resulted in contributing to mosquito-genic conditions.

During the last four decades, the urban agglomeration sprawl has increased from 4 km², with a population of about 52,000 (1961) to 85 km² with a population of over 4,50,000 (2001). The urban growth rate has increased from 16.19% in 1961 to 40.88% in 2001. During this period the total area under irrigation has decreased from 38891 ha to 33525 ha, and the rural populace has also decreased from 79.98 to 34.01%. Because of the disproportionate growth in the urban population, housing in Pondicherry has become rather an acute problem. All agricultural land in and around Pondicherry urban limit are being converted into sites for houses, and houses are being constructed on low lying plots without any provision for a sewage system. During the last two decades, over 60 colonies have come up without any basic amenities and sullage has filled the numerous vacant plots. Numerous cesspits and *kutchha* drains have sprung up in all the colonies, which have increased the breeding sites of mosquitoes.

Problem of Solid Wastes

One of the major consequences of the socio-economic development in Pondicherry is the enormous production of solid wastes which has been estimated to be 450g/person/day³. Solid waste management is an important facet of environmental hygiene. Lapses in the storage, collection, treatment and disposal of solid wastes can lead to pollution of the soil, water and air, which often results in the creation of breeding grounds for biological vectors, such as insect pests and rodents, causing public health problems. Proper planning for collection, transport and storage, and the treatment and disposal of solid wastes has become crucial for ensuring a clean, healthy and pest free environment.

Disease Vectors

Filarial vectors

The type and quantity of solid wastes have increased enormously. Frequently these wastes are either thrown and/or carried by wind into the drainage and rainwater canals.

Once the drains are clogged, they become an ideal breeding ground for mosquitoes, mainly *Culex quinquefasciatus*⁴.

The average annual indoor resting population of vectors of bancroftian filariasis is steadily increasing in almost all the urban agglomerations in Pondicherry. The population (per man hour density: PMD – *ie* the number of mosquitoes collected indoors by an individual in one hour, using an aspirator) of *Cx. quinquefasciatus* has doubled in the last two decades, *ie* from 15.2 during 1980 to 32.0 in 2000 (VCRC unpublished observations). The efforts made so far by the Public Health Department and the municipalities to contain the breeding of mosquitoes and other pests, employing chemical methods could achieve only limited success. Environmental sanitation is the long lasting solution for all these maladies. If proper sanitation is maintained which is the primary responsibility of the civic authorities and the Public Works Department, there would be no need for insecticides. For instance, not even one tenth of the total 15 km length of the drains have a sufficient gradient for the required (velocity: 30cm/sec) water flow. Flowing water will keep the drains free from mosquitoes. Therefore, a public health environmental approach for source reduction through an appropriate solid waste management, directly involving the producers of wastes and the non-governmental organizations as a link with the Government functionaries will be the lasting solution for control of vectors of bancroftian filariasis.

Water bodies in low lying areas infested with floating weeds were the breeding habitats of *Mansonioides* species, the vector of brugian filariasis during the past decades. In the process of urbanization, land reclamation has resulted in the disappearance of these habitats, and thereby the PMD of *Mansonioides* declined from 5 during 1970 to <0.1 in the early 2000 (VCRC unpublished observations).

Malaria vectors

When horizontal expansion of the township became difficult due to lack of space, it started growing vertically. Multistoried buildings outnumbered single storied buildings. Consequently, such developmental activities resulted in the expansion of mosquito breeding habitats horizontally as well as vertically. The overhead tanks and cisterns offer breeding grounds for the malaria vector, *Anopheles stephensi*. Proper netting and the periodical emptying of these tanks are the best option for the control of this vector.

Dengue vectors

Equipments like air conditioners, coolers, *etc.*, provide ideal conditions for the breeding of *Aedes aegypti* (vector

of dengue/dengue haemorrhagic fever). Indiscriminately thrown disposable plastic cups, cans, automobile tyres, broken containers, glasswares, and other objects throughout the town also support the proliferation of *Ae. aegypti*. Though the disease has not been recorded here there exists a potential threat especially when the vector population build up is high (Breteau index : >50, *ie* the total number of containers positive for breeding per 100 houses) and coincides with the availability of persons carrying infection from other endemic areas. Creation of awareness on the breeding of this vector and strict implementation of civic laws are necessary to contain the problem of the dengue vector.

Japanese encephalitis vectors

In India, the first outbreak of JE occurred in Pondicherry in 1955⁵. Again, there were sporadic occurrences in the mid 1980s. Since the vector, *Cx. tritaeniorhynchus* (breeding habitat: rain water pools, paddy fields, *etc.*) continues to be widespread (data on density not available), and the reservoir / amplifying hosts (ardeid birds / pigs) are found throughout this region, the possibility of re-emergence of this disease is quite likely. Epidemiological monitoring and the development of advance warning system will help in preventing the re-emergence of JE.

Leishmaniasis vectors

The natural habitats of phlebotomine sandflies (vectors of leishmaniasis) *viz.*, cattle sheds, *kutch*a houses and huts are now being replaced with *pucca* buildings/houses in most of the localities. These improved structures do not facilitate the proliferation of sandflies and as a result, the number of phlebotomine species has reduced from nine in 1979 to two in 2000. Also, the population density (PMD) of sandflies has shrunk from 37 to 5 during this period (VCRC unpublished observations). Under the present trend of development there seems to be no threat of leishmaniasis in Pondicherry.

Others

The common housefly has been a nuisance to man since time immemorial and its number has increased in recent times in Pondicherry. They breed in close association with man, in human and animal wastes. Houseflies are potential vectors of enteric infections such as dysentery, infantile diarrhoea, typhoid, food poisoning, cholera, worm infection, poliomyelitis and certain skin diseases. Their survival and capacity to transmit diseases are directly linked with solid waste disposal. The unplanned and uncoordinated activity in waste disposal has resulted in innumerable slums and

the breakdown of sanitary services. The solid wastes and wastewater disposal systems have not been planned properly nor implemented strictly, and the town is now an ideal breeding ground for both mosquitoes and houseflies. By improving basic sanitation, we can achieve source reduction and by motivation, sustenance of the healthy environment can be ensured.

Key Issues and Remedies

What government can do?

It is evident that the changes in the environment brought about by man have facilitated the proliferation of vector mosquitoes and houseflies. The process of development and industrialization was supposed to improve the man's living conditions. But, it has not been achieved, because of the unisectorial planning and improper implementation of the projects. The technology should be aimed at prevention of breeding habitats through environmental improvement. The methodology of control is simple and can be summarized as follows: (i) when the water is stagnant, drain or make it moving; (ii) if the water is moving, reduce (compress) the total vector breeding surface area; (iii) if the water is hidden, either fill it with sand or make it accessible to vector control; (iv) in case of clean water, remove obstruction if any; and (v) enforce the existing civic rules.

Mosquito control does not need any sophisticated technology or any new department. If the situation was optimal, *ie.*, proper disposal of solid and liquid waste, neither the mosquito nor the housefly would proliferate. Sanitation is the responsibility of the local bodies and should ideally be carried out by the public health engineers. The responsibility and authority of sanitation and mosquito control should be entrusted to local representatives. People in the urban areas are accustomed to have everything done by a governmental agency and are not prepared to do anything beneficial for the community. This is because the urban population is heterogeneous having migrants from various places with limited social interaction. A sense of belonging to a particular place and the concern for the particular place is also missing. Creation of awareness among the public on the causes and remedies of the disease vector problem, and strict enforcement of civic laws are essential to improve the sanitation and also its sustenance.

What an individual can do?

The vector control programme does not take into consideration people's priority at the time of designing

the programme and hence lacks people's participation. By proper information, education and communication (IEC), individuals may be motivated to adhere the civic rules and participate in the vector control by (i) proper disposal of solid wastes, and not throwing waste into the drains; (ii) avoiding construction of any kind of structure over the drain; (iii) screening / hermetically sealing of septic tanks and unused wells; (iv) checking for mosquito breeding in containers in and around the house and emptying them at least once a week; and (v) informing the local authorities if there is any water body / breeding habitat.

It may be difficult for individuals to solve the total problem arising out of increased vector population, but it is possible for them to lessen the vector menace by individually facilitating the source reduction, and by collectively (community) protecting the environment.

Conclusions

In Pondicherry, people's participation is not difficult to achieve. There exists a distinct possibility of achieving freedom from disease vectors, provided the local bodies prioritize the people's articulated need, and implement

the projects in a judicious way; and if the mosquito/ vector control activities are run by a single authority. The reasons, causes and remedies mentioned hitherto are applicable not only to Pondicherry, but also to many other similar urban situations in India.

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