Introduction

The increasing demographic pressure has resulted in the continuous search of new land for the settlement of mankind. The aggressive intervention of man with the environment has drastically affected the vegetations and other biotic and abiotic factors. These changes in the ecosystems in turn have been imposing very serious epidemiological alterations such as the increased extension in the suburban areas by constructing unplanned housing colonies, depleting the agro-ecosystems, creating improper drainage system etc. In addition, the construction of dams and the enhancement of irrigated conditions in the agro-ecosystems increased the breeding surface area of many vector
mosquitoes, which are responsible for the transmission of major vector-borne diseases in many parts of the world (Serandour et al. 2007).

The vector borne diseases cause a significant morbidity and mortality among the various human populations throughout the world. The life threatening diseases, which are transmitted by mosquito vectors in India are malaria, Japanese encephalitis (JE), dengue/dengue hemorrhagic fever and Chikungunya fever (Banerjee 1996; Sevarkodiyyone and Pandian 2008).

Species composition and density of vector species in a locality determine the existence of the type and magnitude of the mosquito borne diseases. The anthropogenic activities also encourage the proliferation of the vectors of these diseases and these vector mosquitoes breed in water tank, paddy fields, domestic water containers, open drains and other such habitats that favour the breeding of major vectors such as Anopheles stephensi (malarial vector), Aedes aegypti (vector of dengue/Chikungunya virus), Culex tritaeniorhynchus (vector of brain fever or JE virus) and Culex quinquefasciatus, (vector of lymphatic filariasis parasite). In agro-based human settlement areas, paddy cultivation, vegetations near the water bodies and the availability of diverse vertebrate hosts like cattle, pigs and birds tend to enhance the breeding and feeding of several vector and non-vector species. Scattered
human settlement and limited availability of water bodies may lead to either meager number or non-availability of mosquito species. Therefore, documentation of biodiversity of mosquitoes periodically in different geographical areas is the need of the hour, which would help to manage the vector prevalence and mosquito menace.

Species inventory is the main requirement for documentation of biodiversity of mosquitoes in the epidemic and endemic areas. The identification of species generates the necessary materials for taxonomical study and in order to speed up the identification process, the methodology needs to be very simple, rapid and effortless. DNA bar-coding technique has been found promising in the identification of various mosquito species particularly where morphological characters do not support to differentiate and to identify the mass collection of mosquitoes during disease outbreaks. Hence, in this present study such molecular tools were applied to identify the major vectors.

Further, the density of mosquito fauna is considered as another key factor in disease transmission, which reflects on the epidemiology of mosquito borne diseases. The density of mosquito population fluctuates temporally and influenced by environmental variables such as rainfall, temperature and humidity. Therefore, the epidemics of vector borne diseases are modulated by the density of mosquitoes. The fluctuation of
Aedes aegypti density was mainly affected by the local rainfall, dispersal by flight and transportation of eggs and adults along the commerce routes (Reiter et al. 1995). Understanding the pattern of distribution of mosquitoes helps in planning and implementing effective vector management strategies (Killeen et al. 2003). The determination of spatial and temporal variations in the distribution of vector mosquito and also the human biting rate (man – vector contact index) are important parameters to estimate the transmission of pathogens causing human infections. The studies on reporting the highest human biting rate when the mosquito density reaches peak are essential in the present scenario (Stephen et al. 2006) to develop containment strategies for the mosquitoes.

The transmission of pathogens by mosquitoes is strongly linked with their host feeding pattern (Reuben 1987; Kilpatrick et al. 2007). Host selection behavior of mosquitoes determines the efficient transmission of pathogens to the selective hosts or to a specific host. Hence, the chances of pathogen transmission to human are more if the vectors are anthropophilic or predominantly anthropophilic in nature. Further, the drift in the feeding behaviour leads to the change in the host selection pattern i.e. shifting from zoophilic pattern to anthropophilic pattern. Seasonal changes in feeding behavior of many mosquitoes has been documented (Smith 1975). Interestingly, a zoophilic mosquito has
been shown to feed on human in summer, when people sleep outdoors and during winter the same mosquito species feed on cattle, when the humans sleep indoors (Reisen and Boreham, 1979). Moreover, seasonal shift in blood feeding behavior of *Culex* species has also been well documented (Tempelis and Washino 1967; Kent *et al.* 2009). The determination of blood feeding behavior of mosquitoes helps in the better understanding the pathogen life cycle, potential hosts and to develop alternate vector control strategies. In addition, the feeding behavior of various species of mosquitoes in the diel cycle also plays a major role in sharing the available hosts and co-existence of many species in a newly invaded zone (Pandian 1993). Periodical monitoring of blood feeding behavior of female mosquitoes would highlight the possible shifts in their host feeding pattern and in turn will help to understand the disease transmission dynamics.

Identification and the location of the breeding habitats of mosquitoes would enable the health authorities to implement the target oriented vector control strategies. Mosquitoes exhibit preferential habitat selection pattern and breed in potential habitats. Periodical screening of the larval habitats is mandatory for the application of larvicides against the specific vector. The key breeding habitats of *Aedes aegypti* may vary in different geographical situations, the rain water tanks and discarded containers in Queensland (Hanna *et al.* 1998), tyres and drums in Fiji
(Kay et al. 1995), and air-coolers and tyres in Delhi (Sharma et al. 2005). Some of the mosquito species changed their habitats for colonization and co-existence with different species of mosquitoes (Pandian and Manoharan 2000; Fulmali et al. 2008). Therefore, the identification of potential breeding habitats of vector mosquitoes is very vital for implementation of the suitable larval control strategy.

The management of vector borne disease depends on not only the better understanding of the bionomics of vector mosquitoes but also the epidemiology of the vector borne diseases. Further, suitable public health surveillance systems and opinions of community and private medical practitioners would help in better understanding of the incidence of vector borne diseases and their management. In this context, knowledge, attitude and practice (KAP) of the people in the endemic areas about the mosquito borne diseases and the bionomics of mosquitoes are essential for maintaining sustainable vector control programmes and to keep community free from the risk of vector borne diseases. The KAP study provides information to evaluate the existing control programme and to evolve newer strategies for a better management of both vectors and diseases. The level of awareness about the diseases could be unearthed by the KAP study and in past such studies have been conducted by several authors (Sharma et al. 1993; Sharma 2001; Anh et al. 2005; Barbazan et al. 2008 and Suryakala et al. 2009).
In view of the above, the present study has been undertaken to understand the bionomics of mosquitoes and the incidence of mosquito borne diseases in the suburban and rural areas in Tiruppuvanam Block, Sivaganga district, Tamil Nadu state, India during the period between 2004 and 2008 with the following objectives:

- to identify the biodiversity pattern of mosquito species with the help of conventional taxonomic method and molecular entomological tools,
- to assess the density of mosquito species during the survey period,
- to record the spatial distribution pattern of mosquitoes,
- to understand the blood feeding pattern of mosquitoes with reference to host selection behaviour and biting behaviour pattern in the diel cycle,
- to determine the general and preferential habitat selection behaviour of different species of mosquitoes and
- to document the epidemiology of vector borne diseases and bionomics of vector and non-vector mosquitoes by collecting secondary data from Public Health Department of Government of Tamil Nadu, opinions of private medical practitioners and the residents in the study area by conducting a Knowledge, Attitude and Practice (KAP) survey.
The outcome of this study will provide adequate information about the mosquito fauna with reference to their prevalence, abundance, feeding and breeding behaviour. Further, this study will enlighten the impact of mosquito menace on the human population in the study area and steps to be taken to develop vector control strategies in future.