# A Report of Preliminary Vector Survey in Parshuram Municipality of Dadeldhura district

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**TABLE OF CONTENTS**

# ABSTRACT

Vector borne diseases are one of major public health problems in Sudurpashchim Province of Nepal. Entomological surveillance enables us to understand composition, abundance and distribution of vector species in any locality, and is an essential component of malaria vector control programs, operational activities and research. Parashuram Municipality of Dadeldhura district lies in the southern part and have major portion of total population of the district. The present survey was conducted from 25-32 March of 2024 to know the current status of arthropod vectors in this area. A total of 159 specimens of mosquito and sandfly were collected through indoor resting, light trap and larvae collection performed at the study area. Nine species of mosquito along with 76 specimens of sandfly were collected during present study. *Anopheles fluviatilis* was most abundant among mosquitoes with relative abundance 22.64% followed by *Anopheles maculatus pseudowillmori* (10.06%) and *Anopheles culicifacies* (6.29%). *Anopheles annularis, Anopheles maculatus willmori, Anopheles maculatus maculatus, Culex quinquefasciatus, Culex tritaeniorhynchus* and *Armigeres subalbatus* were also recorded during the study. There were found vector species for malaria, filariasis and JE, so it is important to focus on management of breeding habitats and minimizing human-vector contact in this area.

**Key Words:** Dadeldhura, Parashuram, Anopheles, Culex, Armigeres, Sandfly

# 1. INTRODUCTION

Insects belong to the largest phylum in the animal kingdom, arthropoda, and play key roles in ecosystem. Yet, blood-feeding i.e. hematophagous arthropods such as mosquitoes, sandflies, ticks, mites etc. serve as vectors for devastating parasitic and viral human diseases and show tremendous individual variation in their capacity to transmit diseases (Baxter et al., 2017). Vector-borne diseases (VBDs) are caused by parasites, viruses and bacteria and transmitted to humans by different vectors. VBDs are major public health problems particularly in tropical and sub-tropical regions of the world. In the WHO South-East Asia Region (SEAR), the VBDs that are of major public health importance are malaria, dengue, Japanese encephalitis (JE), chikungunya, lymphatic filariasis and kala-azar (WHO, 2014). In addition to these, scrub typhus has been a major public health problem in Nepal since 2015 (Dhimal et al., 2021).

Mosquitoes are medically important insects as they act as vectors for major prevalent vector borne diseases in Nepal such as Malaria, Dengue, Lymphatic filariasis and Japanese encephalitis. Mosquitoes are being searched and studied in Nepal from 1958 in connection with "Malaria Eradication Program". Malaria was such a disaster back then in Nepal, so to reduce its burden different program were launched by the Government. First Malaria Control project was launched in 1954 with the support from USAID then National Malaria Eradication Program in 1958 again Malaria Control Program in 1978. To address perennial occurrence of malaria in foot hills, inner terai, valleys, and hard core forests of both terai and hills Roll Back Malaria (RBM) Program was launched in 1998 following the call of WHO to revamp the program. Nepal is working currently in Malaria Elimination Program 2014-2025 with the goal of malaria free Nepal by 2025 (EDCD, 2018). The high risk of acquiring the disease is attributed to the abundance of vector mosquitoes, mobile and vulnerable population, relative inaccessibility of the area, suitable temperature, environmental and socio-economic factors. Since presence and abundance of vector species affects disease burden proportionally, so National Malaria

Strategic Plan (2014-2025) endorsed vector surveillance as core intervention to reduce and interrupt the malaria transmission (EDCD, 2020a).

Malaria is a complex disease caused by protozoan parasites (Genus: *Plasmodium*) and transmitted by blood-feeding infectious *Anopheles* mosquitoes ( Dutta & Dutt, 1978). Mosquitoes are bilaterally symmetrical belonging to the family Culicidae. These are delicate, slender flies; legs are two or three times as long as body, antennae filiform. Body is strongly humped; both head and abdomen drooping downwards. Larvae and pupae are aquatic. A total of 3,719 extant species of Culicidae are currently formally recognized worldwide (Mosquito Taxonomic Inventory, 2023). About 537 are species of *Anopheles* (Harbach, 2013) were reported and only 70-80 are known to transmit human malaria worldwide. Of these, 41 are considered to be the dominant vector species and capable of transmitting malaria by large (Sinka et al., 2012).

In 1990, Darsie and Pradhan published an extensive account of the mosquitoes of Nepal, recording 130 species in 14 genera. A total of 24 species of *Aedes* mosquitoes were reported from Gandaki, Janakpur, Mahakali, Seti, Koshi, Bagmati, Narayani and Karnali Zones of Nepal. This genus has been reported from low to high altitudes of Jumla district. The recorded 45 species of *Anopheles* mosquitoes are distributed from the Terai and inner Terai areas to the hills and mountains of the country. Among 45 *Anopheles* species only seven have been reported as malaria vectors of primary importance. These include: *Anopheles minimus, An. fluviatilis, An. annularis, An. maculatus, An. dravidicus, An. pseudowillmori*, and *An. willmori*. After *Anopheles* another largest genus of mosquito distributed in Nepal is *Culex* with 29 recorded species. Like *Anopheles, Culex* are also distributed throughout the country except high mountains but has been reported in the high altitudes of Jumla from various habitats. Over the last decades, deforestation and effective malaria control program using Dichloro- Diphenyl Trichloroethane (DDT) eliminated *An. minimus* during 1960s (Parajuli et al, 1981). *An. fluviatilis* is now the primary malaria vector in Nepal, *An. annularis* the secondary malaria vector and the *An. maculatus* complex members are seasonal malaria vectors in the mountain region of Nepal (Darsie & Pradhan, 1990; Rana, K.J., 2001).

Malaria has remained as a major public health problem impacting on the health and lives of a large proportion of people particularly in remote areas with low economies and concentrated along international borders (Dhimal et al., 2014a). As entomological surveillance can be defined as the regular, systematic collection, analysis and interpretation of entomological data for risk assessment, planning, implementation, monitoring and evaluation of vector control interventions; all the surveillance activities must be clearly linked to programme decisions to ensure optimal vector control (EDCD, 2020b). Effective vector control is reliant on knowledge of local vector species and their susceptibility to insecticides, as well as on vector and human behaviours that may allow mosquitoes to avoid contact with interventions and thereby maintain residual transmission (Afrane et al., 2005). It is well established that effective vector control programmes can make a major contribution towards advancing human and economic development. Vector control interventions have one of the highest returns on investment in public health. Aside from direct health benefits, reductions in vector-borne diseases will enable greater productivity and growth, reduce household poverty, increase equity and women's empowerment, and strengthen health systems (EDCD, 2020b).

Malaria is a significant public health concern in Nepal, especially during the monsoon season when mosquito breeding is more prevalent. The government and various organizations have been working to control malaria transmission through vector control measures, improved diagnosis, and timely treatment. Periodic collection of vector data is essential to inform vector control strategies and track their impact on malaria transmission. According to malaria micro-stratification- 2023, three provinces are under moderate to high risk. These provinces collectively have 10 high risk wards and 35 moderate risk wards (EDCD, 2024). The present priliminary vector surveillance was carried out to investigate arthropod vector population of Parashuram Municipality ward number 7 of Dadeldhura district. This study will be helpful in launching vector and disease control strategies in future.

# 2. MATERIALS AND METHODS

## 2.1. Study Area

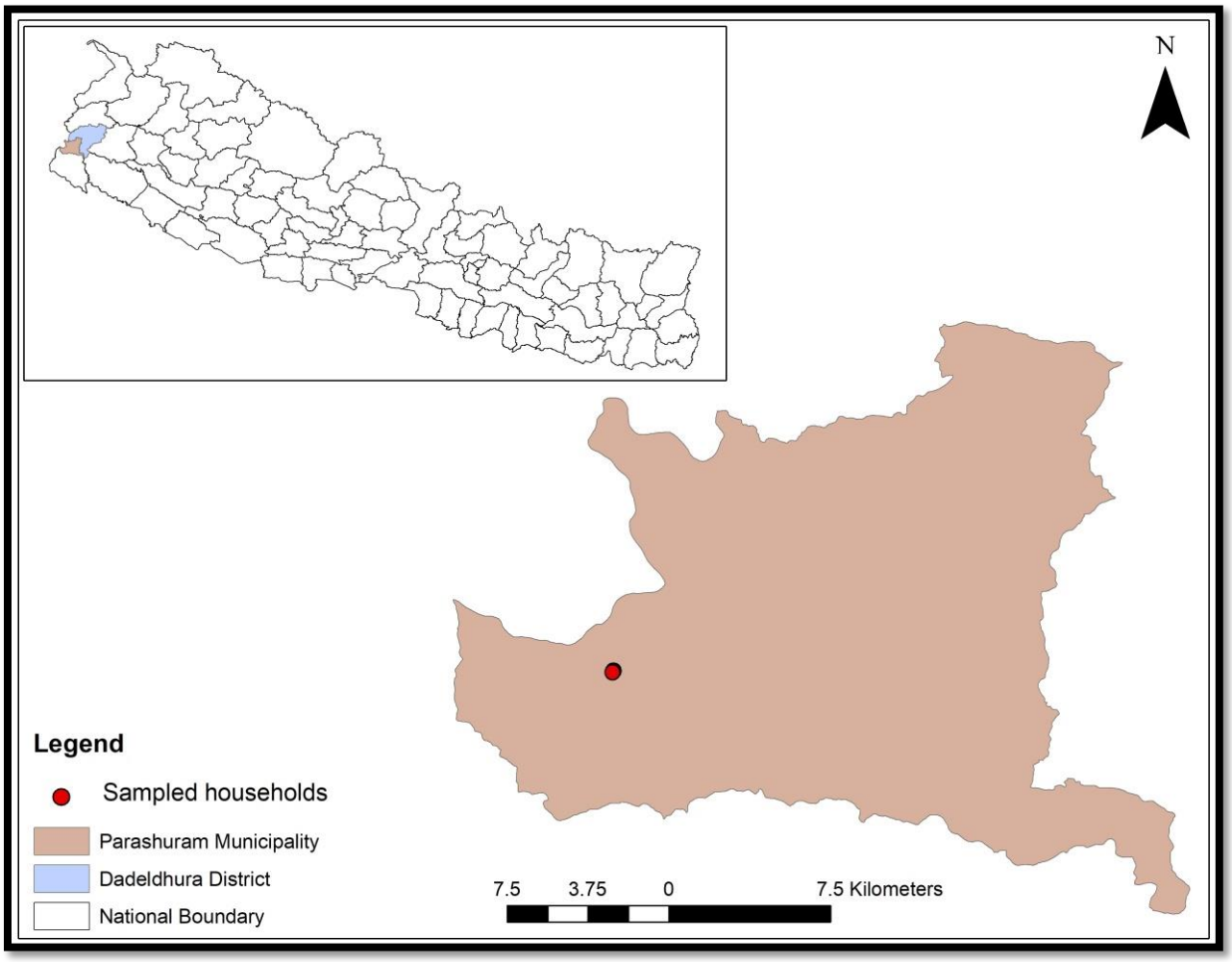


Figure: 1. Map of Study Area

Dadeldhura district of Nepal is located in Sudurpaschim Province having the spatial extent between latitude 28.59ºN to 29.26ºN and longitude 80.12ºE to 80.47ºE, covering an area of 1,538 $km^2$. Parashuram Municipality was taken as study site which is surrounded by Aalital RM in east, India border in west, Bhageswar rural municipality in North and Kanchanpur district in South. This municipality pose tropical climate. About half of the total population of the district is occupied collectively by Parashuram

Municipality and Aalital Rural Municipality; they both lie in the southern part of the district. Parashuram-7 was chosen for vector surveillance.

### 2.2. Materials

- ✓ Aspirators
- ✓ Hand Torch
- ✓ Light Trap
- ✓ Plastic Cups
- ✓ Dipper and Dropper
- ✓ Vials
- ✓ Cotton, Mask, Gloves
- ✓ Chloroform
- ✓ Petri dishes
- ✓ Stereoscope

### 2.3. Vector Sampling and Identification

The entomological survey was performed from 25-31 March, 2024. Adult mosquitoes/sandflies were collected through collection six human dwellings and four cattle shed. Collection sites were selected on the first day and fixed for everyday collection. Indoor resting mosquitoes were collected using torchlights and aspirators in the morning. Light trap was placed inside most suitable cattle shed among the sheds selected for morning collection. GPS points for each sampling sites were recorded along with temperature and humidity.

Oral informed consent was taken from each household before starting the collection of mosquitoes either in houses or in animal shelters. In cases where household member disagreed, the house was excluded from the collection plan and the immediate next one was chosen for study.

All the collected samples were brought to Entomology Laboratory of Province Health Directorate at Mahendranagar, Kanchanpur. Immature stages were kept for rearing in laboratory conditions. Adult mosquitoes, both collected and emerged from larval collection, were immobilized using Chloroform and identified using relevant taxonomic keys (Darsie & Pradhan, 1990; WHO, 2020)

### 2.4. Data Analysis

Data were managed in Microsoft Excel 2013, analysed and interpreted using its tools.

# 3. RESULTS

A total of 169 specimens of mosquito and sandfly were collected through indoor resting, light trap and larval collections performed at the study area. Nine species of mosquito; six species of Anopheles, two species of Culex and one species of Armigeres along with many specimens of sandfly were recorded (Table 1). *Anopheles fluviatilis* was most abundant among mosquitoes with relative abundance 22.64% followed by *Anopheles maculatus pseudowillmori* (10.06%) and *Anopheles culicifacies* (6.29%). *Anopheles annularis, Anopheles maculatus willmori, Anopheles maculatus maculatus, Culex quinquefasciatus, Culex tritaeniorhynchus* and *Armigeres subalbatus* were also recorded during the study. Total 76 sandfly specimens were collected through light traps making relative abundance 47.80%. Both male and female individuals were recorded and counted for analysis.

Table 1: Species composition of Vectors in Parashuram Municipality

| S.N. | Species | Total | Relative Abundance(%) | Collection Methods |
|---|---|---|---|---|
| 1 | *Anopheles fluviatilis* | 36 | 22.64 | IRC, LT |
| 2 | *Anopheles annularis* | 2 | 1.26 | IRC |
| 3 | *Anopheles maculatus pseudowillmori* | 16 | 10.06 | IRC, LT |
| 4 | *Anopheles maculatus willmori* | 1 | 0.63 | IRC |
| 5 | *Anopheles maculatus maculatus* | 8 | 5.03 | LT, LC |
| 6 | *Anopheles culicifacies* | 10 | 6.29 | IRC |
| 7 | *Culex quinquefasciatus* | 6 | 3.77 | IRC |
| 8 | *Culex tritaeniorhynchus* | 1 | 0.63 | LT |
| 9 | *Armigeres subalbatus* | 3 | 1.89 | LT |
| 10 | Sandfly | 76 | 47.80 | LT |
| | | **159** | | |

Total 66 mosquito specimens were collected through indoor resting collection from animal dwellings. Human dwellings were also searched for mosquitoes but cannot find any. *Anopheles fluviatilis* was the most dominant mosquito species through indoor resting collections followed by *Anopheles maculatus pseudowillmori, Anopheles culicifacies* and others. In light trap, 89 specimens were collected, where sandfly was most abundant (76

specimens) followed by *Anopheles maculatus willmori, Anopheles maculatus maculatus* and others (Figure 2). Further, abdominal condition of indoor resting female mosquitoes and mosquitoes collected from light was also investigated and most individuals were found to be fulfed (Annex 1 and Annex 2 respectively). From the larvae collected from nearby water sources of study area, two male and two female specimens of *Anopheles maculatus maculatus* were emerged.

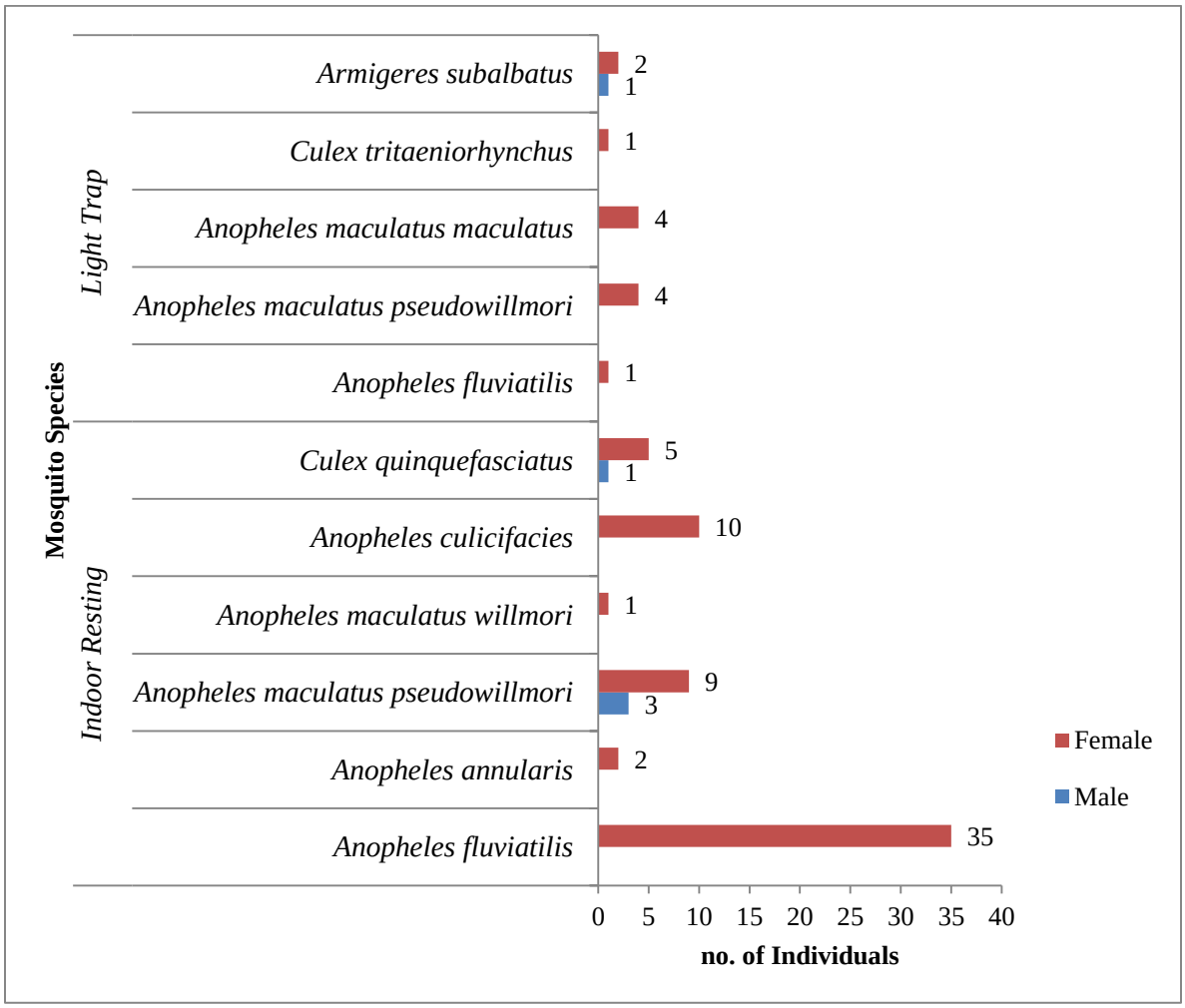


Figure 2: Abundance of vector species through both collection techniques applied

# 4. DISCUSSIONS

Nine species of mosquito and many specimens of sandfly were collected and identified during present study. Among the malaria vectors *Anopheles fluviatilis, Anopheles annularis* and *Anopheles maculatus* complex was recorded in this study. As from previous studies, *An. fluviatilis* is the primary vector species in Nepal, where as *An. annularis* is a secondary vector and *An. maculatus* complex is considered as seasonal vector (Dhimal et al., 2014b). Vectors of malaria has been reported from different geo-ecological areas of Nepal (Dhimal et al., 2014c; Pradhan et al., 1970) and in this study as well all three malaria vectors were recorded. Further *Culex quinquefasciatus* and *Culex tritaeniorhynchus* were recorded from the study area, which are vectors for filariasis and JE respectively.

# 5. CONCLUSIONS AND RECOMMENDATIONS

The vectors for malaria, filariasis and JE were recorded during this study so the management of breeding sources and minimizing human-vector contact will be important measure to reduce the chances of disease outbreak at the study area.

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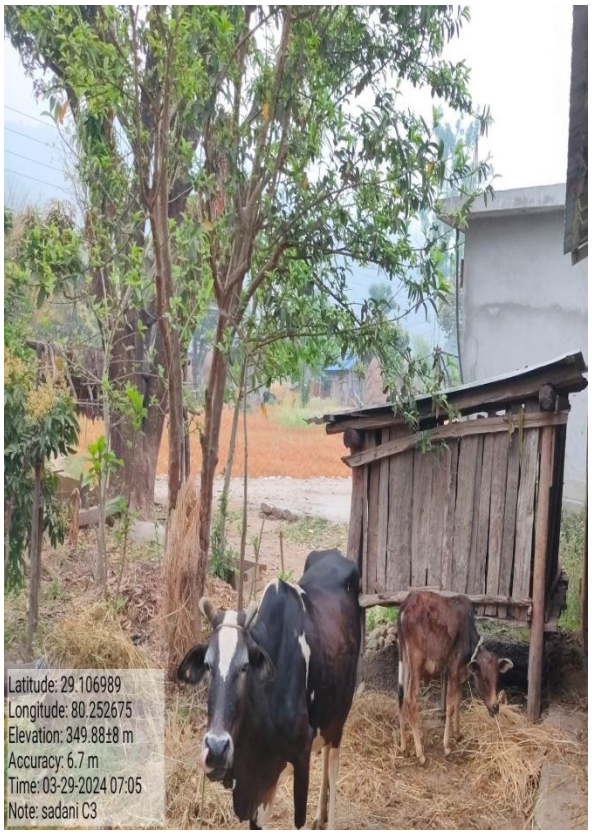
# PHOTOPLATES



2024.03.28 16:39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Note: sadani C3


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Elevation: 359.17±6 m
Accuracy: 7.6 m
Time: 03-29-2024 06:54
Note: sadani C1
Powered by NoteCam

## Annex: 1

Abdominal conditions of indoor resting mosquitoes from animal and human dwelling collection

| S.N. | Species | Male | Female | Total | Unfed | Fulfed | Gravid | Half-gravid |
|---|---|---|---|---|---|---|---|---|
| 1 | *Anopheles fluviatilis* | 0 | 35 | 35 | 0 | 18 | 7 | 10 |
| 2 | *Anopheles annularis* | 0 | 2 | 2 | 0 | 2 | 0 | 0 |
| 3 | *Anopheles maculatus pseudowillmori* | 3 | 9 | 12 | 0 | 7 | 0 | 2 |
| 4 | *Anopheles maculatus willmori* | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 5 | *Anopheles culicifacies* | 0 | 10 | 10 | 0 | 9 | 0 | 1 |
| 6 | *Culex quinquefasciatus* | 1 | 5 | 6 | 0 | 1 | 3 | 1 |

## Annex: 2

Abdominal conditions of indoor resting mosquitoes from animal and human dwelling collection

| S.N. | Species | Male | Female | Total | Unfed | Fulfed | Gravid | Half-gravid |
|---|---|---|---|---|---|---|---|---|
| 1 | *Anopheles fluviatilis* | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 2 | *Anopheles maculatus pseudowillmori* | 0 | 4 | 4 | 1 | 3 | 0 | 0 |
| 3 | *Anopheles maculatus maculatus* | 0 | 4 | 4 | 0 | 3 | 1 | 0 |
| 4 | *Culex tritaeniorhynchus* | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 5 | *Armigeres subalbatus* | 1 | 2 | 3 | 2 | 0 | 0 | 0 |
| 6 | Sandfly | | | 76 | | | | |