A Report of Preliminary Survey for Mosquito Vectors in Punarbas Municipality of Kanchanpur 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. Punarbas Municipality of Kanchanpur district lies in the southern part of the district and connected to India border as well. The present survey was conducted from 21-27th January of 2024 to know the current status of mosquito vectors in this area. A total of 50 specimens of mosquito belonging to five species were collected and identified through indoor resting collection performed at the study area. During the study *Anopheles annularis* was found most abundant (32 specimens), followed by *Culex quinquefasciatus* (13 specimens), *Anopheles barbirostris* (3 specimens), *Anopheles fluviatilis* (2 specimens) and *Armigeres* sp. (1 specimen). There were found vector species for malaria and filariasis so it is important to focus on management of breeding habitats and minimizing human-vector contact in this area.

Key Words: Kanchanpur, Punarbas, Anopheles, Culex

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- 2022, 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 integrated vector surveillance was carried out to investigate arthropod vector population of Punarbas municipality ward number 9. This study will be helpful in launching vector and disease control strategies in future.

2. MATERIALS AND METHODS

2.1. Study Area

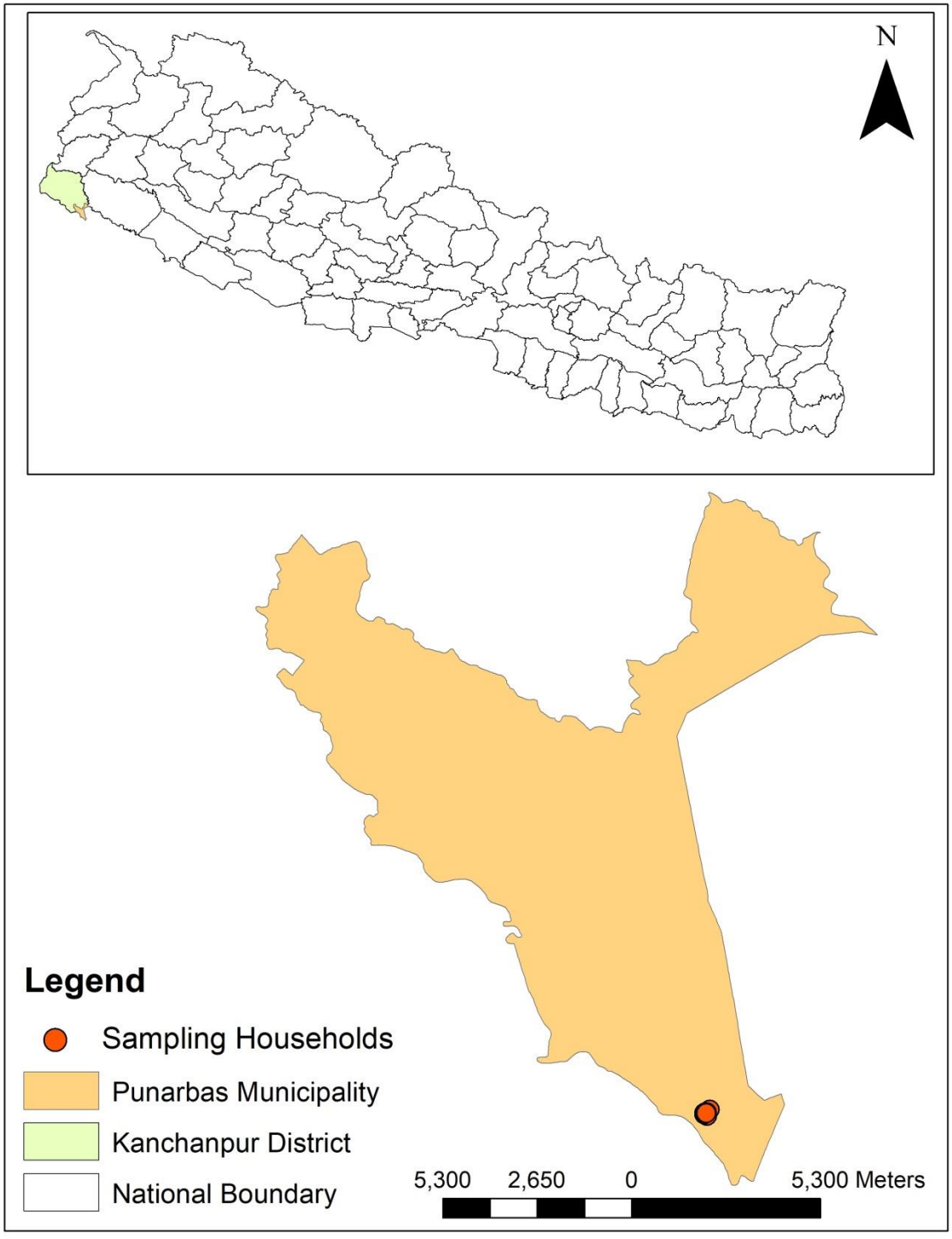


Figure: 1. Map of Study Area

Kanchanpur district of Nepal is located in Sudurpaschim Province having the spatial extent between latitude 28º38'N to 29º28'N and longitude 80º03'E to 80º33'E, covering an area of 1610 km^2. Punarbas Municipality lies in southern part of the district and has most of area near India border. The Municipality is surrounded by Kailali District and India in the east, Belauri municipality in the west, Laljhadi RM and Krishnapur municipality in north, and India in the south. This municipality has an area of 104 sq. km. and has 11 ward in total; of which vector surveillance was conducted in Ward no. 9.

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 on from 21-27th January, 2024 (2080/10/07 to 2080/10/13B.S.). Adult mosquitoes were collected from six human dwellings and four cattle shed, those were selected randomly 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. Adult mosquitoes 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 50 specimens of mosquito were collected through indoor resting collection performed at the study area. Three species of Anopheles, one species of Culex and one species of Armigeres mosquito were identified during present study (Table 1). *Anopheles annularis* was found to be most abundant followed by *Culex quinquefasciatus, Anopheles barbirostris, Anopheles fluviatilis* and *Armigeres* sp. Both male and female individuals were recorded and counted for analysis.

Table 1: Species composition of Vectors in Punarbas Municipality

S.N.	Species	No. of specimens
1	*Anopheles annularis*	31
2	*Anopheles fluviatilis*	2
3	*Anopheles barbirostris*	3
4	*Culex quinquefasciatus*	13
5	*Armigeres* sp.	1
	Total	**50**

Culex quinquefasciatus was the only species that has been recorded from both human and animal dwellings (Figure 2). Abdominal condition of indoor resting female mosquitoes was also investigated and number of unfed and fulfed mosquitoes were found to be equal (Annex 1).

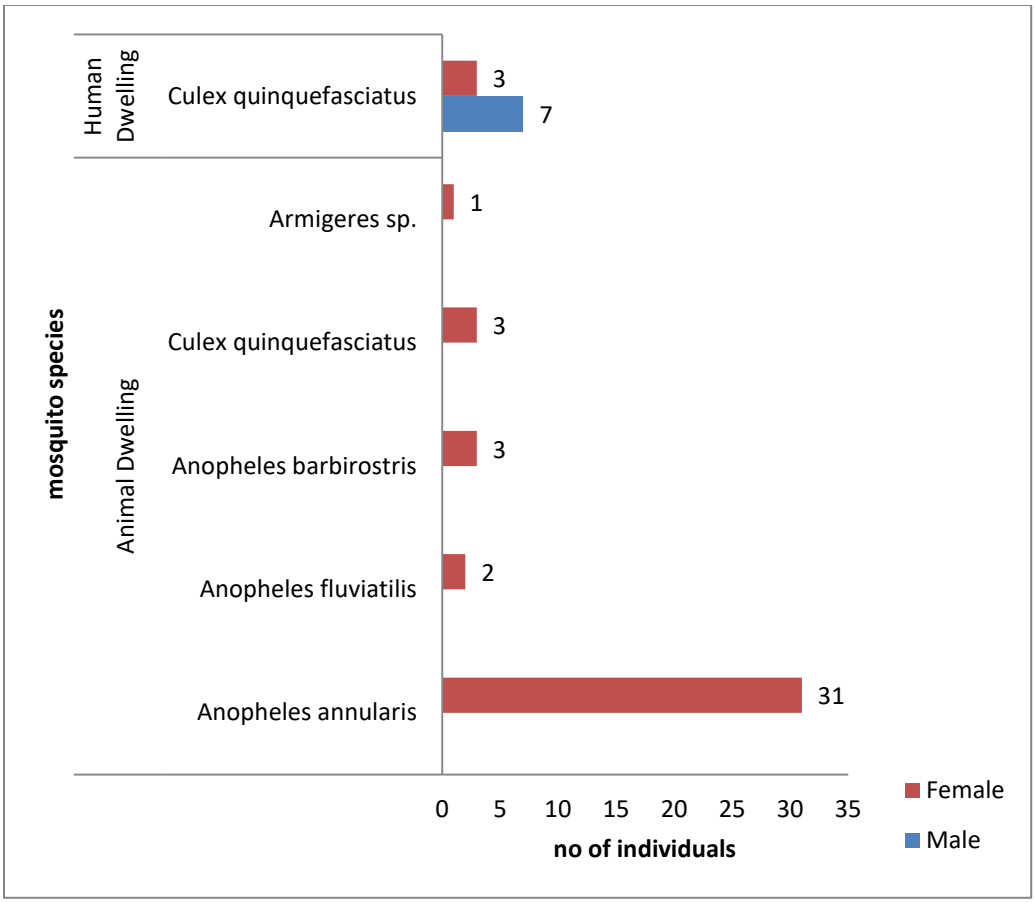


Figure 2: Abundance of vector species through Indoor Resting Collection

4. DISCUSSIONS

Five species of mosquito were collected and identified during present study. Among the malaria vectors *Anopheles annularis* and *Anopheles fluviatilis* were 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 two malaria vectors were recorded. Further *Culex quinquefasciatus* was also recorded from the study area, which is the vector for filariasis.

5. CONCLUSIONS AND RECOMMENDATIONS

The vectors for malaria and filariasis 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.

REFERENCES

Afrane, Y. A., Lawson, B. W., Githeko, A. K., & Yan, G. (2005). Effects of Microclimatic Changes Caused by Land Use and Land Cover on Duration of Gonotrophic Cycles of Anopheles gambiae (Diptera: Culicidae) in Western Kenya Highlands. *Journal of Medical Entomology*, *42*(6), 974–980. https://doi.org/10.1093/jmedent/42.6.974

Baxter, R. H. G., Contet, A., & Krueger, K. (2017). Arthropod Innate Immune Systems and Vector-Borne Diseases. *Biochemistry*, *56*(7), 907–918. https://doi.org/10.1021/acs.biochem.6b00870

Darsie, R. F., & Pradhan, S. P. (1990). The mosquitoes of Nepal: Their identification, distribution and biology. *Mosquito Systematics*, *22*(2), 69–130.

Dhimal, M., Ahrens, B., & Kuch, U. (2014a). Malaria control in Nepal 1963–2012: Challenges on the path towards elimination. *Malaria Journal*, *13*(1), 241. https://doi.org/10.1186/1475-2875-13-241

Dhimal, M., Ahrens, B., & Kuch, U. (2014b). Species composition, seasonal occurrence, habitat preference and altitudinal distribution of malaria and other disease vectors in eastern Nepal. *Parasites & Vectors*, *7*(1), 540. https://doi.org/10.1186/s13071-014-0540-4

Dhimal, M., Ahrens, B., & Kuch, U. (2014c). Species composition, seasonal occurrence, habitat preference and altitudinal distribution of malaria and other disease vectors in eastern Nepal. *Parasites & Vectors*, *7*, 540. https://doi.org/10.1186/s13071-014-0540-4

Dhimal, M., Dumre, S. P., Sharma, G. N., Khanal, P., Ranabhat, K., Shah, L. P., Lal, B. K., Jha, R., Upadhyaya, B. P., Acharya, B., Shrestha, S. K., Davidson, S. A., Charoensinphon, P., & Karki, K. B. (2021). An outbreak investigation of scrub typhus in Nepal: Confirmation of local transmission. *BMC Infectious Diseases*, *21*(1), 193. https://doi.org/10.1186/s12879-021-05866-6

EDCD. (2020a). *National Malaria Strategic Plan (updated)*.

EDCD. (2018). *Nepal Malaria Strategic Plan 2014-2025*. https://km.mohp.gov.np/document/%02%03%04%05%06%07%08%05%06%05nepal-malaria-strategic-plan-2014-2025

EDCD. (2020b). *National Guideline on Integrated Vector Management 2020*. EDCD. https://www.edcd.gov.np/resource-detail/national-guideline-on-integrated-vector-management-2020-new

EDCD. (2024). *Malaria Elimination Program.* EDCD.

Harbach, R. E. (2013). The Phylogeny and Classification of Anopheles. In *Anopheles mosquitoes—New insights into malaria vectors*. IntechOpen. https://doi.org/10.5772/54695

Hiran Dutta, M., & Ashok Dutt, K. (1978). Malarial ecology: A global perspective. *Social Science & Medicine. Part D: Medical Geography*, *12*(2), 69–84. https://doi.org/10.1016/0160-8002(78)90010-2

Mosquito Taxonomic Inventory. (2023). *Valid Species*. https://mosquito-taxonomic-inventory.myspecies.info/valid-species-list

Pradhan, J. N., Shrestha, S. L., & Vaidya, R. G. (1970). Malaria Transmission In High Mountain Valleys Of West Nepal Including First Record Of Anopheles Maculatus

Willmori (James) As A Third Vector Of Malaria. *Journal of Nepal Medical Association*, *8*(3), Article 3. https://doi.org/10.31729/jnma.1384

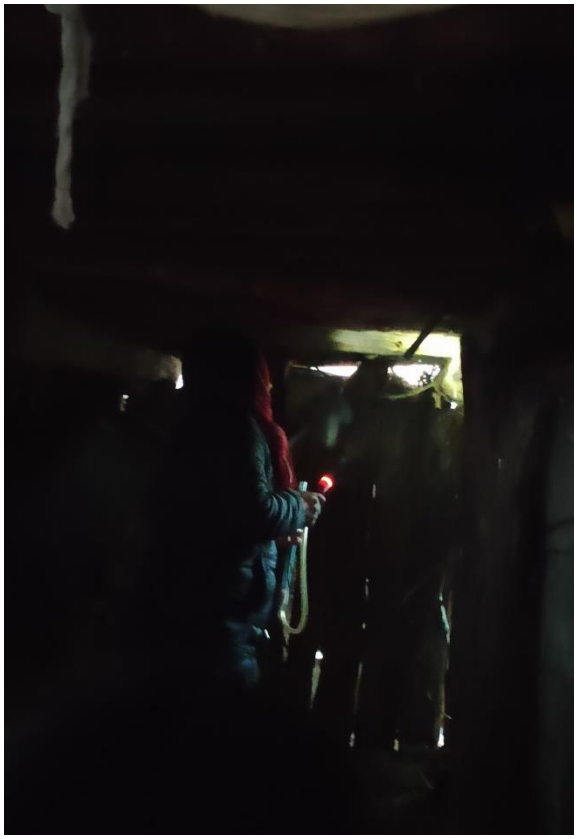
Rana, K.J. (2001). History of Malaria and Malaria control in Nepal. *Aravali Printers and Publishers P. Ltd. New Delhi.* https://scholar.google.com/scholar_lookup?title=History%20of%20Malaria%20and%20Malaria%20Control%20in%20Nepal&publication_year=2001&author=Rana%2CKJ#d=gs_cit&t=1683906088492&u=%2Fscholar%3Fq%3Dinfo%3Aa71uJS9PPhkJ%3Ascholar.google.com%2F%26output%3Dcite%26scirp%3D0%26hl%3Den

Sinka, M. E., Bangs, M. J., Manguin, S., Rubio-Palis, Y., Chareonviriyaphap, T., Coetzee, M., Mbogo, C. M., Hemingway, J., Patil, A. P., Temperley, W. H., Gething, P. W., Kabaria, C. W., Burkot, T. R., Harbach, R. E., & Hay, S. I. (2012). A global map of dominant malaria vectors. *Parasites & Vectors*, *5*(1), 69. https://doi.org/10.1186/1756-3305-5-69

WHO. (2020). *Pictorial identification key of important disease vectors in the WHO South-East Asia Region*. World Health Organization. Regional Office for South-East Asia. https://apps.who.int/iris/handle/10665/332202

World Health Organization. Regional Office for South-East Asia. (2014). *Vector-borne diseases* (SEA-CD-300). WHO Regional Office for South-East Asia. https://apps.who.int/iris/handle/10665/206531

PHOTOPLATES

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Longitude: 80.505107
Elevation: 202.95±2 m
Accuracy: 8.7 m
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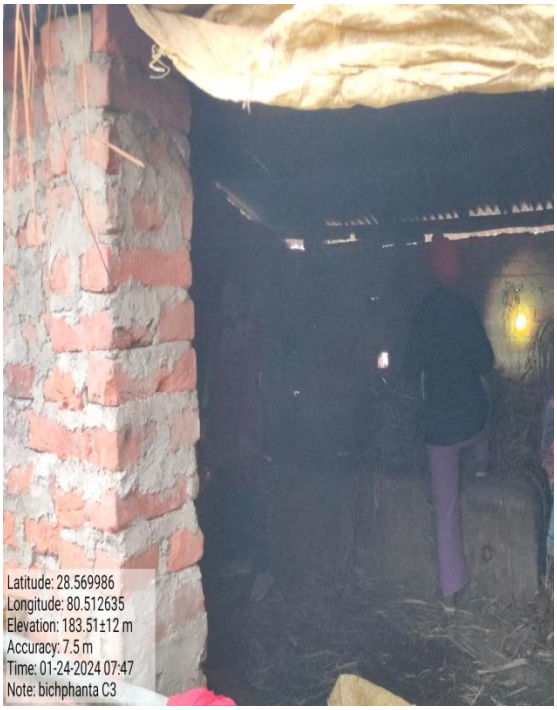
Note: light trap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Elevation: 183.51±12 m
Accuracy: 7.5 m
Time: 01-24-2024 07:47
Note: bichphanta C3


परासन स्वास्थ्य चौकी
यहाँ २४ सै घण्टा प्रसुती सेवा उपलब्ध छ।
2024-01-24 09:24

Annex: 1

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

S.N.	Species	Male	Female	Total	Unfed	Fulfed	Half-gravid	Gravid
Animal Dwelling								
1	*Anopheles annularis*	0	31	31	14	15	0	2
2	*Anopheles fluviatilis*	0	2	2	1	1	0	0
3	*Anopheles barbirostris*	0	3	3	0	0	0	3
4	*Culex quinquefasciatus*	0	3	3	1	0	0	2
5	*Armigeres* sp.	0	1	1	1	0	0	0
Human Dwelling								
1	*Culex quinquefasciatus*	7	3	10	1	2	0	0

Annex: 2

GPS points of houses (IRC)

House	**Longitude**	**Latitude**
CD1	80.513575	28.570839
CD2	80.512925	28.57015
CD3	80.512843	28.569343
CD4	80.512165	28.569731
HD1	80.513575	28.570839
HD2	80.512731	28.570151
HD3	80.512157	28.570003
HD4	80.512635	28.569986
HD5	80.512288	28.570121
HD6	80.512635	28.569986

(CD=Cattle Dwelling, HD=Human Dwelling)