A Report of Integrated Vector Surveillance in Aalital Rural 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. The present survey was conducted from 2080/12/20 to 2080/12/26 B.S. to know the current status of arthropod vectors Alital rural municipality of Dadeldhura district. Total 191 mosquitos and sandfly specimens were collected during the field work of which most abundant was *Anopheles fluviatilis* (28.27%), followed by *Culex quinquefasciatus* (26.18%), *Anopheles maculatus pseudowillmori* (17.80%) and others. *Anopheles annularis, Anopheles culicifacies, Anopheles splendidus, Culex tritaeniorhynchus* and *Aedes aegypti* were also recorded during this study. Total 20 specimens of sandfly were collected making 10.47% of all collection. *Culex quinquefasciatus* was collected through all the collection methods applied while sandflies were collected through light trap only. Vector species for malaria, filariasis, JE and dengue were found present at the study area, so it is important to focus on management of breeding habitats and minimizing human-vector contact in this area.

Key Words: Dadeldhura, Alital, Anopheles, Culex, Aedes, 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 integrated vector surveillance was carried out to investigate arthropod vector population of Alital Rural Municipality 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

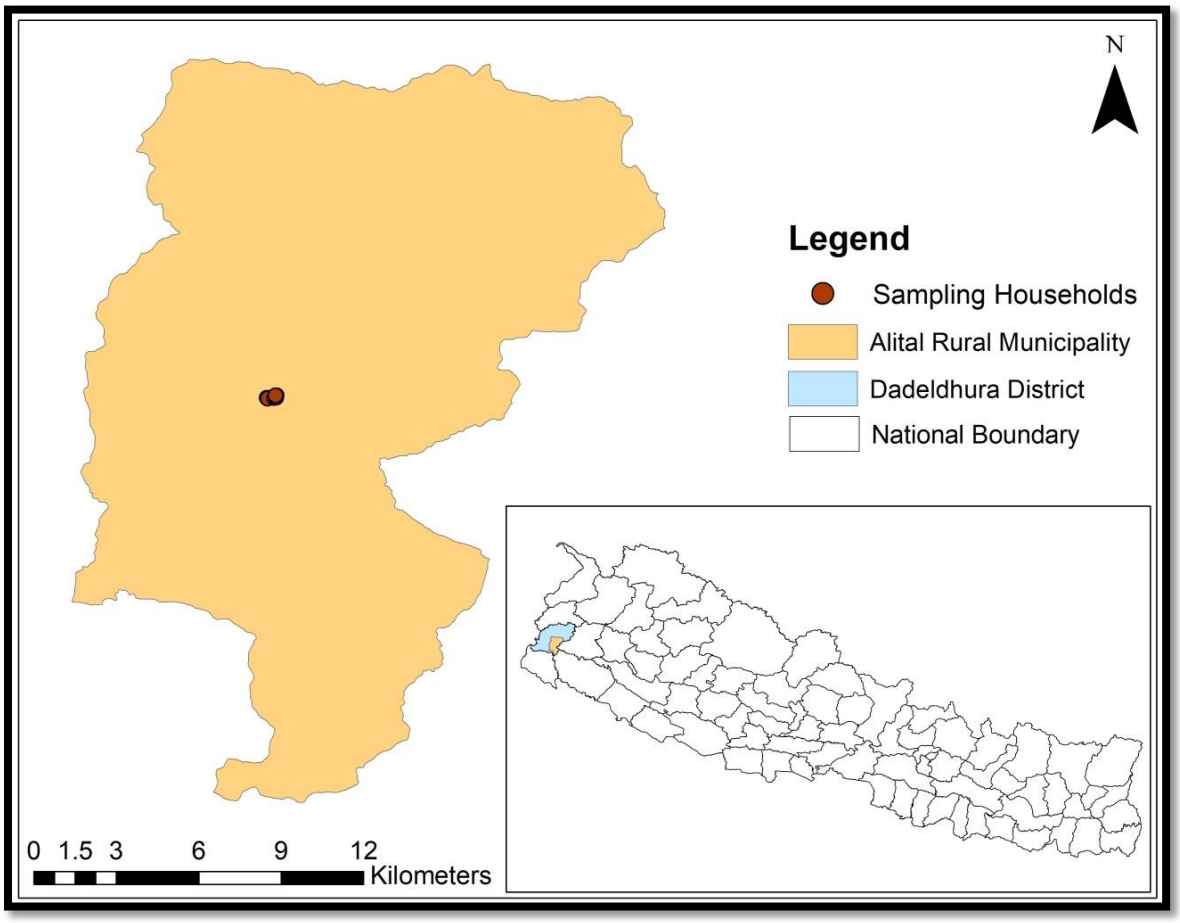

Figure: 1. Map of Study Area

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. Alital Rural Municipality was taken as study site which is surrounded by Jorayal RM in east, Parashuram RM in west, Amargadhi Municipality in North and Kailali district in Southeast. 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. Alital-5 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 2-8 April (2080/12/20 to 2080/12/26 B.S.) as guided by SOP for Integrated Vector Surveillance 2023 (EDCD, 2023). Both adult and immature were sampled. For the adult collection six human dwellings and four cattle sheds were selected and fixed for everyday collection. Indoor resting mosquitoes were collected using torchlights and aspirators in the morning. Light traps were placed inside most suitable cattle shed among the sheds selected for morning collection. River beds, irrigation canal, artificial containers were searched for immature stages and collection were made by using dippers and droppers. 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 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

3.1. Species composition of vectors

Eight species of mosquitos along with a few specimens of sandfly were collected during present study. Among the mosquitoes; five species of Anopheles, two species of Culex and one species of Aedes were identified (Table 1). *Anopheles fluviatilis* was found to be most abundant (28.27%), followed by *Culex quinquefasciatus* (26.18%), *Anopheles maculatus pseudowillmori* (17.80%) and others. *Anopheles annularis, Anopheles culicifacies, Anopheles splendidus, Culex tritaeniorhynchus* and *Aedes aegypti* were also recorded during this study. Total 20 specimens of sandfly were collected making 10.47% of all collection. *Culex quinquefasciatus* was collected through all the collection methods applied while sandflies were collected through light trap only. Both male and female individuals were recorded and counted for analysis.

Table 1: Species composition of Vectors in Alital Rural Municipality

S.N.	Species	no. of Individuals	Relative Abundance (%)	Collection Methods
1	*Anopheles maculatus pseudowillmori*	34	17.80	AIRC, LT
2	*Anopheles annularis*	11	5.76	AIRC
3	*Anopheles fluviatilis*	54	28.27	AIRC, LT
4	*Anopheles culicifacies*	2	1.05	AIRC
5	*Anopheles splendidus*	18	9.42	AIRC, LT
6	*Culex quinquefasciatus*	50	26.18	AIRC, HIRC, LC
7	*Culex tritaeniorhynchus*	1	0.52	LT
8	*Aedes aegypti*	1	0.52	LT
9	Sandfly	20	10.47	LT
		191		

(AIRC= Animal dwelling Indoor Resting Collection, HIRC= Human dwelling Indoor Resting Collection, LT= Light Trap, LC= Larval Collection)

3.2. Indoor Resting Collection

Total 157 mosquito specimens were collected through indoor resting collection from both animal and human dwellings. *Culex quinquefasciatus* was the only mosquito species

found in human dwellings. In animal dwellings, *Anopheles fluviatilis* was most abundant species followed by *Anopheles maculatus pseudowillmori, Culex quinquefasciatus* and others. *Anopheles annularis, Anopheles splendidus* and *Anopheles culicifacies* were also recorded in this study (Figure 2). Many male specimens were also collected. Further abdominal condition of indoor resting female mosquitoes was also investigated and most individuals were found to be fulfed (Annex 1).

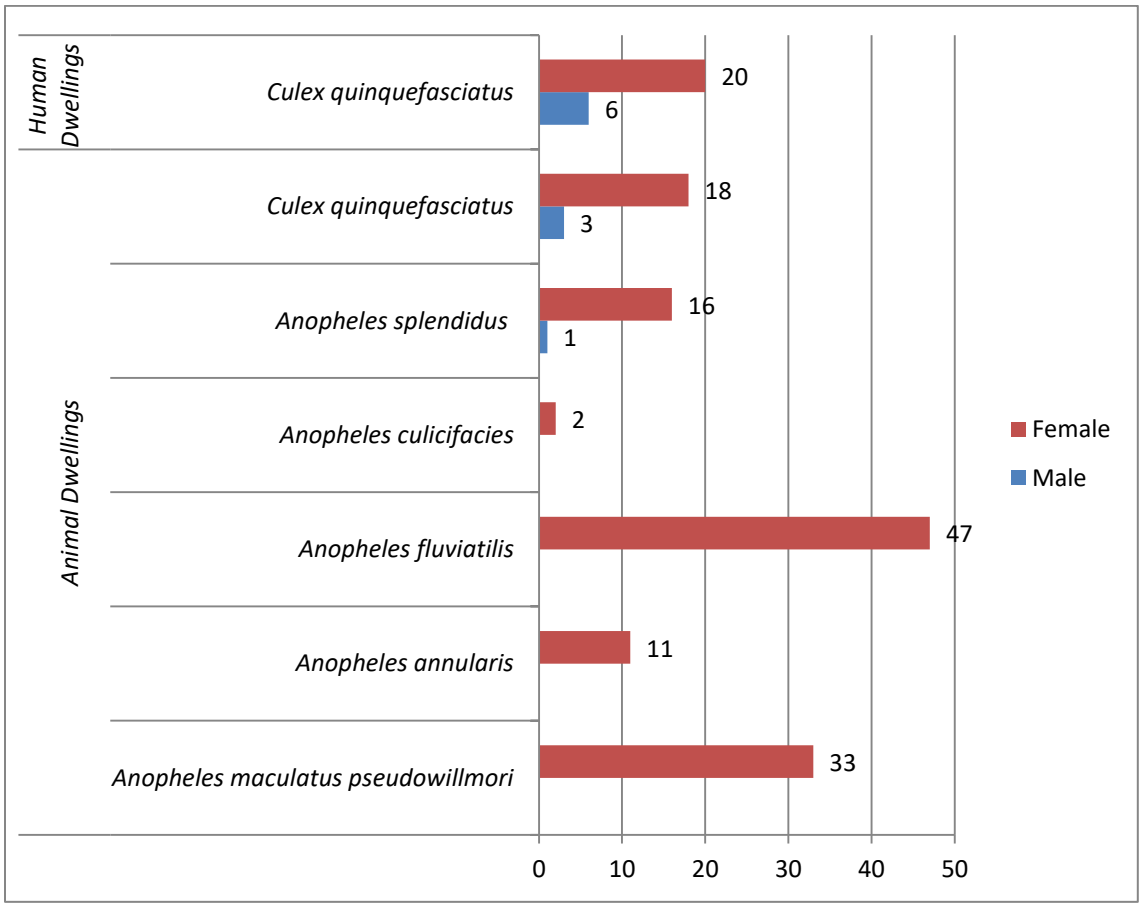

Figure 2: Abundance of vector species in IRC

3.3. Light Trap

Two light traps were kept in cattle sheds of the study area from 6 pm to 6 am. Through the light traps *Anopheles fluviatilis, Anopheles maculatus pseudowillmori, Anopheles splendidus, Culex tritaeniorhynchus* and *Aedes aegypti* were collected (Figure 3). *Anopheles fluviatilis* was the most dominant mosquito species collected through light

trap. Twenty specimens of sandfly were also collected from the light traps. On examining abdominal condition of female specimens, most of them were found to be fulfed.

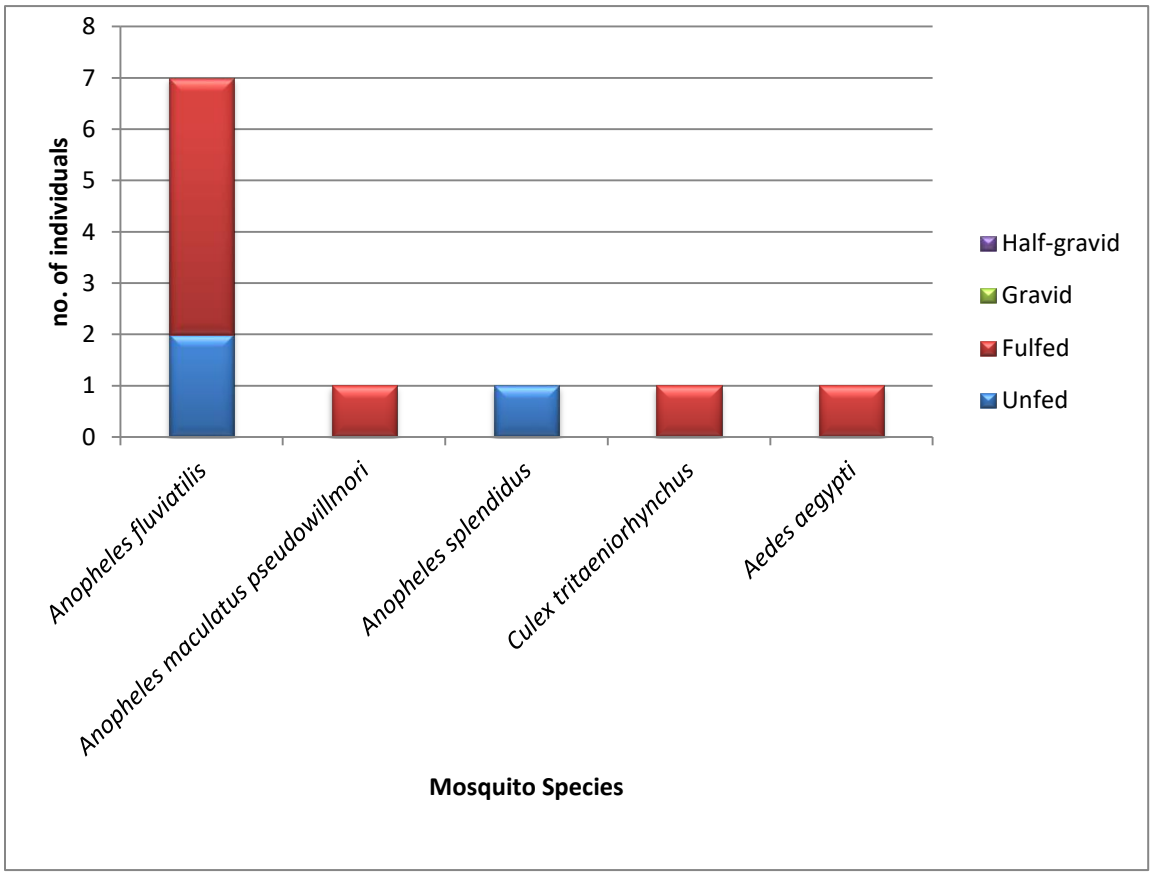

Figure 3: Abundance of Vector Species through Light Trap

3.4.Larval Collection

For the larvae collection, nearby water sources were sampled. Larvae were collected from irrigation canals and three male *Culex quinquefasciatus* adults were emerded upon rearing in the laboratory.

4. DISCUSSIONS

Eight species of mosquito along with a few sandfly specimens were collected and identified during present study. Among the malaria vectors *Anopheles fluviatilis* was the dominant species followed by *Anopheles maculatus* complex and *Anopheles annularis*. 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. *Culex quinquefasciatus* and *Culex tritaeniorhynchus*; vectors for filariasis and JE respectively, were also recorded during this study. Further, *Aedes aegypti* was recorded from the study area, which is primary vector of dengue in Nepal.

5. CONCLUSIONS AND RECOMMENDATIONS

Vector species for malaria, filariasis, JE and dengue were found present at the study area, so it is important to focus on management of breeding habitats and minimizing human-vector contact in this area will be important measure to reduce the chances of disease outbreak at the study area.

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PHOTOPLATES


Latitude: 29.125813
Longitude: 80.49311
Elevation: 621.22±35 m
Accuracy: 8.3 m

Annex: 1

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

Animal Dwelling								
S.N.	Species	Male	Female	Total	Unfed	Fulfed	Gravid	Half-gravid
1	*Anopheles maculatus pseudowillmori*	0	33	33	0	23	4	6
2	*Anopheles annularis*	0	11	11	0	11	0	0
3	*Anopheles fluviatilis*	0	47	47	0	35	0	12
4	*Anopheles culicifacies*	0	2	2	0	1	1	0
5	*Anopheles splendidus*	1	16	17	4	12	0	0
6	*Culex quinquefasciatus*	3	18	21	1	9	4	4
Human Dwelling								
S.N.	Species	Male	Female	Total	Unfed	Fulfed	Gravid	Half-gravid
1	*Culex quinquefasciatus*	6	20	26	1	11	4	4

Annex: 2

GPS points of houses (IRC)

IRC sites	Longitude	Latitude
CD1	80.491008	29.125592
CD2	80.49122	29.125386
CD3	80.49311	29.125813
CD4	80.493746	29.125682
HD1	80.49103	29.12556
HD2	80.491315	29.12544
HD3	80.493305	29.125626
HD4	80.494009	29.125739
HD5	80.494139	29.1264
HD6	80.493862	29.126395

(CD=Cattle Dwelling, HD=Human Dwelling)