2018

Malaria Micro-stratification

Government of Nepal
Ministry of Health & Population
Department of Health Services
Epidemiology and Disease Control Division
Kathmandu, Nepal

Acknowledgement

It gives me great pleasure to bring to you the final "Malaria Micro-stratification 2018" report which is an important document for monitoring and planning specific intervention activities to help the country reach elimination of malaria by the year 2025 as specified in the Nepal Malaria Strategic Plan (NMSP) 2014-2025 AD.

In 2012, Village Development Committee (VDC) wise micro- stratification was done which collected basic information from VDCS of malaria reported districts and intervention activities were conducted accordingly. Based on the NMSP 2014-2025 and the recommendation of the external mid-term review (MTR) done in 2013, a ward level micro-stratification was conducted in 2016. As a regular process, to understand the current status of malaria in the communities, ward level malaria related information were collected from 2014 till 2016 and the data was analyzed to stratify malaria risk into high, moderate, low and no risk wards to aid the program in devising targeted interventions. This report will certainly guide program managers and implementer across regions and districts to be specific and astute in their planning ahead thereby being both effective and efficient.

I would like to express my gratitude to the team based at Disease Control Section and PMU, EDCD for their tireless effort for preparing this final report. A big gratitude goes to Dr. Suman Thapa, who provided the overall technical support in conducting the study as well as his support to finalize this report. I would also like to thank various supporting partners including World Health Organization (WHO), USAID/PMI for their technical contribution and support during various steps of the study. I would also take this opportunity to thank the district and the teams from Ministry of Social Development in Provinces including the Provincial Health Directorates, District Public Health Officers (DPHOs), Vector Control Inspectors (VCI)/ Vector Control Supervisors (VCS)/ Malaria Inspectors (MIs) and other staff who have contributed in this study especially obtaining ward level information.

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Abbreviations

AL	Artemether-Lumefantrine combination
API	Annual Parasite Incidence
BCC	Behavior Change Communication
CDC	Center for Diseases Control
DHO	District Health Office
DPHO	District Public Health Office
EDCD	Epidemiology and Disease Control Division
EDPT	Early Diagnosis and Prompt Treatment
EPHS	Essential Public Health Services
GIS	Geographic Information System
GPS	Global Positioning System
HMIS	Health Management Information System
ICIMOD	International Center for Integrated Mountain Development
IMCI	Integrated Management of Childhood Illness
IRS	Indoor Residual Spraying
LLIN	Long Lasting Insecticide Treated Net
MDGs	Millennium Development Goals
MI	Malaria Inspectors
MOHP	Ministry of Health and Population
MS	Micro stratification
NMP	National Malaria Program
Pf	Plasmodium falciparum
PMU	Programme Management Unit
Pv	Plasmodium vivax
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
SOP	Standard Operating Procedure
SP	Sulfadoxine–Pyrimethamine
TWG	Technical Working Group
TOR	Terms of Reference
USAID/PMI	United States Aid for International Development/President Malaria Initiatives
VBDRTC	Vector Borne Disease Research and Training Center
VCI	Vector Control Inspector
VCO	Vector Control Officer
VDC	Village Development Committee
WHO	World Health Organization

Executive Summary

Malaria risk stratification identifies geographical areas that are at a potential risk of malaria transmission based on the recent malaria burden, receptivity characteristics, and the potential vulnerability of the area to malaria. Malaria risk stratification is a prerequisite for a rational targeted intervention and an essential step for an effective and efficient resource mobilization.

In the past, malaria risk stratification in Nepal was conducted at the district level and the population of the district was defined as the population at risk of malaria. But, with the substantial decline in the burden of malaria during the past decades, and the evidence that only few Village Development committees (VDCs) within the district reported malaria cases while other VDCs remained free of malaria; there was a need to conduct the study at a more basic level such as wards.

Malaria stratification was conducted in 2016 and the study provided the strategic evidence of malaria transmission at the wards level and the population of the ward was defined as the population at risk of malaria. The external malaria program review in 2016 recommended an annual updated malaria risk stratification based on the most recent data. Besides, the review recommended that since the country is moving towards elimination; the weightage allotted to disease burden should be allotted more weight.

Malaria risk stratification 2018 was tailored to suit the changing epidemiology of malaria in the country and to ensure appropriate weightage is allotted to key determinants of malaria transmission as recommended by external malaria program review. Malaria data from last three years reveal that even within Rural Municipalities or Municipalities, malaria is concentrated within some wards while other wards remain relatively free of malaria. In these settings, transmission is typically sufficiently low and spatially heterogeneous to warrant a need for estimates of malaria risk at a community level, the wards. In order, to refine the risk stratification at the community level and thereby define the total population at risk of malaria; malaria risk micro- stratification was conducted at the wards level of Rural Municipality or Municipalities.

The methodology used recent malaria burden data supplemented by information on the spatial distribution of key determinants of transmission risk including climate, ecology, and the presence or abundance of key vector species and vulnerability in terms of human population movement. The method was based on 2012 and 2016 micro-stratification study and it was recommended by Epidemiology and Disease Control Division (EDCD) and Malaria Technical Working Group (TWG). EDCD provided the overall oversight of the study.

Disease burden, geo-ecology & entomological risk, and vulnerability were given a defined weight and each ward received a weightage response on the three determinants. A median annual API was calculated for each ward based on the last 3 years (16th July 2015-15th July 2018) malaria burden data of the ward and a mean API was derived from the 3 years median API. A standard deviation was calculated and 2 X SD + mean was taken as a high disease burden ward and the ward was allotted 100 % of total disease burden weight (0.6). Similarly, moderate and low disease burden wards were identified and allotted their weightage response. Receptivity was allotted a total weight of 0.3, which was further divided into eco-environment (0.1) and presence of vectors (0.2). Vulnerability was allotted a total weight of 0.1, which was further divided, and weightage response was allotted as: high mobility areas (0.1) and moderate (0.05) to low (0.01) mobility areas. The weightage response of each determinant for a ward was calculated and the summation

of the three determinants was converted into percentage. A cut off percentage of 75 or more was agreed as the criteria to define a high-risk ward.

Based on this method, microstratification 2018 was updated and the wards were designated as high, moderate, low and no risk wards. High risk wards were identified in 49 wards scattered across 13 districts. Out of these high-risk wards, 6 wards in Province 2, 1 ward in Province 3, 3 wards in Province 5, 8 wards in Karnali Province and 31 wards in Sudurpashchim Province while no high-risk ward was detected in Province 1 and Gandaki Province. Furthermore, moderate risk wards were identified in 153 wards in 19 districts (7 additional districts to the 12 districts that contained high risk wards) of these moderate risk wards, 1 ward in Province 1, 8 wards in Province 2, 1 ward in Province 3, 1 ward in Gandaki Province, 31 wards in Province 5, 20 wards in Karnali Province and 91 wards in Sudurpashchim Province.

Malaria transmission is concentrated in the Sudurpashchim and Karnali Province with these two provinces accounting for approx. 80 % high risk burden and around 73 % moderate risk burden. Malaria transmission has reached low level of endemicity in most of the Terai regions (plain lands) but malaria infection is increasingly being detected in upper hilly river valleys, which was traditionally classified as “No Malaria” risk. A relative incidence analysis of malaria infection in upper hilly river valleys suggest that malaria infection was endemic in the area, with adults developing immunity with repeated exposures as they grow older and children bearing the brunt of the infection due to immature immunity (incidence is significantly higher in children less than 14 years as compared to adolescents and adults 15+).

Additionally, NMP should target interventions to address heterogeneity in infectious disease that is likely to limit the infection further among certain vulnerable population in the community and the detection of malaria in upper hilly river valleys, which were previously classified as “ No Risk.” Therefore, as the country embarks on the path to elimination, it is recommended that micro-stratification be updated every year with the updated risk stratification being a requisite for an effective and efficient intervention.

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Background

Malaria is a priority public health problem of Nepal where approximately 43.3% of the population is at risk of malaria (1). The population and the area at risk of malaria have been shrinking over the years primarily as a result of effective and successful malaria programme. Earlier the population living in a district was taken as the denominator but the most recent micro stratification, 2018 identified the population living in a ward as the denominator. There are pockets of areas within the village with ongoing transmission of malaria while other areas within the village are not conducive for malaria transmission. The high and moderate malaria risk areas consist of foothills, forests fringe, forests in Terai and inner Terai valleys, whereas the low risk area consist of southern planes and northern hills/ hill river valleys.

The trend of confirmed malaria cases during the last three decades show fluctuations, with a peak in 1985 when the number exceeded 42,321, representing the highest malaria case-load ever recorded in Nepal (1). This was followed by a steep decline each year till date with a few major outbreaks in between. The last outbreak occurred in 2006 in the villages of Banke accounting for 36 deaths. Although clinical malaria cases increased during the early years of the control phase, mostly due to scale up and expansion of community based integrated management of childhood illness (CBIMCI) programme throughout the nation, yet implementation of appropriate modification in the guidelines and ensuring increased access to diagnosis and treatment of malaria has contributed to a gradual decreasing trend in clinical malaria during the last few years (108,179 in 2010 versus 20,861 in 2014/15). Total confirmed malaria cases declined by approximately 90 % over a decade (12,750 cases in 2002 versus 1128 cases in 2016/17), while deaths have been reported a few in between 2011 till 2016 mostly imported cases. Three deaths were reported due to malaria reported in 2016 were imported from Africa and India. The proportion of Plasmodium falciparum (Pf) infection accounts for around 13% while 87% of the total cases are Plasmodium vivax (Pv) infections. The proportion of imported cases shows increasing trend throughout the last five years, which is a major challenge for the current elimination program (1).

Nepal has achieved and exceeded the malaria target of the Millennium Development Goals (MDGs) and universal coverage of malaria control interventions, and the Roll Back Malaria (RBM) targets of 2010. The country has made significant progress in controlling malaria transmission over the past decade. The gains are attributed mainly to a change in drug therapy from the custom sulphadoxime- pyremethamine (SP) therapy to Artemether and lumefrantine (AL), IRS in high-endemic foci, the distribution of LLINs in high-endemic areas, and other enabling factors such as strategic partnerships, socio-economic development and free health service delivery through government health institutions (2).

1. Introduction

In Nepal, the first malaria micro-stratification was limited to district level where a district was identified as the basic administrative unit. The population at risk of malaria was defined as the total population of the district. But, analyses of malaria information throughout the years from the districts do not support the view that the total population of the district are at risk since malaria is a focal disease and is usually seen in hard to reach population and marginalized community. Therefore, microstratification conducted in 2012 reached upto VDC level and micro-stratification conducted in 2016 provided the insight of malaria risk at ward level and this strategic information was very useful to the National Malaria Program to target effective interventions at ward level. The recent study on 2018 concluded that 67 districts out of the 77 districts and about 43.26% of the total population are residing in areas at risk (high, moderate and low) of malaria. It further streamlined that 202 wards in 20 districts (as per new federal structure) are at high or moderate risk of malaria. Approximately 3.96% of total population are living in malaria endemic (high & moderate risk) areas. Among them, 0.22 million live in high risk areas (49 wards), 0.93 million in moderate risk areas (253 wards) and 11.34 million in low risk areas (2543 wards). The high and moderate risk areas include foothills, forests fringe areas, forests in Terai and inner Terai valleys as well as upper hilly river valley of mountainous districts, whereas the low risk area consist of southern plains and northern hills/ hill river valleys.

A ward may be geographically diverse and distinct in ecology and land use; people living in hill top settlement but working down in their fields in foothills and at times sleeping there to guard their crops, or some parts of the wards lying close to the forest while other parts of the ward may be a day or two days walk from the forested area. Furthermore, the ecological and entomological context may be different in such a diverse geographical spread and generalization may not be appropriate since the hill tops sloping environment may not sustain mosquitoes because of low temperatures and fast moving streams despite adequate rainfall and humidity. However, the plain area in the foothills may be ideal for vector breeding with appropriate temperature and rainfall and slow moving streams. A review of malaria information since the last three years reveal that even within a ward, malaria is concentrated within some tole while other toles are not affected at all. As per the recommendation of MTR 2013, microstratification has been conducting in ward lever in order to refine the risk stratification at the community level and thereby define the total population at risk of malaria. The current micro-stratification has adopted and aligned the recommendations generated in earlier micro-stratification to further refine the risk at an even smaller administrative unit.

Determinants of Malaria Transmission: Transmission of malaria is dependent on the receptivity and vulnerability characteristics of an area. Receptivity is dependent on the presence and behavior bionomics of vectors, and ecological/climatic conditions favorable for transmission of malaria. Vulnerability depends on the population movement to malaria risk/endemic areas, possibility of influx of malaria patients or vectors or the possibility of malaria parasite introduction. The pool of reservoir of infection in an area is determined by the level of disease burden – proportion of people infected in a year in a defined population.

Micro stratification is the study of the three critical factors that determine malaria transmission: disease burden (API)- confirmed malaria cases per 1000 risk population) in the last three years, receptivity (ecology)in an environment which support the vectors, vector behaviors and bionomics that define relative efficiency of the vector, and the duration of transmission; and lastly

vulnerability in terms of population movement (3). The three key determinants are given weights to stratify the malaria risk. In this study receptivity (based on eco-environmental & entomological characteristics) was allotted 0.3, disease burden was allotted 0.6, and vulnerability (based on population movement) was allotted 0.1; a total of 1.0 was the maximum weight allotted for micro stratification.

Disease Burden: The disease burden was defined as the average annual parasite incidence (API) over a three years period (16 July 2015 to 15 July 2018). Median API was calculated for each year of the wards. Mean API was calculated from the 3 years of the median API. The calculation was done as per below:

Disease burden – weight is based on case classification.
Weight - Imported case = 0.1 and Indigenous case = 0.5
Calculation is done as follows:

1. **Median API calculated for each year of the area**
2. **Mean API calculated from the 3 years median API**
3. **SD calculated**
4. **2X SD + mean = High burden API (0.3).**
5. **if API > 0.3 of an ward then 100 % of disease burden weight is allotted;**
6. **API > 0.15 - < 0.3 = taken as moderate burden allotted 67 % of total disease burden**
7. **API > 0.01 - < 0.15 = taken as LOW burden allotted 33 % of total disease burden.**

Receptivity: This determinant accounted for the climate, geo-ecology and vectors species prevalent in the ward. Climatic, topographical, and land use data were extracted from various sources including Department of Meteorology, Department of Survey and ICIMOD. An entomological cross-sectional study was conducted in 2016, 2017 and 2018 with representative sampling of sites from 5 different ecological zones. The data related to vector species and their behaviors were thus extrapolated mainly from this afore mentioned study and to some extent complemented by previous historical evidences. The receptivity was given an overall weightage of 0.3 as per below:

a. **Altitude (0.025):**
   Altitude <= 2000, then 0.025
   Altitude > 2000 and < = 2500, then 50 % of 0.025
   Altitude > 2500 and < = 4000, then 25% of 0.025
   Altitude > 4000, then 0

b. **Temperature (0.025) : Average temperatures**
   Temperature < 16, then 0
   Temperature >=16 and < 18, then 50% of 0.025
   Temperature > =18 and < = 35, then 100% of 0.025
   Temperature > 35, then 25% of 0.025

c. **Forest (0.025): coverage of the area**
   Forest > 50% of total area, then 0.025
   Forest >= 20% and <=50% of total area, then 50% of 0.025
   Forest < 20% and > 0% of total area, then 25% of 0.025

d. **Water Bodies (0.025): coverage of the area**
   Water Bodies >= 20%, then 0.025
   Water Bodies >=10% and <20%, then 50% of 0.025
   Water Bodies >=1% and <10%, then 25% of 0.025

e. **Vector (0.2): vectors identified in the area as per ecology of the area**
   Based on presence of vector species, Anthropophilic index and transmission period and ecology, Nepal is categories as follows:
   Cultivated plain Terai : low
   Forested plain Terai : High to Moderate
   Inner Terai : High to Moderate
   Hilly upper river valley: Moderate to Low
   High Himalayas: No
   High: 0.2
   Moderate: 0.15
   Low: 0.1
   No: 0

Vulnerability: This determinant was measured in terms of population movement especially in outside country. Wards reporting regular movement of population to outside of country received full marks (0.1) and other received half marks (0.05).

2. Objectives

The primary objective of the micro-stratification study was to define the risk of malaria at the ward level of a municipalities, which is the basic unit of the community. This will also provide strategic malaria information on the total area and the population at risk of malaria. In addition to this, the study will provide ward level malaria information which will be instrumental in planning, monitoring and evaluating effective interventions especially in a scenario where Nepal has envisioned malaria elimination within the eight years. Effective targeted interventions at the ward level are efficacious and efficient mode of resource management because it will ensure maximum resource where it is required. The study ensured community participation with interaction with local people during on site field activities at the ward level for documenting eco - environmental situation of the wards. The study inadvertently helped build the capacity of national programme to conduct similar studies at regular intervals in future.

3. Methods

This is the updated microstratification of 2016 which is based on verified line listings and Case Investigation Forms of 2015/016, 2016/017 and 2017/018. Around 95 % alignment in 2015/016 and 2016/017 data and around 85 % in 2017/018.

4. Entomology Study

4.1 Entomological survey:

Entomology Survey was conducted in each developmental regions of the country representing ecological substrata i) outer plain terai, ii) Forest, forest fringe and hill, iii) inner Terai and iv) hill and upper hilly river valley. At least one ward was randomly selected from each malaria risk area (high, moderate and low) but with representation of various ecological substrata (i.e. plain cultivated terai, forest and forest fringe, foot hill, inner terai and mountain and upper river valley) of five development regions. Altogether forty wards were selected for the study and at least five wards were selected from each development region. The wards were selected based on micro stratification 2016 as well as the burden of malaria cases reported between 2015 and 2018 (July).

4.2 Entomological Field techniques:

The following field methods were conducted during the study.

1. Indoor Hand Collection
2. Outdoor Hand Collection
3. Human landing/bait catches
4. Animal biting catches
5. Larval surveys
6. Entomological Laboratory techniques

The following laboratory techniques were used during the survey period

1. Identification of adult and larva of mosquito
2. Examination of abdominal condition
3. Salivary gland dissection for sporozoites and or preservation of specimen for ELISA
4. Ovary dissection for parity determination
5. Preservation of specimen for further investigation (cytogenetic study)
6. Blood meal identification (preservation of specimen for ELISA or precipitation test)

The study findings characterized the species and behavior bionomics of the vectors in five distinct ecological zones. This finding along with the findings of a national workshop conducted in 2013, "Entomological stratification of malaria transmission risk in different ecological settings" was used to allot the entomological weight of a ward. If the ward was grouped under the categorized ecological zone then it was presumed that the species akin to the ecological zone would be prevalent in the ward.

5. Data System

District level teams with the help and support of health workers from the HFs collected the data (HMIS 9.3 and linelisting of all positive cases) based on cases diagnosed during the months (HMIS 5.2) in a paper format. After the verification of the data (HMIS 9.3), posted to DHIS2 (web based) and compiled linelisting submitted to EDCD (malaria program) in regular basis.

Line listings of the cases were reviewed, and it was cross checked in the malaria case register and HMIS data. Only, cross checked data after data verification with line listings were utilized in the study. Central data bank was established in EDCD and electronic version of the data collected in each district was transferred to the center. The central data bank compiled the data for analyses. The flow of malaria information is outlined below.

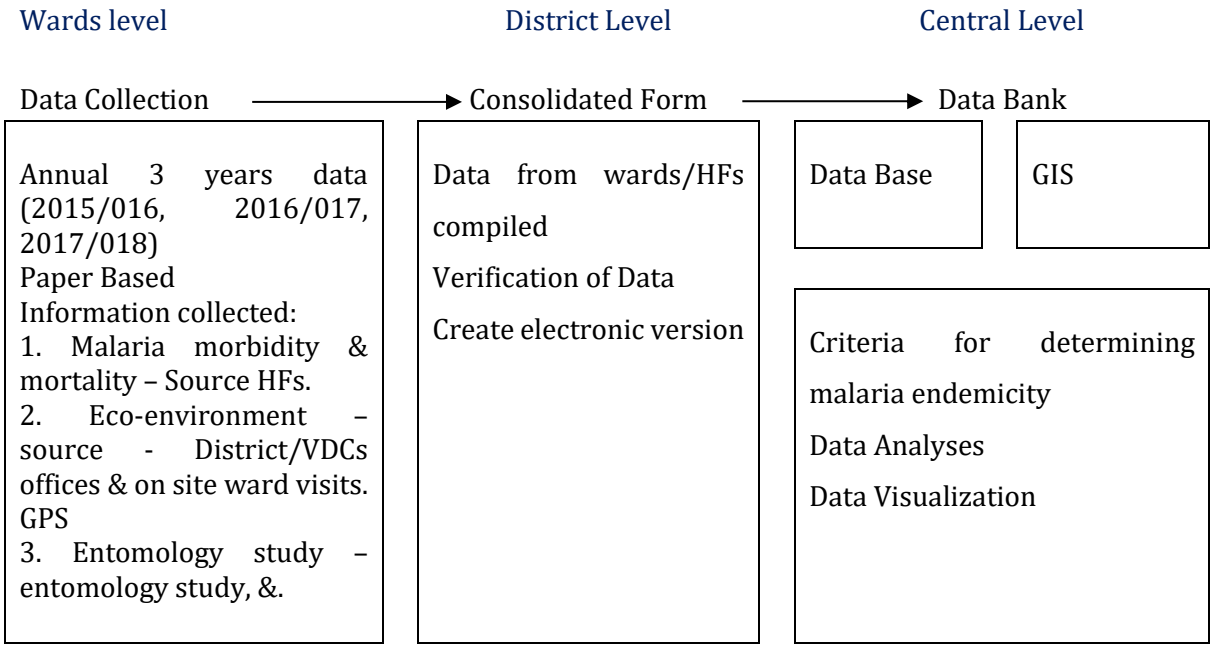

Figure 1: Malaria Information Flow

6. Monitoring

There were two tiers of robust monitoring activities that would ensure adequate checks in the study.

Monitoring Checklist:

a) HMIS data (2015/016, 2016/017, 2017/018) and maps of districts/VDC (with wards clearly visible.

b) Electronic data collection gadgets - GPS. An onsite GPS coordinate including altitude was taken for all the wards visited during the study. This would aid the program develop maps using GIS in the future to help plan interventions and also study the pattern of transmission of malaria in the country. Furthermore it would help create heat maps of risk areas in the future based on disease transmission.

7. Data Analysis

The malaria risk stratification takes into account several key determinants of malaria transmission, disease burden (API- malaria cases per 1000 risk population) in the last three years; ecology that determines the presence of the vectors, relative efficiency of the vectors in malaria transmission, duration of transmission in ecological zones; and vulnerability in terms of population movement. The key determinants (termed as major variables) are given weights to

stratify the malaria risk. Data analyses have been done by using Center for Diseases Control (CDC) tool to assess performance of ten Essential Public Health Services (EPHS). The methodology of assessment tool was adopted after discussion with EDCD to identify areas of malaria risk. GIS analyses were also done in ward basis. A ward was considered in a defined ecological zone, if major part of the ward fell in that zone. The same principal was applied in determining the land use of the ward as well.

7.1. Scoring Methodology for Micro-stratification of Malaria Risk

Each determinant was allotted a weight and a response value to the determinant, weightage response value of the determinant was calculated by multiplication of the weight and response value. These weighted values were combined to construct the overall risk score. This methodology was implemented through three steps. Both qualitative and quantitative variables were converted to qualitative variables. A four-point, Likert-type response, was assigned to each variable. The variables and weight considered for the micro stratification was finalized after discussion with EDCD and TWG/Malaria. The variables and the weight were identified as follows: (i) disease burden with "0.6" wt.; (ii) transmission risk (receptivity) with "0.3" wt. (iii) and population movement (vulnerability) with "0.1" wt (Table 1).

Table 1: Overall Scoring of Malaria Risk

Level	Overall risk	(Sum of Wt. of variable and Response of variable)* 100	
Indicators : Weight (wt.)	Disease Burden (0.6)	Ecology (0.3)	Vulnerability (0.1)
Variable : Response weight High (1.0) - **H** Mod (0.67) - **M** Low (0.33) – **L** No (0.0) - **N**	**Annual Parasite Incidence in three years** Average API > = 0.3 – **H,** Average API is 0.15 to < 0.3 – **M,** Average API is 0.01 to <0.15 – **L**	**Transmission risk Combination of geo-ecosystem & vector species** (Refer Annex 4)	**Population movement :** Movement to outside of country from Farwestern, Midwestern and Central region-0.1 Movement to outside of country from Eastern and Western region-0.05.

7.2 Operational definition of risk

Risk definition was formulated by EDCD team for identification of malaria risk. Overall score range from 0 to 100%, which was classified into four categories based on operational definition of malaria risk.

No Risk: No evidence of malaria transmission including in the last three years; ecology is not favorable for transmission (e.g., urban areas; high altitude areas); there may be cases but imported from other areas. A ward is considered no risk if overall score is 1 to 25%.

Low risk: Evidence of transmission, but no indigenous case in the last three years; average three-years API = 0; malaria risk is present due to favorable ecology or evidence of presence of vectors, and there is movement of population to/from malaria endemic areas. A ward is considered low risk if overall score is 26 to 50%.

Moderate risk: Evidence of transmission and presence of indigenous cases in the last three years; average three-year API is less than 1/1,000 population; malaria risk is present due to favorable ecology or presence of vectors, and there is movement of population. A ward is considered moderate risk if overall score is 51 to 75%.

High risk: Evidence of ongoing transmission and there are indigenous cases in the last three years; average three-year API = equal to or greater than 1/1,000 population; malaria risk is present due favorable ecology and /or presence of vectors and there is population movement. A ward is considered high risk if overall score is 76 to 100%.

8. Results

Malaria micro-stratification was conducted in 2012 to identify risk of malaria at the VDC level to ensure effective targeted interventions to achieve the vision of "Malaria Free Nepal by 2026". The study had recommended ward wise micro-stratification to generate strategic information for informed decision making and to validate the risk factors. The malaria risk stratification was based on three key variables: disease burden (API –malaria cases per 1000 risk population) in the last 3 years, receptivity (ecology) that determine the presence of the vectors, relative efficiency of vectors in malaria transmission, duration of transmission in ecological zones and vulnerability means population movement in risk areas. This ward level stratification is the updated study of microstratification 2016 which is conducted based on new federal structure of the country. This study defines the malaria risk areas and provides the strategic information for informed decision making for planning and implementation of interventions at ward level.

8.1 Disease burden:

The burden of malaria in a ward was derived from review of 2015 -2018 malaria data from the central level database. Based on the average API of recent three years (2015 -2018), wards with average API 0.3 or more were defined as high disease burden, wards with average API more than 0.15 to less than 0.3 were defined as moderate disease burden, and wards with average API of 0.01 to 0.15 were defined as low disease burden.

8.2 Receptivity:

The vectors bionomics and their behaviors and transmission potential are determined by the geo - ecological setting, which has profound influence on their reproduction and sustainability. Receptivity was categorized based on altitude, temperature, forest coverage, water bodies and ecology of the area. The country is divided into 5 distinct ecological zones such as Cultivated Plain Terai, Forested Plain Terai, Inner Terai, Hilly Upper River Valley and High Himalayas. Inner terai has a high and moderate transmission potential of same species of vectors and is dependent on different ecological settings. While hilly upper river valley also supports vectors, which sustain malaria transmission.

8.3 Vulnerability:

The third determinant factor for risk transmission is vulnerability measured in terms of population movement. If there is a frequent movement to outside country from Far western, Midwestern and Central Region is categorized as high risk and from Eastern and Western Region as moderate risk.

8.4. Result (Overall risk):

The results of this study were based on summation of scores of each determinant that the ward received. The three determinants and their weight were - disease burden with weight of 0.6, receptivity (geo-ecology) with weight of 0.3 and vulnerability with weight of 0.1. Based on this analysis, a ward with a score of more the 75% was categorized as high risk, a ward with a score of more than 50 % to 75% was categorized as a moderate risk ward, a ward with a score of more than 25 % to 50% was categorized as low risk, and a ward with a score of 25% or less was categorized as no risk.

The study revealed that a total of 2,745 wards out of total 6,743 wards were found to be at some level of risk of transmission. Out of these, 49 wards in 25 municipalities (G.P and N.P.) of 13 districts were found to be at high risk (0.73% of total risk wards), 153 wards (2.27% of total risk wards) across 66 municipalities of 19 districts were categorized as moderate risk and 2,543 wards (37.71% of total risk wards) were categorized as low risk wards whereas the remaining 3,998 wards (59.29% of total risk wards) came under no risk categories. Based on the latest population census, a total of 2,16706 people (0.75%) live in high risk wards, similarly 9,27,414 people (3.21%) live in moderate risk wards and 1,13,41,464 people (39.30%) live in low risk wards and 1,63,71,406 (56.73%) live under no risk wards.

At a provincial level approximately 64% of the high risks wards are in Sudurpashchim Province. Among the 49 high risk wards, 31 wards (63.27%) are in Sudurpashchim Province alone with the remaining 8 wards (16.33%) in Karnali Province, 3 wards (6.12%) in Province 5, 1 ward (2.04%) in Province 3 and 6 wards (12.24%) in Province 2. Province 1 and Gandaki Province don't not have any high risk wards.

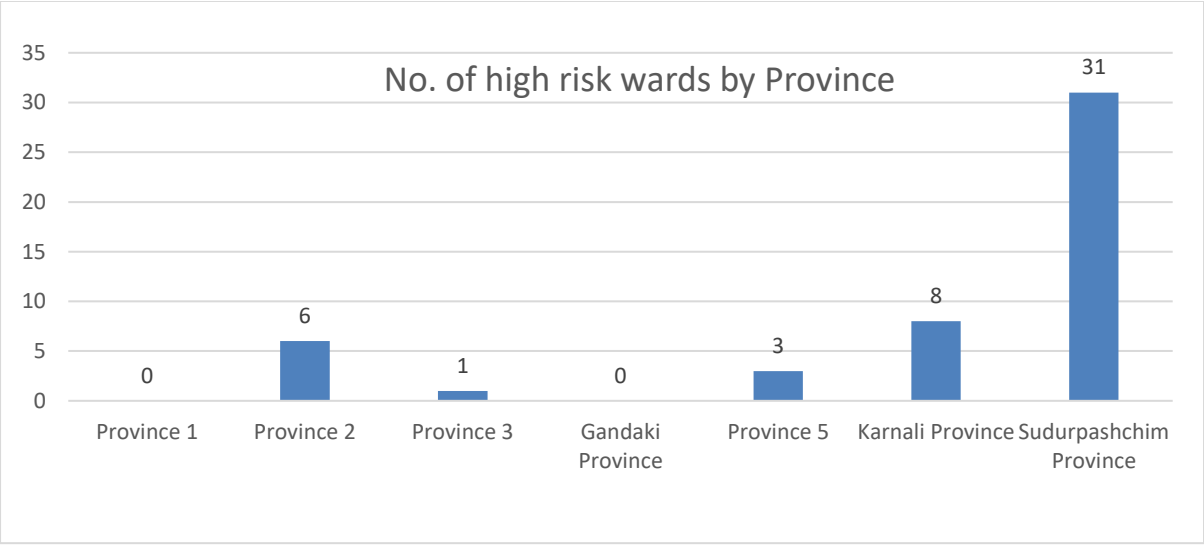

Figure 2: Number of high risk wards by province

Among the total 153 moderate risk wards, Sudurpashchim Province have 91 moderate risk wards (59.48%), Karnali Province have 20 moderate risk wards (13.07%), Province 5 have 31 moderate risk wards (2.26%), whereas Gandaki Province, Province 3 and Province 1 have 1 each moderate risk wards (0.65% each) and Province 2 have 8 moderate Risk Wards (5.23%). The highest numbers of moderate risk wards are concentrated in the Sudurpashchim and Karnali Province (72.5%) suggesting the major risk in these areas as well as additional targeted interventions.

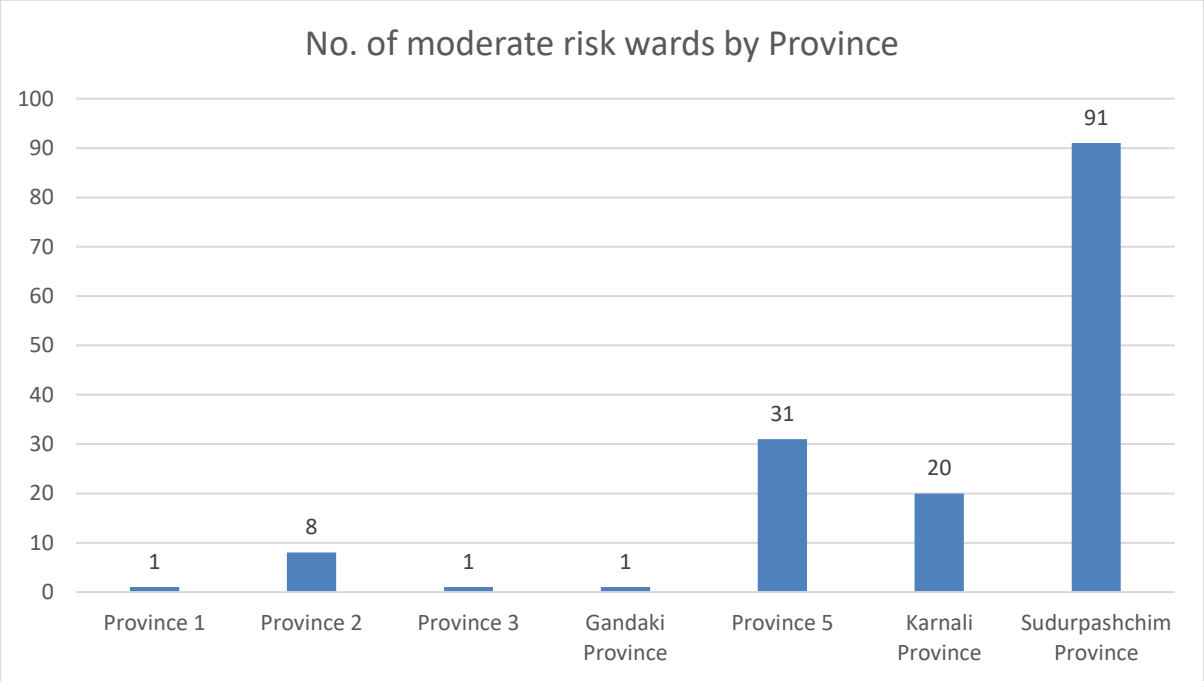

Figure 3: Number of moderate risk wards by province

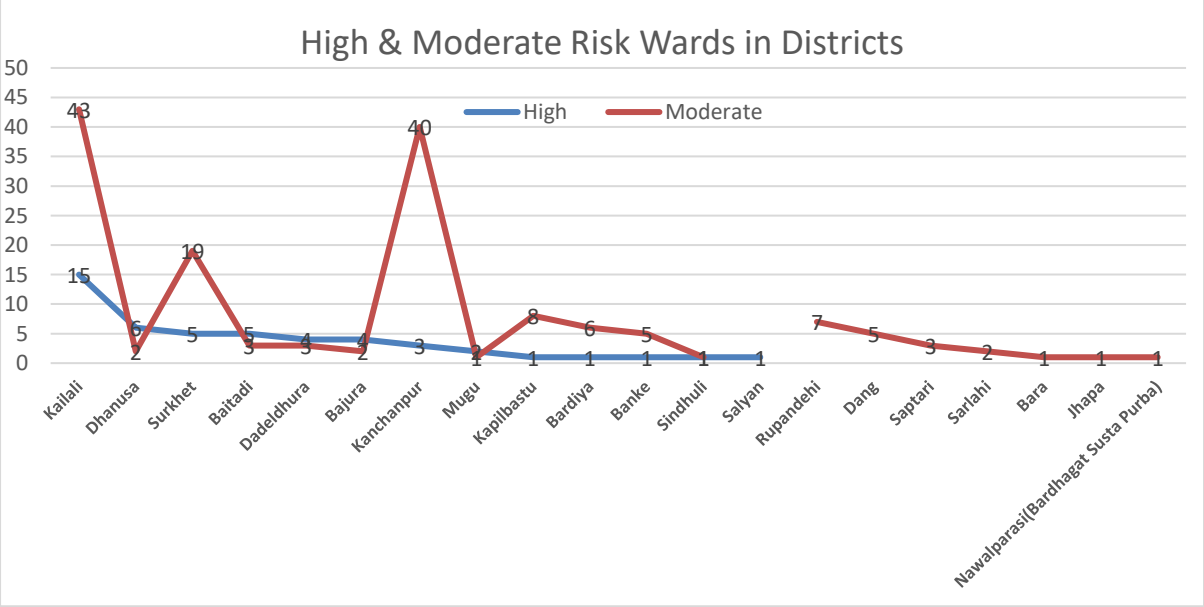

Figure 4: Number of high and moderate risk wards in districts

The total population at high and moderate risk of malaria is 11,44,120 (see table), living in 202 wards in 20 districts.

Table 2: Risk Population by Province

Province	No. of districts	High Risk		Moderate Risk		Low Risk		No Risk		Total	
		No. of Wards	Population	No. of Wards	Population	No. of Wards	Population	No. of Wards	Population	No. of Wards	Population
Province 1	14	0	0	1	5892	272	1341018	884	3598948	1157	4945858
Province 2	8	6	28588	8	27205	389	1997703	868	3872403	1271	5925899
Province 3	13	1	3118	1	6303	359	1674812	760	4288171	1121	5972404
Gandaki Province	11	0	0	1	2513	251	1167818	507	1443629	759	2613960
Province 5	12	3	16303	31	178235	372	2222923	577	2490260	983	4907721
Karnalai Province	10	8	21138	20	86615	392	1158056	298	443568	718	1709377
Sudurpashchim Province	9	31	147559	91	620651	508	1779134	104	234427	734	2781771
Grand Total	**77**	**49**	**216706**	**153**	**927414**	**2543**	**11341464**	**3998**	**16371406**	**6743**	**28856990**

Projected population data taken from census 2011 CBS

9. Limitations

- Routine recording and reporting of malaria cases through HMIS (DHIS 2), EWARS and MDIS systems do not cover most of the private health facilities such as private clinics and hospitals, medical colleges, and other private sectors, so underestimate of malaria disease burden is likely.
- Line listings of malaria cases during the 3 years were available for only 85-95% of total reported cases. This may have impact on weights allotted to disease burden of some wards.
- Entomological information is limited to a few representative ecological strata and the study relied on historical evidence from earlier study to complement the limitations. The adverse effects of large scale use of insecticides in agriculture and the impacts of global warming and climate change on vector bionomics and behaviors is lacking.
- Clinical malaria cases from the public and private hospitals, medical collages, clinics and pharmacies are not reported and may contribute to underestimate of malaria burden in the country.
- It is possible that some wards may have been a misclassified in a lower category if people sought medical care in private hospitals.

10. Conclusion and Recommendation

Previous strategic information (2012 micro-stratification) had been used for guiding an efficient, cost effective and comprehensive program in the community at the level of VDCs that may have contributed to the decline of malaria burden and risk population in the country. This current study is more informative and specific with analysis of transmission of malaria at the basic administrative level, i.e. the wards. The information derived from the study may be useful for informed decision making to plan and implement an effective and efficient program targeted towards elimination. As the dynamics of malaria epidemiology is changing in the country, the area at risk of malaria may change continuously so it is recommended that regular micro-stratification should be conducted every year based on the disease burden in the most recent year. Following recommendations are given below.

1. Every year NMP should review and update micro-stratification at ward level or below to make it more specific regularly.
2. Community level case diagnosis, treatment, surveillance and program intervention should be more focused through local government especially in Karnali Province and Sudurpashchim Province.
3. Entomological survey should be conducted to cover all geographical areas of Nepal.
4. Increased access to early diagnosis and treatment in all public and private hospital and clinics should be ensured, and the data from all settings should be made accessible for monitoring purposes.
5. All positive cases should be notified within 24 hrs from the diagnosis from both public and private sectors, all confirmed cases should be investigated and classified, geo reference of the case should be recorded using GPS within 3 days from the diagnosis. All cases should be treated as per NMTP.
6. Case Surveillance and classification of cases should be strengthened, and foci investigation and outbreak should be linked with entomological information.
7. Suggestions for key surveys and research studies
    - Mapping of all cases by indicating ward or Village or Tole
    - KAP Survey to increase public awareness and support for the programme.

11. References

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Annex

List of High & Moderate Risk Wards (MS 2018)

Total High Risk Wards: 49 **Total Moderate Risk Wards: 153**

Province 1: Total High Risk Wards = 0, Total Moderate Risk Wards = 1

Districts	Municipalities (Wards)	Risk Type
Jhapa	Gauriganj (6)	Moderate (1)

Province 2: Total High Risk Wards = 6, Total Moderate Risk Wards = 8

Districts	Municipalities (Wards)	Risk Type
Bara	Jitpur Simara NP (6)	Moderate (1)
Dhanusa	Ganeshman Charnath NP (1, 3, 9); Mithila NP (3, 4, 11)	High (6)
	Ganeshman Charnath NP (6); Sabaila NP (3)	Moderate (2)
Saptari	Bodebarsaien NP (2); Saptakoshi NP (11); Surunga NP (9)	Moderate (3)
Sarlahi	Ishworpur NP (1, 2)	Moderate (2)

Province 3: Total High Risk Wards = 1, Total Moderate Risk Wards = 1

Districts	Municipalities (Wards)	Risk Type
Sindhuli	Kamalamai NP (14)	High (1)
	Dudhouli NP (9)	Moderate (1)

Gandaki Province: Total High Risk Wards = 0, Moderate Risk Wards = 1

Districts	Municipalities (Wards)	Risk Type
Nawalparasi (East)	Gaidakot NP (18)	Moderate (1)

Province 5: Total High Risk Wards = 3, Total Moderate Risk Wards = 31

Districts	Municipalities (Wards)	Risk Type
Banke	Raptisonari (3)	High (1)
	Bajnath (1, 2, 4); Duduwa (2); Narainapur (3)	Moderate (5)
Bardiya	Thakurbaba NP (2)	High (1)
	Bansgadhi NP (1, 2, 5); Barbardiya NP (6); Thakurbaba NP (1, 3)	Moderate (6)
Dang	Babai (5, 7); Rapti (9); Shantinagar (6); Tulsipur NP (13)	Moderate (5)
Kapilbastu	Maharajgunj NP (4)	High (1)
	Buddhabhumi NP (7); Krishnanagar NP (7); Maharajgunj NP (7, 10); Mayadevi (1, 6); Shivraj NP (10); Yasodara (6)	Moderate (8)
Rupandehi	Devdaha NP (9, 11); Kothimai (7); Lumbini Sanskritik NP (6); Sammarimai (4); Siddharthnagar NP (1, 3)	Moderate (7)

Karnali Province: Total High Risk Wards = 8, Total Moderate Risk Wards = 20

Districts	Municipalities (Wards)	Risk Type
Mugu	Khatyad (8, 10)	High (2)
	Khatyad (11)	Moderate (1)
Salyan	Kalimati (3)	High (1)
Surkhet	Barattaal (2); Chaukune (5, 8); Panchapuri NP (4, 10)	High 5)
	Barattaal (4); Bheriganga NP (1, 6); Birendranagar NP (2, 9, 10, 11); Chaukune (4, 6, 7); Chinghad (3); Ghurbhakot NP (7, 11, 14); Lekhbesi NP (9, 10); Panchapuri NP (3, 5, 8)	Moderate (19)

Sudurpashchim Province: Total High Risk Wards = 31, Total Moderate Risk Wards = 91

Districts	Municipalities (Wards)	Risk Type
Baitadi	Melauli NP (1, 6, 7); Pancheswor (6); Shibnath (6)	High (5)
	Melauli NP (3); Pancheswor (3); Shibnath (4)	Moderate (3)
Bajura	Budinanda NP (1, 5, 6, 7)	High (4)
	Budinanda NP (2); Himali (6)	Moderate (2)
Dadeldhura	Parsuram NP (4, 5, 6, 12)	High (4)
	Aalital (2, 5); Parsuram NP (3)	Moderate (3)
Kailali	Bhajani NP (5); Dhangadi NP (9); Godawari NP (4, 10, 11, 12); Janaki (6); LamkiChuha NP (4, 5, 6, 8, 10); Tikapur NP (4, 8, 9)	High (15)
	Bardagoriya (1, 2, 5); Bhajani NP (2, 3); Chure (3, 4); Dhangadi NP (1, 2, 4, 5, 7, 12, 14, 15, 19); Gauriganga NP (1, 2, 6, 7, 9); Godagodi NP (3); Godawari NP (1, 2, 3, 5, 6, 8, 9); Janaki (1, 2, 3, 4, 8, 9); LamkiChuha NP (1, 2, 3); Tikapur NP (1, 2, 5, 6, 7)	Moderate (43)
Kanchanpur	Belauri NP (1); Bhimdatta NP (9); Mahakali NP (3)	High (3)
	Bedkot NP (3, 4, 6); Belauri NP (2, 3, 4, 6, 7, 8, 9, 10); Beldandi (2); Bhimdatta NP (3, 4, 6, 7, 13, 18); Krishnapur NP (2, 4, 5, 6, 7); Laljhandi (2); Mahakali NP (1, 4, 7, 8); Purnabash NP (4, 7, 8, 9, 11); SuklaPhanta NP (1, 2, 4, 5, 7, 8, 12)	Moderate (40)

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Province	District	GP/NP	Ward NO.	Population	Score	Risk Type
1	Jhapa	Gauriganj	6	5892	60	Moderate
2	Saptari	Bodebarsaien NP	2	4781	58	Moderate
2	Saptari	Saptakoshi NP	11	2136	74	Moderate
2	Saptari	Surunga NP	9	3540	58	Moderate
2	Dhanusa	Ganeshman Charnath NP	1	5604	79	High
2	Dhanusa	Ganeshman Charnath NP	3	4085	79	High
2	Dhanusa	Ganeshman Charnath NP	6	3371	66	Moderate
2	Dhanusa	Ganeshman Charnath NP	9	3964	79	High
2	Dhanusa	Mithila NP	3	6258	79	High
2	Dhanusa	Mithila NP	4	2851	79	High
2	Dhanusa	Mithila NP	11	5826	79	High
2	Dhanusa	Sabaila NP	3	3014	61	Moderate
2	Sarlahi	Ishworpur NP	1	4172	58	Moderate
2	Sarlahi	Ishworpur NP	2	3736	58	Moderate
2	Bara	JitpurSimara NP	6	2455	58	Moderate
3	Sindhuli	Dudhouli NP	9	6303	64	Moderate
3	Sindhuli	Kamalamai NP	14	3118	78	High
4	Nawalparasi(Bardhagat Susta Purba)	Gaidakot NP	18	2513	52	Moderate
5	Rupandehi	Devdaha NP	9	3923	54	Moderate
5	Rupandehi	Devdaha NP	11	6308	57	Moderate
5	Rupandehi	Kothimai	7	5896	61	Moderate
5	Rupandehi	Lumbini Sanskritik NP	6	6370	54	Moderate
5	Rupandehi	Sammarimai	4	4822	57	Moderate
5	Rupandehi	SiddharthNagar NP	1	6270	74	Moderate
5	Rupandehi	SiddharthNagar NP	3	7280	54	Moderate
5	Kapilbastu	Buddhabhumi NP	7	4324	58	Moderate
5	Kapilbastu	Krishnanagar NP	7	5696	61	Moderate
5	Kapilbastu	Maharajgunj NP	4	3705	78	High
5	Kapilbastu	Maharajgunj NP	7	5465	65	Moderate
5	Kapilbastu	Maharajgunj NP	10	5321	75	Moderate
5	Kapilbastu	Mayadevi	1	8016	58	Moderate
5	Kapilbastu	Mayadevi	6	6112	75	Moderate
5	Kapilbastu	Shivraj NP	10	4319	55	Moderate
5	Kapilbastu	Yasodara	6	5592	61	Moderate
5	Dang	Babai	5	5487	51	Moderate
5	Dang	Babai	7	4258	62	Moderate
5	Dang	Rapti	9	1874	72	Moderate
5	Dang	Shantinagar	6	3452	51	Moderate
5	Dang	Tulsipur NP	13	6033	51	Moderate
5	Banke	Bajnath	1	7462	51	Moderate
5	Banke	Bajnath	2	7822	55	Moderate
5	Banke	Bajnath	4	7143	65	Moderate
5	Banke	Duduwa	2	8948	62	Moderate

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5	Banke	Narainapur	3	5154	55	Moderate
5	Banke	Raptisonari	3	5515	81	High
5	Bardiya	Bansgadhi NP	1	5968	65	Moderate
5	Bardiya	Bansgadhi NP	2	3047	65	Moderate
5	Bardiya	Bansgadhi NP	5	6796	51	Moderate
5	Bardiya	Barbardiya NP	6	6398	51	Moderate
5	Bardiya	Thakurbaba NP	1	5912	72	Moderate
5	Bardiya	Thakurbaba NP	2	7083	78	High
5	Bardiya	Thakurbaba NP	3	6767	55	Moderate
6	Salyan	Kalimati	3	3811	78	High
6	Surkhet	Barattaal	2	2930	93	High
6	Surkhet	Barattaal	4	3552	56	Moderate
6	Surkhet	Bheriganga NP	1	3319	62	Moderate
6	Surkhet	Bheriganga NP	6	3336	56	Moderate
6	Surkhet	Birendranagar NP	2	8856	56	Moderate
6	Surkhet	Birendranagar NP	9	7943	53	Moderate
6	Surkhet	Birendranagar NP	10	9763	56	Moderate
6	Surkhet	Birendranagar NP	11	7787	56	Moderate
6	Surkhet	Chaukune	4	3241	60	Moderate
6	Surkhet	Chaukune	5	2736	77	High
6	Surkhet	Chaukune	6	2482	55	Moderate
6	Surkhet	Chaukune	7	3447	60	Moderate
6	Surkhet	Chaukune	8	2469	93	High
6	Surkhet	Chinghad	3	3458	51	Moderate
6	Surkhet	Ghurbhakot NP	7	2724	53	Moderate
6	Surkhet	Ghurbhakot NP	11	2881	55	Moderate
6	Surkhet	Ghurbhakot NP	14	3791	55	Moderate
6	Surkhet	Lekhbesi NP	9	3988	72	Moderate
6	Surkhet	Lekhbesi NP	10	3638	62	Moderate
6	Surkhet	Panchapuri NP	3	3659	73	Moderate
6	Surkhet	Panchapuri NP	4	2646	77	High
6	Surkhet	Panchapuri NP	5	3050	73	Moderate
6	Surkhet	Panchapuri NP	8	3708	60	Moderate
6	Surkhet	Panchapuri NP	10	3342	93	High
6	Mugu	Khatyad	8	1766	84	High
6	Mugu	Khatyad	10	1438	77	High
6	Mugu	Khatyad	11	1992	64	Moderate
7	Bajura	Budinanda NP	1	2788	76	High
7	Bajura	Budinanda NP	2	1750	60	Moderate
7	Bajura	Budinanda NP	5	1836	86	High
7	Bajura	Budinanda NP	6	1708	86	High
7	Bajura	Budinanda NP	7	2365	76	High
7	Bajura	Himali	6	3075	63	Moderate
7	Kailali	Bardagoriya	1	6538	56	Moderate
7	Kailali	Bardagoriya	2	6580	56	Moderate
7	Kailali	Bardagoriya	5	6622	53	Moderate
7	Kailali	Bhajani NP	2	4629	51	Moderate

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7	Kailali	Bhajani NP	3	7104	51	Moderate
7	Kailali	Bhajani NP	5	6916	88	High
7	Kailali	Chure	3	3337	73	Moderate
7	Kailali	Chure	4	3569	68	Moderate
7	Kailali	Dhangadi NP	1	15754	53	Moderate
7	Kailali	Dhangadi NP	2	13694	53	Moderate
7	Kailali	Dhangadi NP	4	10084	53	Moderate
7	Kailali	Dhangadi NP	5	12798	53	Moderate
7	Kailali	Dhangadi NP	7	9939	53	Moderate
7	Kailali	Dhangadi NP	9	3605	77	High
7	Kailali	Dhangadi NP	12	11001	70	Moderate
7	Kailali	Dhangadi NP	14	8916	70	Moderate
7	Kailali	Dhangadi NP	15	5301	67	Moderate
7	Kailali	Dhangadi NP	19	7633	53	Moderate
7	Kailali	Gauriganga NP	1	7329	56	Moderate
7	Kailali	Gauriganga NP	2	4462	56	Moderate
7	Kailali	Gauriganga NP	6	6576	60	Moderate
7	Kailali	Gauriganga NP	7	5821	56	Moderate
7	Kailali	Gauriganga NP	9	4811	56	Moderate
7	Kailali	Godagodi NP	3	6944	56	Moderate
7	Kailali	Godawari NP	1	9377	56	Moderate
7	Kailali	Godawari NP	2	8170	56	Moderate
7	Kailali	Godawari NP	3	8319	60	Moderate
7	Kailali	Godawari NP	4	8337	77	High
7	Kailali	Godawari NP	5	6335	53	Moderate
7	Kailali	Godawari NP	6	6851	60	Moderate
7	Kailali	Godawari NP	8	7885	53	Moderate
7	Kailali	Godawari NP	9	6989	56	Moderate
7	Kailali	Godawari NP	10	7009	77	High
7	Kailali	Godawari NP	11	5472	93	High
7	Kailali	Godawari NP	12	5982	93	High
7	Kailali	Janaki	1	5467	60	Moderate
7	Kailali	Janaki	2	6490	51	Moderate
7	Kailali	Janaki	3	5242	53	Moderate
7	Kailali	Janaki	4	6056	68	Moderate
7	Kailali	Janaki	6	4330	77	High
7	Kailali	Janaki	8	6818	70	Moderate
7	Kailali	Janaki	9	7401	73	Moderate
7	Kailali	LamkiChuha NP	1	15807	53	Moderate
7	Kailali	LamkiChuha NP	2	7149	56	Moderate
7	Kailali	LamkiChuha NP	3	6250	60	Moderate
7	Kailali	LamkiChuha NP	4	10442	77	High
7	Kailali	LamkiChuha NP	5	5923	77	High
7	Kailali	LamkiChuha NP	6	9899	77	High
7	Kailali	LamkiChuha NP	8	6492	93	High
7	Kailali	LamkiChuha NP	10	5471	90	High
7	Kailali	Tikapur NP	1	38422	60	Moderate

7	Kailali	Tikapur NP	2	7450	53	Moderate
7	Kailali	Tikapur NP	4	4858	90	High
7	Kailali	Tikapur NP	5	5480	73	Moderate
7	Kailali	Tikapur NP	6	5335	65	Moderate
7	Kailali	Tikapur NP	7	6983	51	Moderate
7	Kailali	Tikapur NP	8	5832	88	High
7	Kailali	Tikapur NP	9	3785	88	High
7	Kanchanpur	Bedkot NP	3	6716	55	Moderate
7	Kanchanpur	Bedkot NP	4	5109	52	Moderate
7	Kanchanpur	Bedkot NP	6	4693	55	Moderate
7	Kanchanpur	Belauri NP	1	3482	82	High
7	Kanchanpur	Belauri NP	2	6002	72	Moderate
7	Kanchanpur	Belauri NP	3	5603	52	Moderate
7	Kanchanpur	Belauri NP	4	5629	52	Moderate
7	Kanchanpur	Belauri NP	6	7260	52	Moderate
7	Kanchanpur	Belauri NP	7	3847	65	Moderate
7	Kanchanpur	Belauri NP	8	6324	52	Moderate
7	Kanchanpur	Belauri NP	9	6435	69	Moderate
7	Kanchanpur	Belauri NP	10	7497	52	Moderate
7	Kanchanpur	Beldandi	2	6760	52	Moderate
7	Kanchanpur	Bhimdatta NP	3	6169	52	Moderate
7	Kanchanpur	Bhimdatta NP	4	6188	55	Moderate
7	Kanchanpur	Bhimdatta NP	6	9862	52	Moderate
7	Kanchanpur	Bhimdatta NP	7	5459	72	Moderate
7	Kanchanpur	Bhimdatta NP	9	7745	85	High
7	Kanchanpur	Bhimdatta NP	13	5319	72	Moderate
7	Kanchanpur	Bhimdatta NP	18	18700	52	Moderate
7	Kanchanpur	Krishnapur NP	2	10682	52	Moderate
7	Kanchanpur	Krishnapur NP	4	9685	58	Moderate
7	Kanchanpur	Krishnapur NP	5	7948	58	Moderate
7	Kanchanpur	Krishnapur NP	6	5903	55	Moderate
7	Kanchanpur	Krishnapur NP	7	7752	55	Moderate
7	Kanchanpur	Laljhandi	2	3772	65	Moderate
7	Kanchanpur	Mahakali NP	1	5031	52	Moderate
7	Kanchanpur	Mahakali NP	3	5013	92	High
7	Kanchanpur	Mahakali NP	4	4568	55	Moderate
7	Kanchanpur	Mahakali NP	7	5615	69	Moderate
7	Kanchanpur	Mahakali NP	8	3520	52	Moderate
7	Kanchanpur	Purnabash NP	4	3969	53	Moderate
7	Kanchanpur	Purnabash NP	7	3134	64	Moderate
7	Kanchanpur	Purnabash NP	8	4891	53	Moderate
7	Kanchanpur	Purnabash NP	9	7832	70	Moderate
7	Kanchanpur	Purnabash NP	11	5320	53	Moderate
7	Kanchanpur	SuklaPhanta NP	1	5734	52	Moderate
7	Kanchanpur	SuklaPhanta NP	2	2162	65	Moderate
7	Kanchanpur	SuklaPhanta NP	4	3579	72	Moderate
7	Kanchanpur	SuklaPhanta NP	5	5662	52	Moderate

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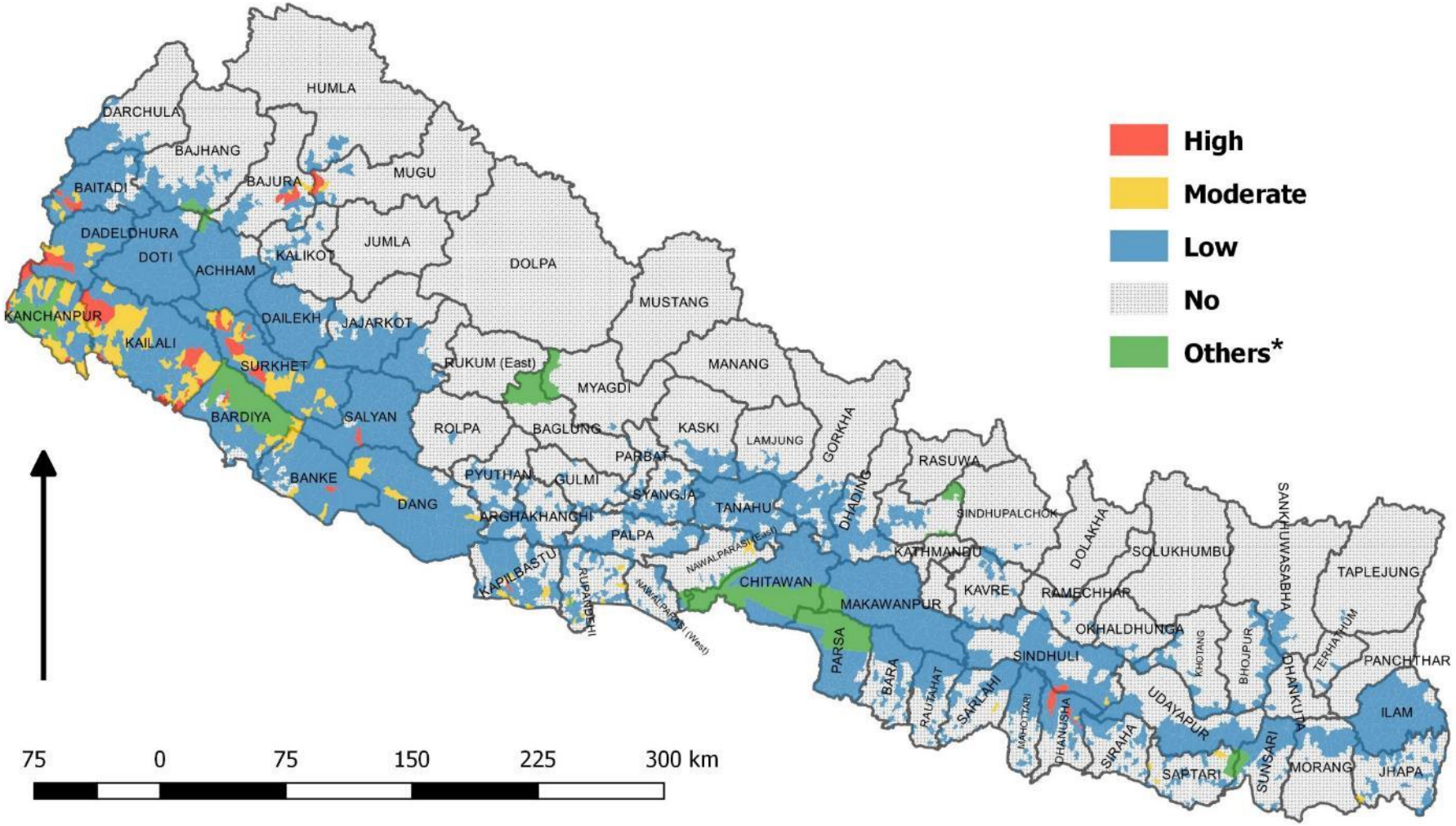
7	Kanchanpur	SuklaPhanta NP	7	5807	52	Moderate
7	Kanchanpur	SuklaPhanta NP	8	5111	52	Moderate
7	Kanchanpur	SuklaPhanta NP	12	5285	65	Moderate
7	Dadeldhura	Aalital	2	2159	66	Moderate
7	Dadeldhura	Aalital	5	2231	66	Moderate
7	Dadeldhura	Parsuram NP	3	2466	52	Moderate
7	Dadeldhura	Parsuram NP	4	4642	89	High
7	Dadeldhura	Parsuram NP	5	3134	86	High
7	Dadeldhura	Parsuram NP	6	2619	76	High
7	Dadeldhura	Parsuram NP	12	3585	89	High
7	Baitadi	Melauli NP	1	4033	76	High
7	Baitadi	Melauli NP	3	2478	60	Moderate
7	Baitadi	Melauli NP	6	1911	76	High
7	Baitadi	Melauli NP	7	3766	76	High
7	Baitadi	Pancheswor	3	3048	63	Moderate
7	Baitadi	Pancheswor	6	2392	76	High
7	Baitadi	Shibnath	4	3192	60	Moderate
7	Baitadi	Shibnath	6	2187	83	High

Director

Ward Level Risk Classification Map (MS 2018)



*Others means National Parks, Conservative areas, Wildlife Reserves etc.