



DEPARTMENT OF

Geographical Sciences

BE GLOBAL

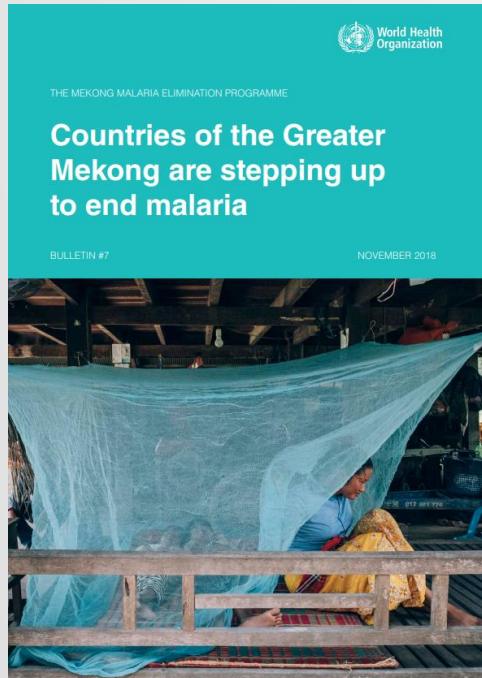
# MYANMAR MALARIA EARLY WARNING SYSTEM (MMEWS)

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Allison Baer  
Department of Geographical Sciences, University of Maryland

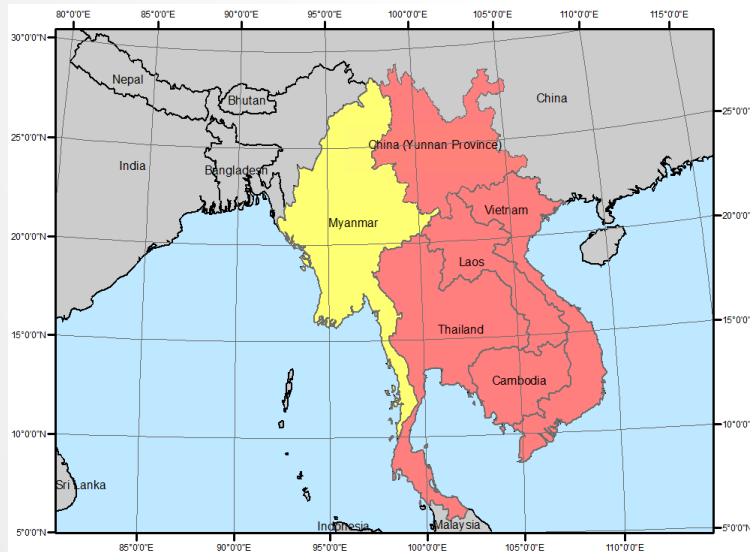
Christopher Plowe, Myaing Myaing Nyunt  
*Formerly Duke University*

Poe Poe Aung  
Duke Global Health Institute, Myanmar

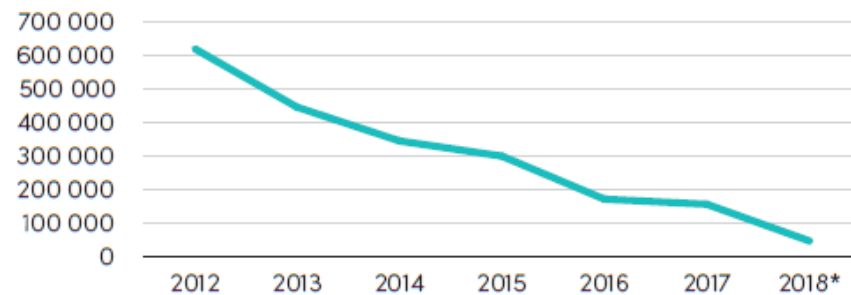
# MALARIA OCCURRENCE IN GM COUNTRIES HAS DROPPED



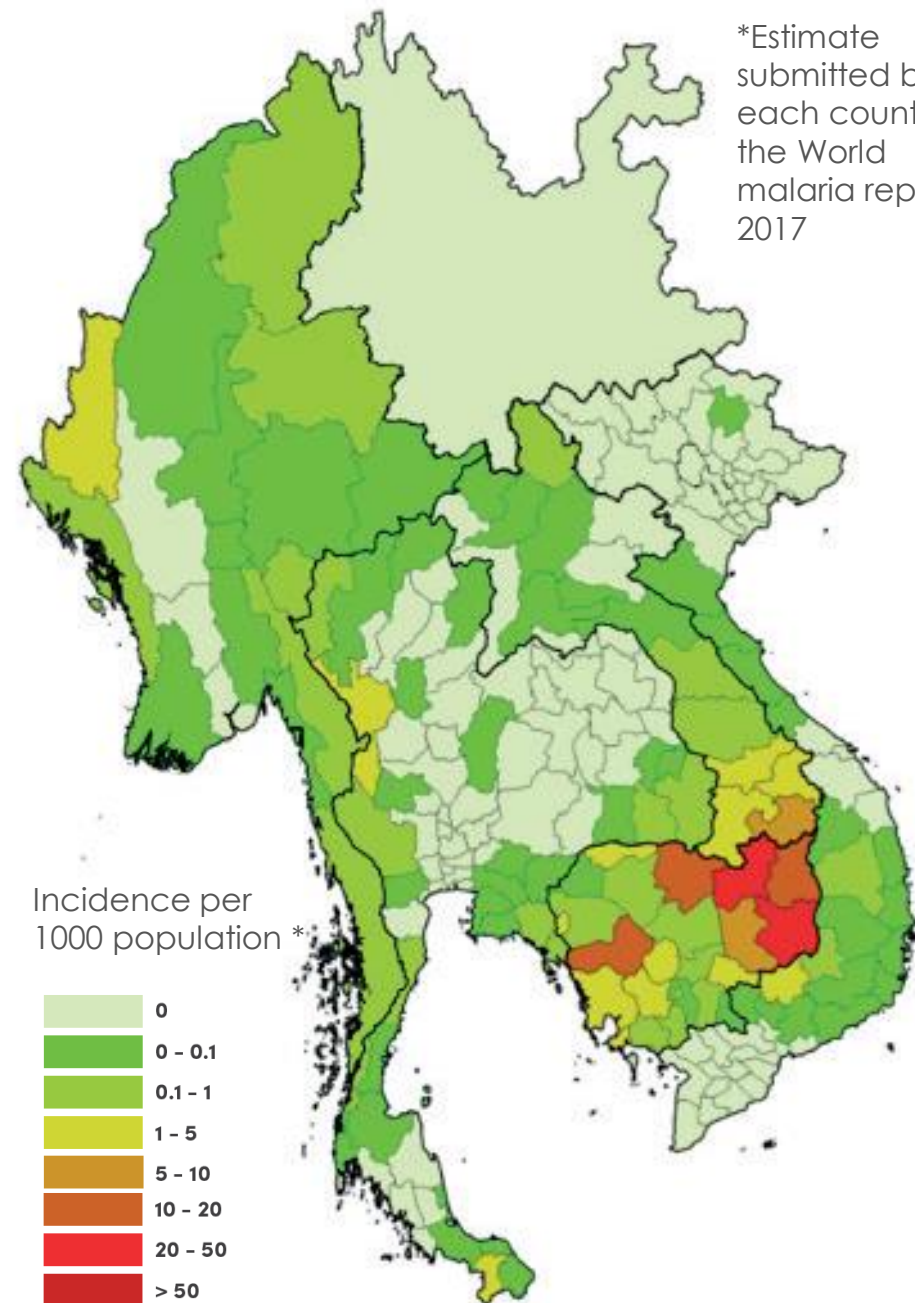
WHO's Mekong Malaria Elimination Programme



Malaria cases in the six GMS countries (2012-2018)



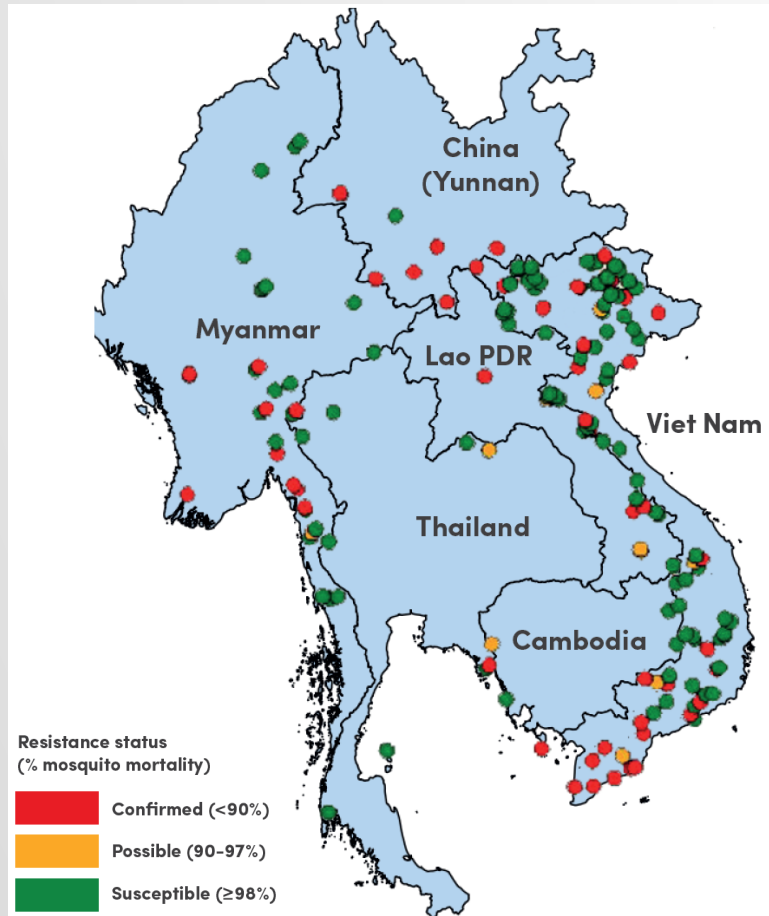
\*Estimate submitted by each country to the World malaria report 2017



Incidence per 1000 population \*

# GMR REMAINS A KEY MALARIA BATTLEGROUND

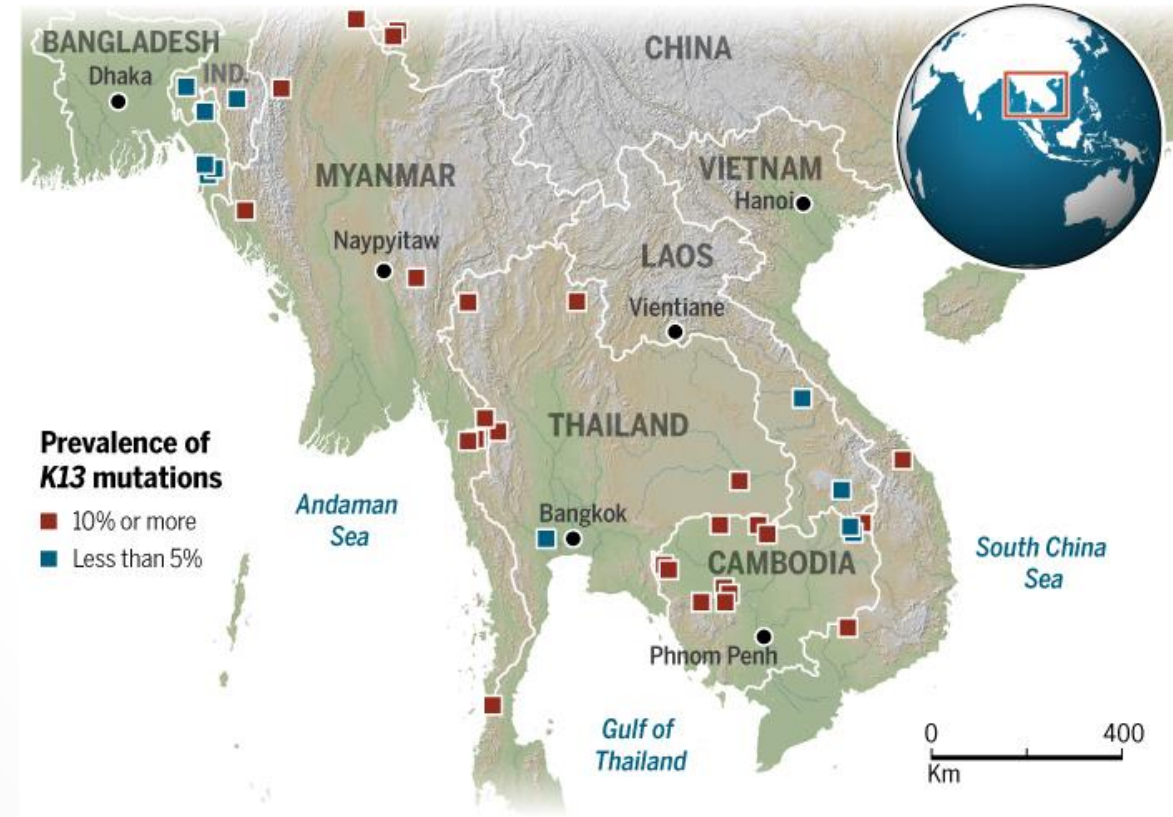
Resistance of malaria vectors to pyrethroids in the GMS (2010- 2018)



WHO's Mekong Malaria Elimination Programme

## A GROWING THREAT

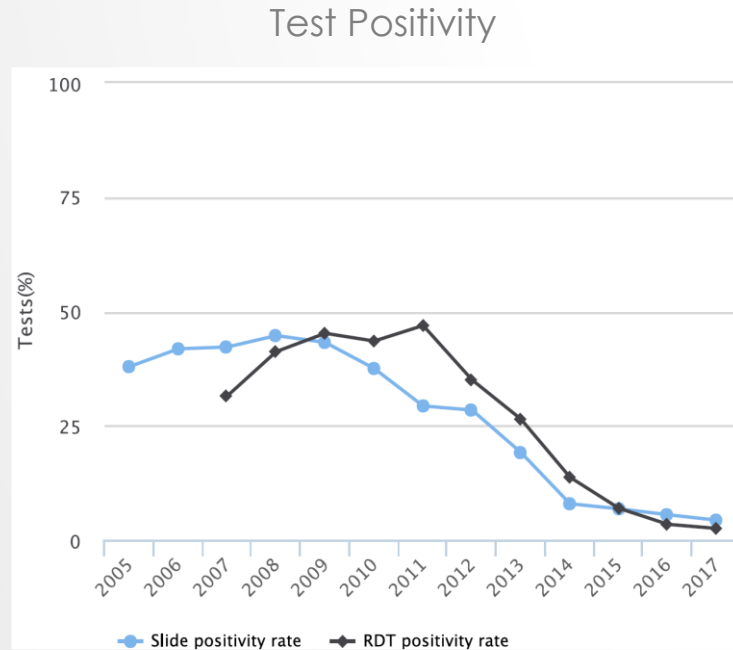
Artemisinin-resistant parasites are now widespread in the Mekong. Resistance has been linked to mutations in the parasites' *K13* gene; the map shows the percentage of samples with *K13* mutations reported since 2010.



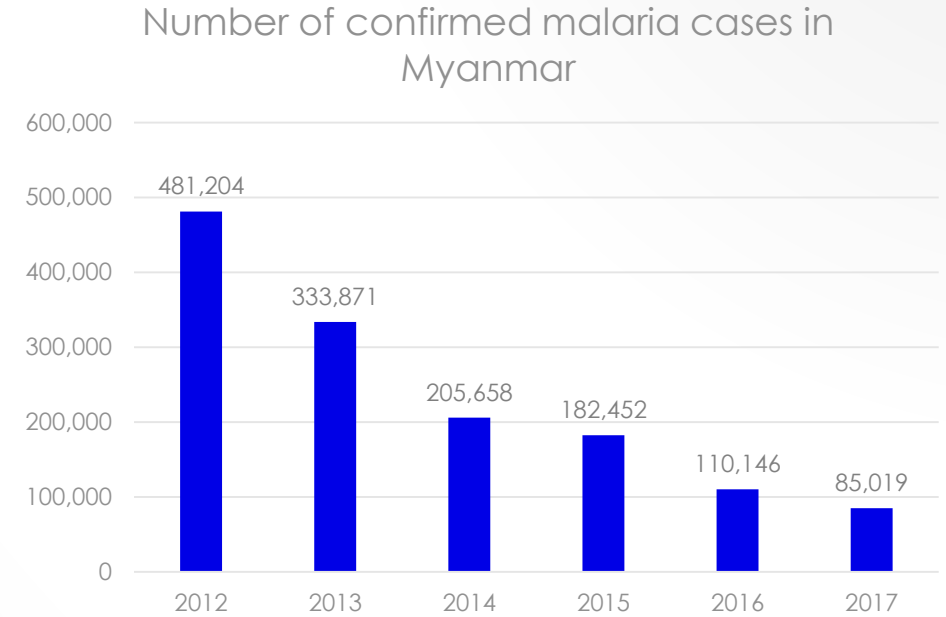
Roberts, L. (2016) Drug resistance triggers war to wipe out malaria in the Mekong region  
Science, AAAS <https://www.sciencemag.org/>

# MYANMAR – A GREAT SUCCESS STORY

82% drop in malaria cases between 2012 to 2017  
[WHO's Mekong Malaria Elimination Programme]



[World Malaria Report 2018]



[President's Malaria Initiative (Burma) Abbreviated Malaria Operational Plan FY 2019]

# MYANMAR'S ASYMPTOMATIC MALARIA

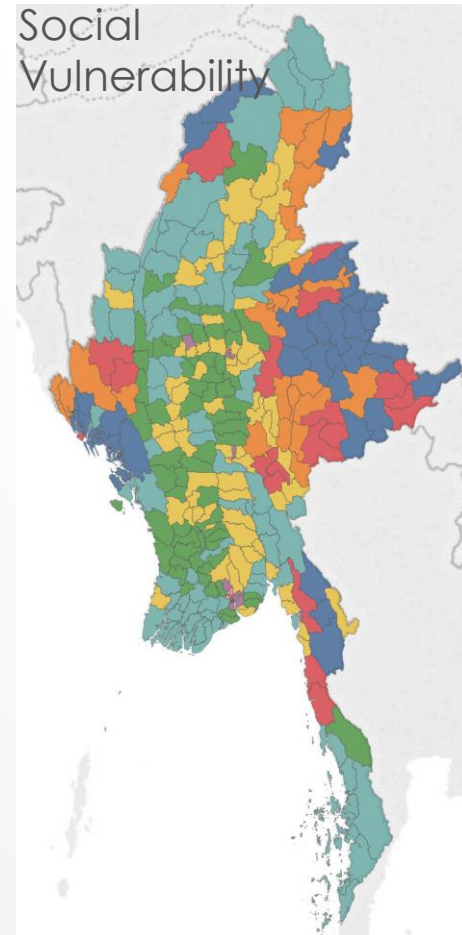
Our data in Ann Township, Rakhine State, Myanmar:

- Study 1 (n = 990):
  - 1 – RDT positive
  - 92 – usPCR positive
- Study 2 (n = 1,000):
  - 5 – RDT positive
  - 96 – usPCR positive



Malaria elimination may require elimination of all parasites

# MYANMAR'S SURVEILLANCE CHALLENGES



- 1 Extreme outliers in terms of development needs and/or exposure to conflict
- 2 Conflict-affected areas with poor human development
- 3 Hubs in conflict-affected areas
- 4 Very low access to basic services and infrastructure
- 5 Agricultural townships with the highest profits per capita
- 6 Agricultural areas with secondary cities and towns
- 7 Up-and-coming peri-urban and urban areas
- 8 Affluent, densely populated city centres

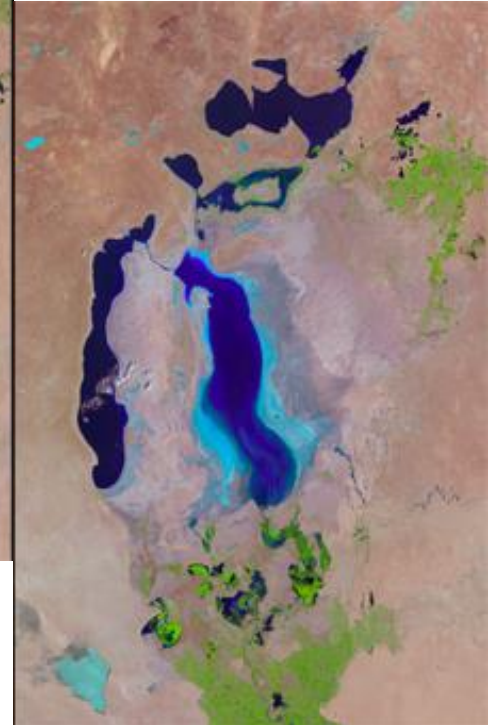
Humanitarian Assistance and Resilience Programme Facility & the Myanmar Information Management Unit (2018)

# TARGETED MALARIA ELIMINATION IMPERATIVE

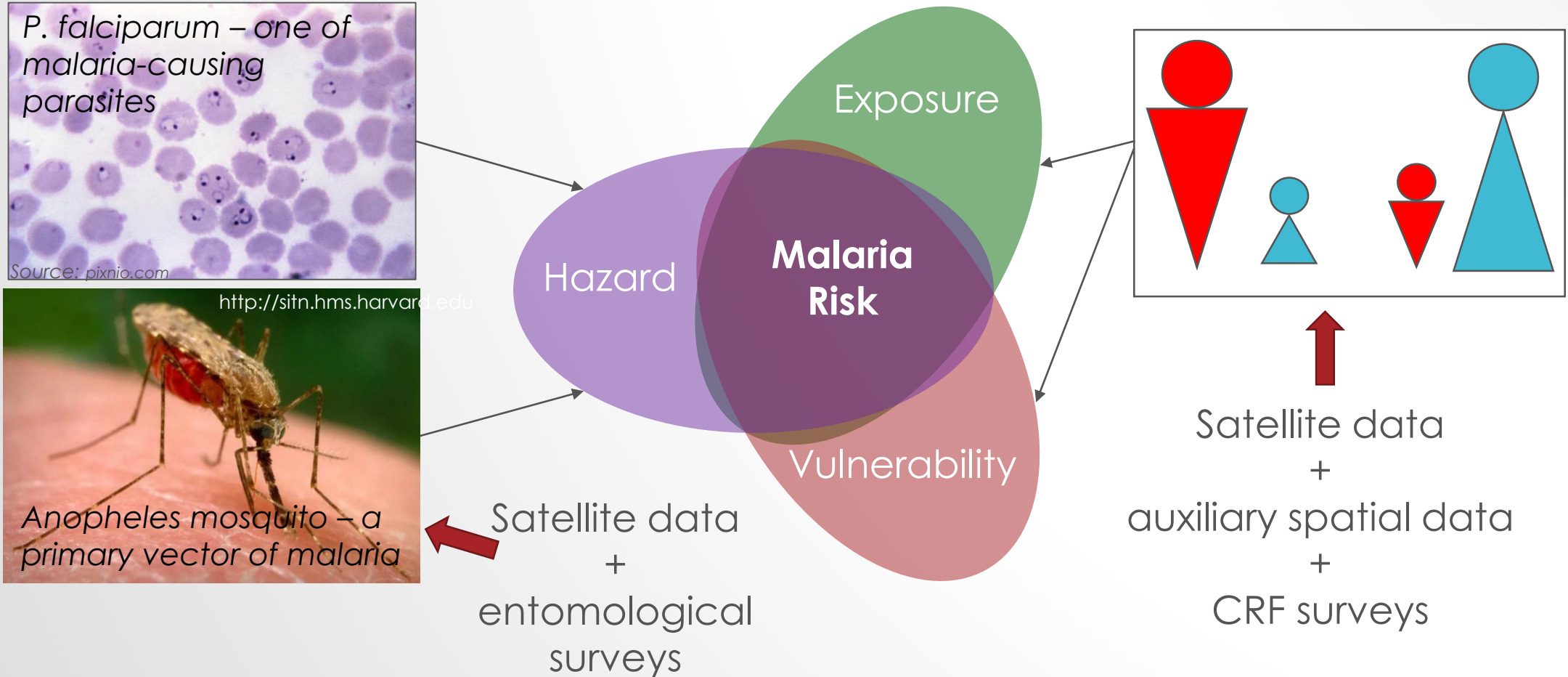
As the “malaria lake” is drained, malaria transmission separates into “pools” and then shrinks into “puddles”, understanding malaria risk as it varies over time and space becomes essential for effective targeting of interventions.



[https://www.nasa.gov/mission\\_pages/landsat/news/40th-top10-aralse](https://www.nasa.gov/mission_pages/landsat/news/40th-top10-aralse)

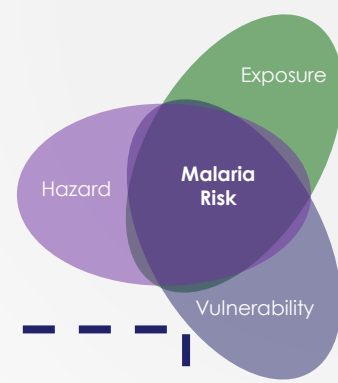


# MALARIA RISK





# MALARIA BURDEN POTENTIAL (MBP) NEW



## Hazard as available

Parasitemia  
(0.5)

### Vector Abundance

Surface Water  
(0.167)

Surface T  
(0.167)

Veg Stress  
(0.166) 8-day

## Exposure

annual / as available

Population Distribution  
(0.4)

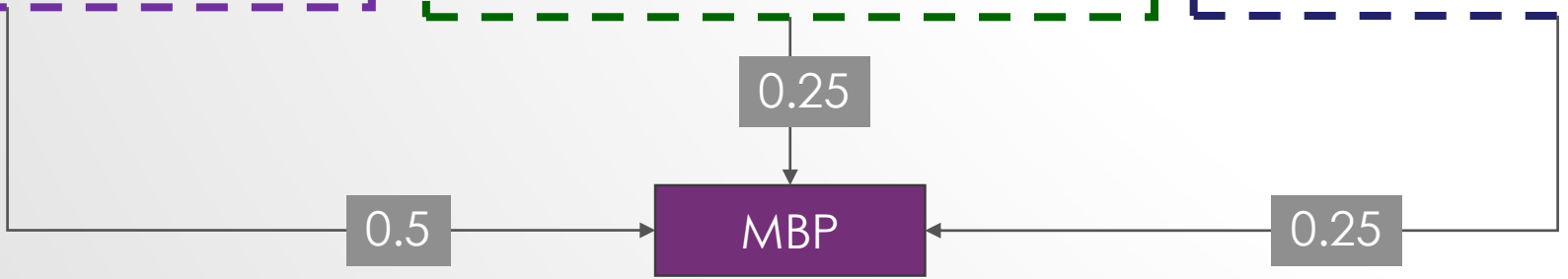
Occupational Exposure  
(0.6)

## Vulnerability

annual / as available

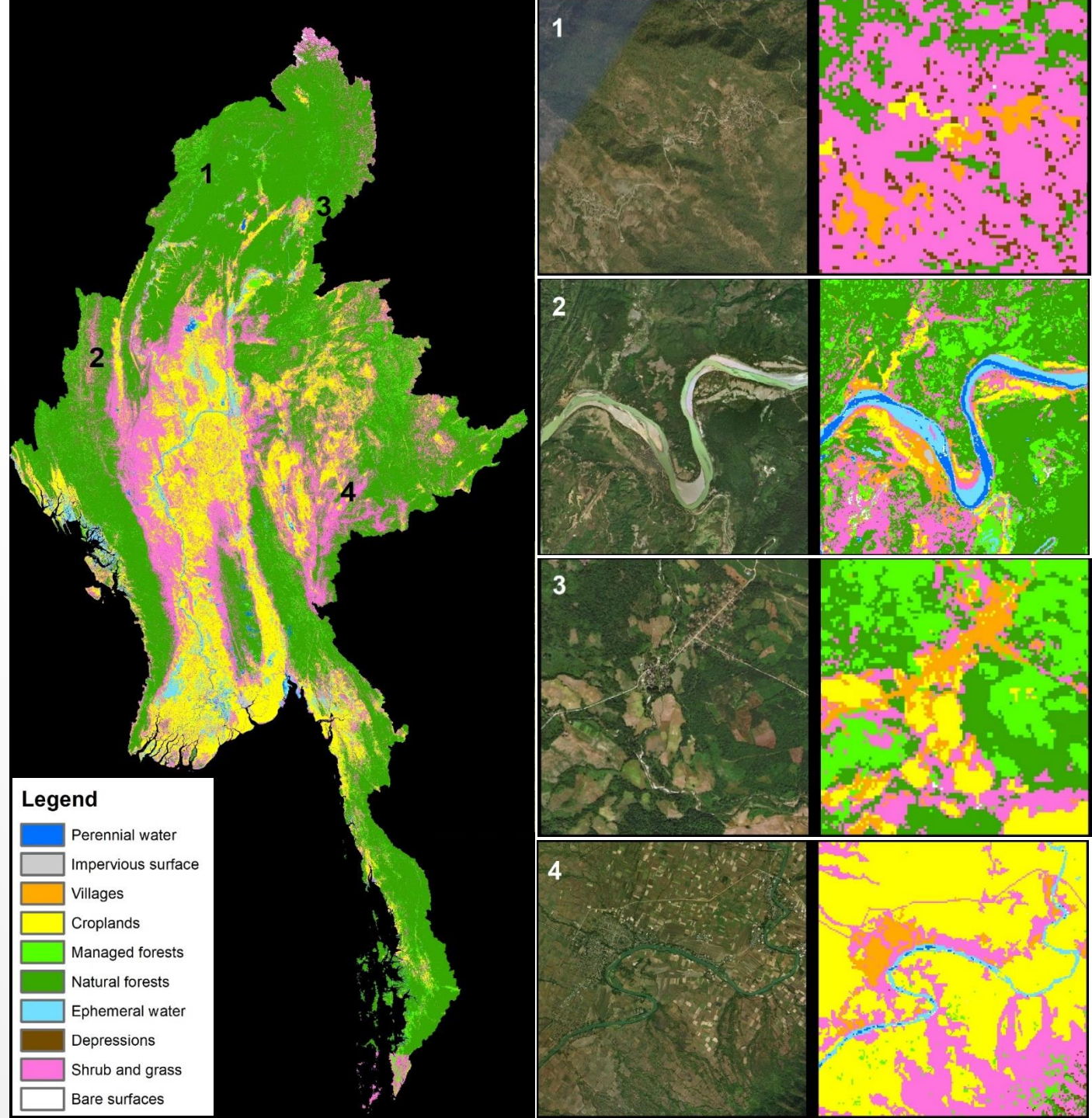
Access to Care  
(0.6)

Social Vulnerability  
(0.4)

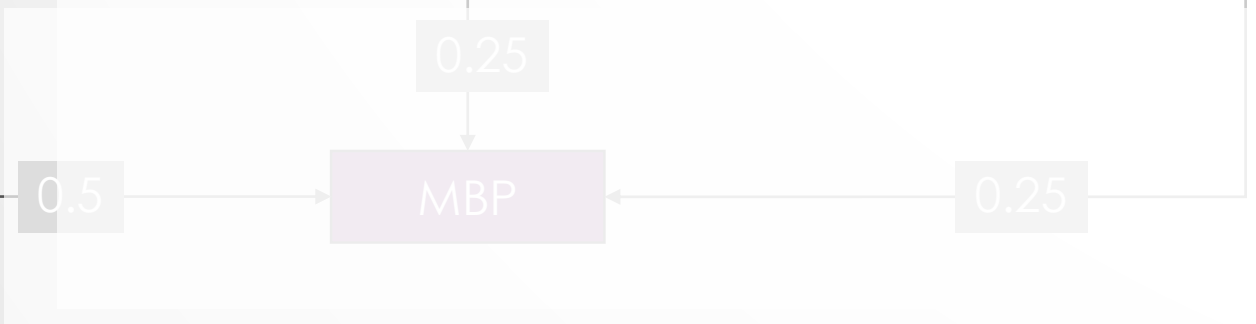
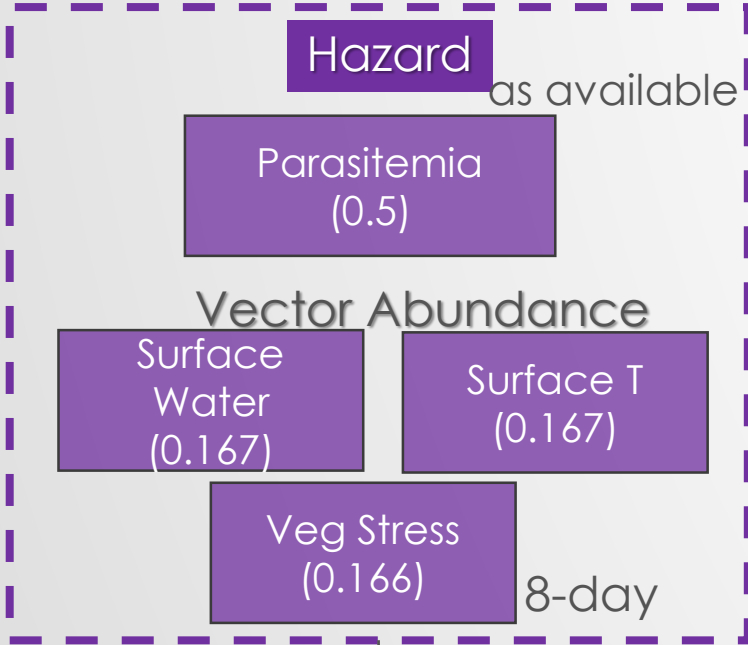
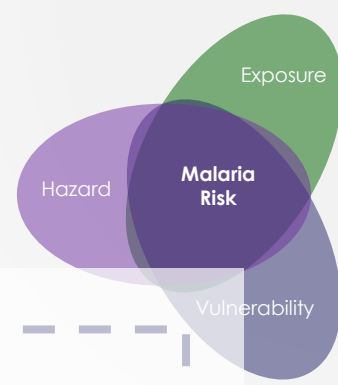


# BASE MAP

- Chen, D., Baer, A., He, J., Hoffman-Hall, A., Shevade, V., Ying, Q., Loboda, T.V. 2020. Land cover land use map for Myanmar at 30-m resolution for 2016. PANGAEA, <https://doi.pangaea.de/10.1594/PANGAEA.921126>



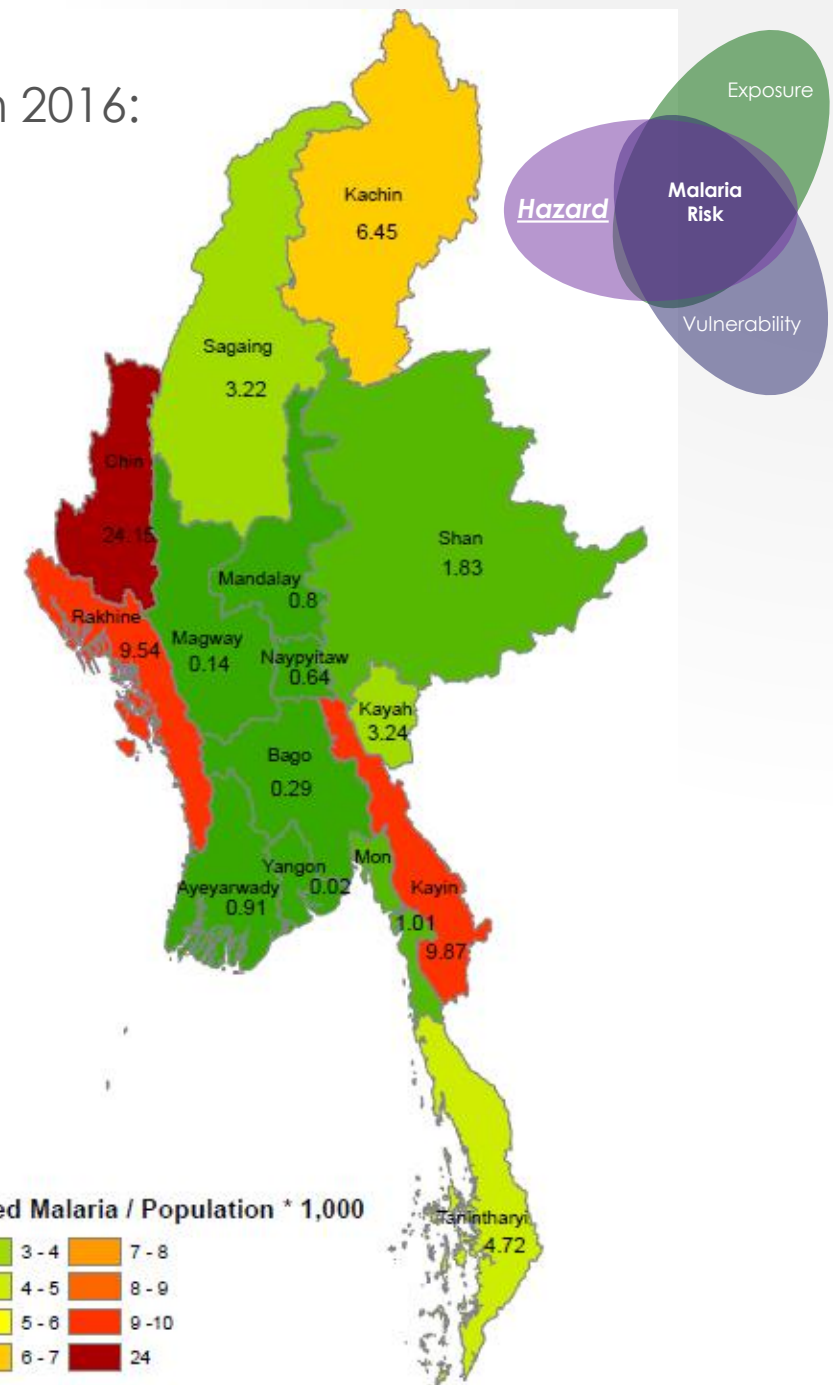
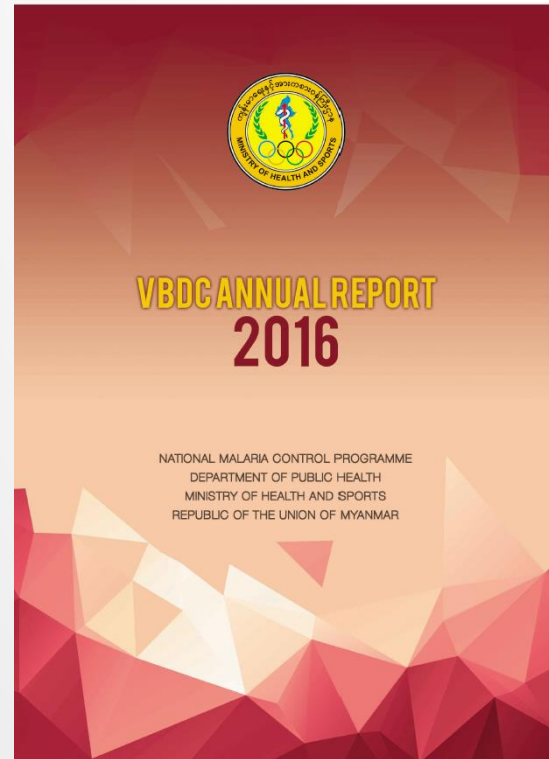
# MALARIA BURDEN POTENTIAL (MBP) NEW



Annual Parasite Incidence (API) by state in 2016:  
All malaria

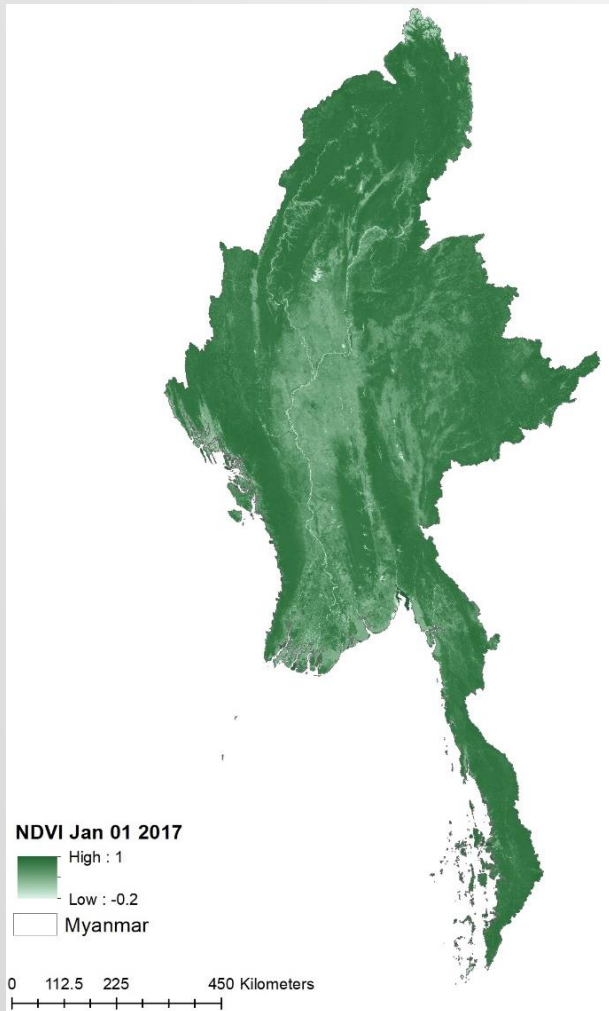
# HAZARD: PARASITES

Nothing we can do  
from space here –  
relying on reported  
information

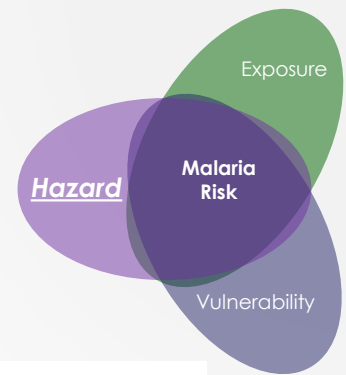


# HAZARD: MOSQUITOES

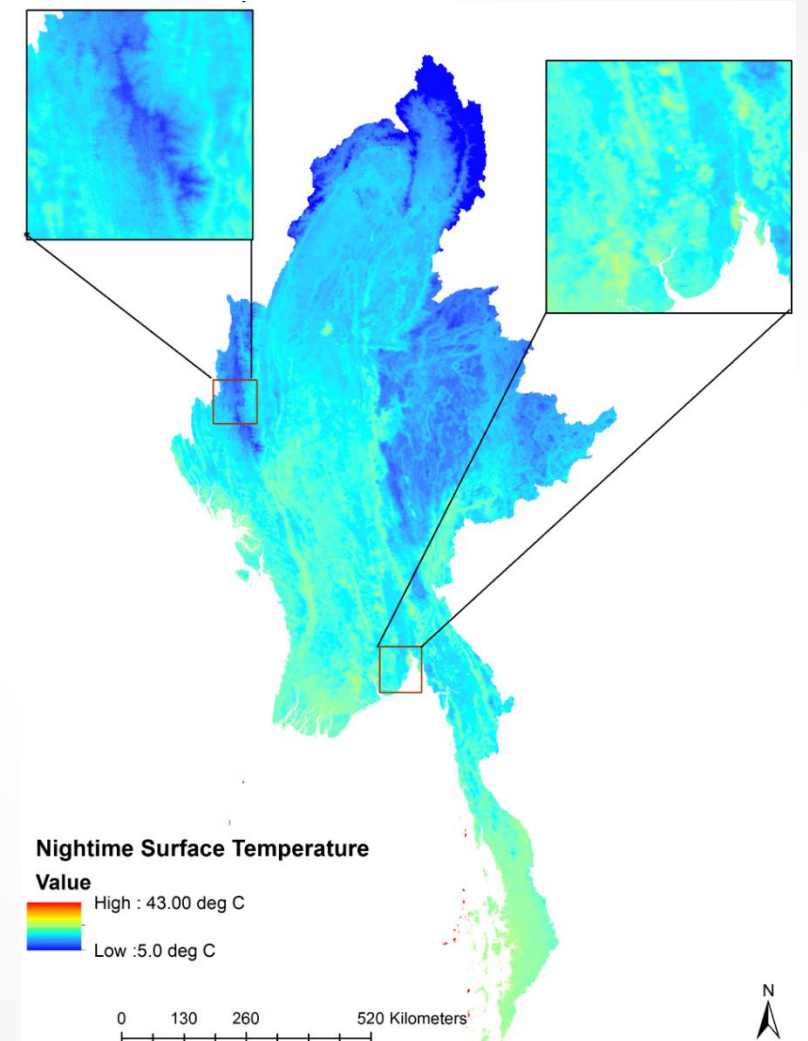
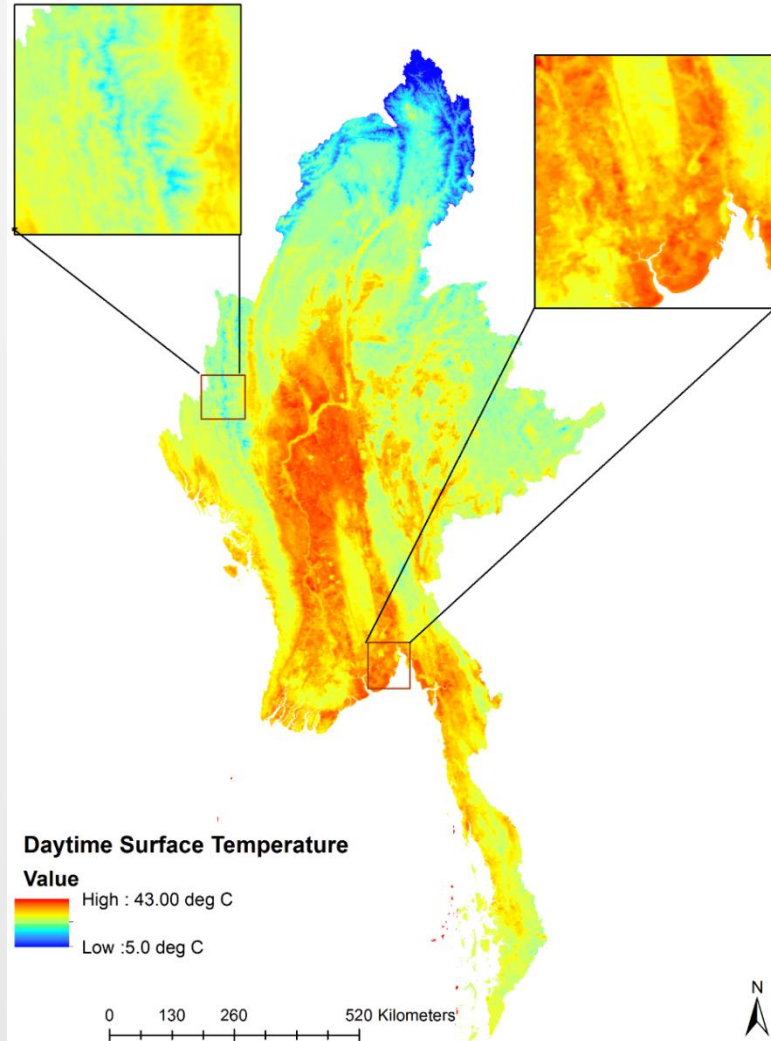
Vegetative Stress



Monitoring environmental conditions that support mosquito well-being



Land Surface Temperature

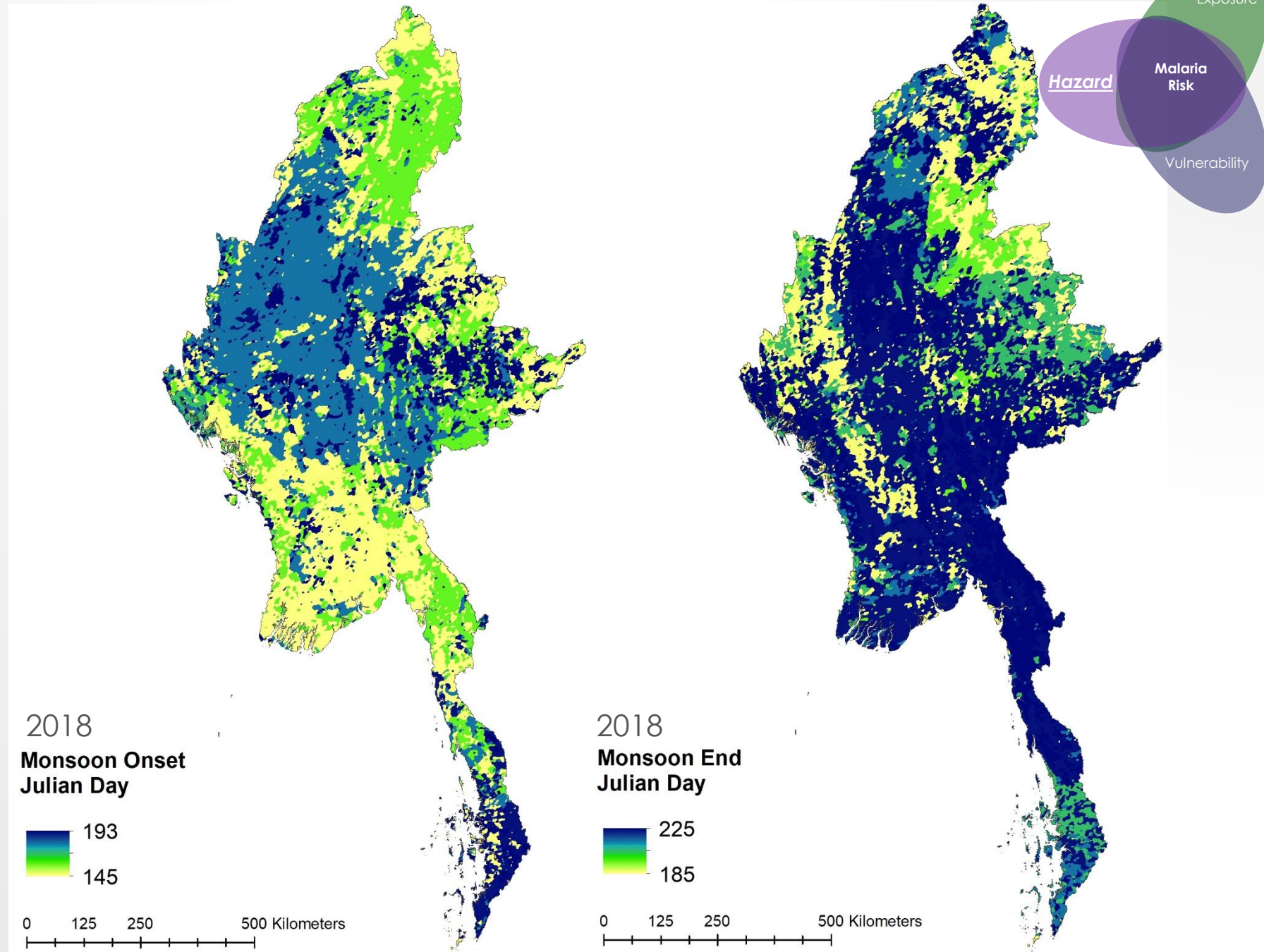


# HAZARD: MOSQUITOES

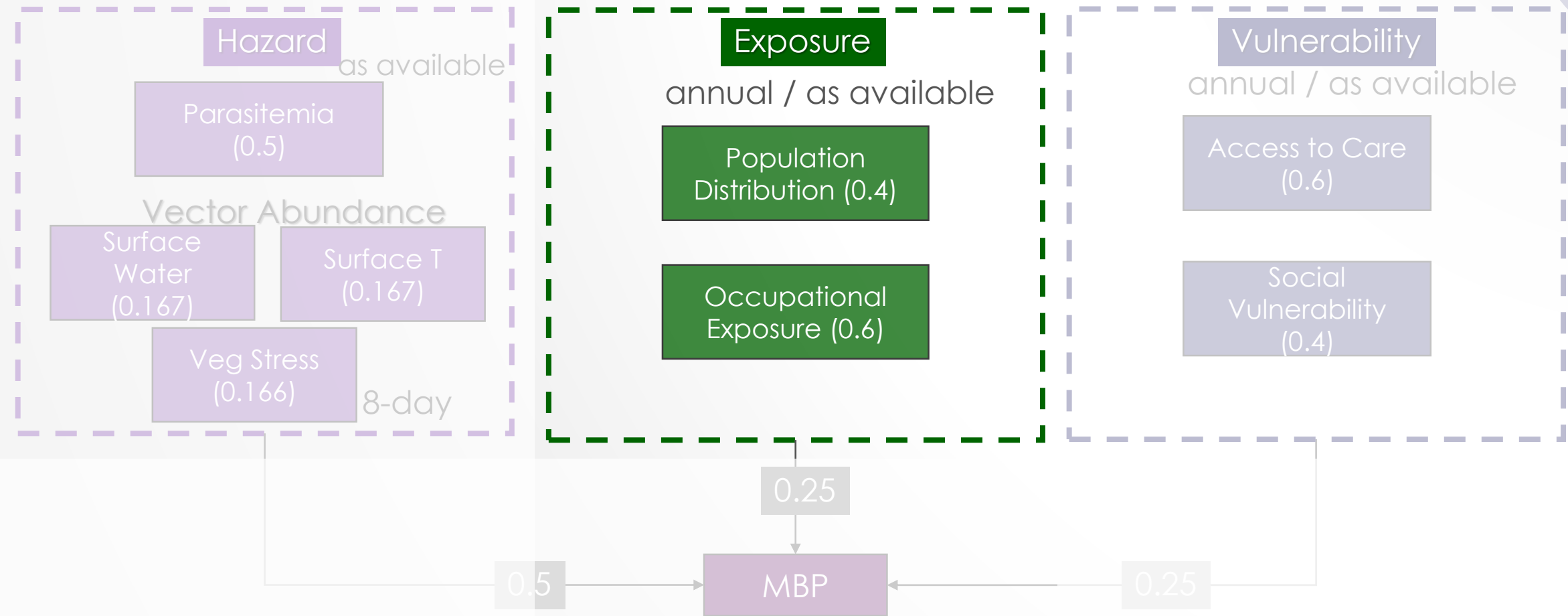
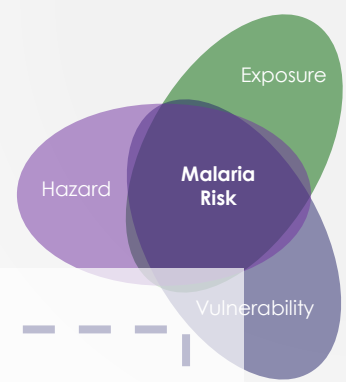
Establishing date of onset and end of monsoon season:

4 consecutive weeks of cloudy observations

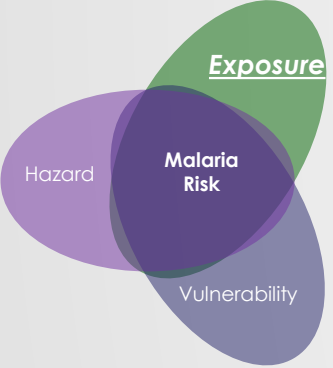
1<sup>st</sup> break of cloud cover after 4 consecutive weeks



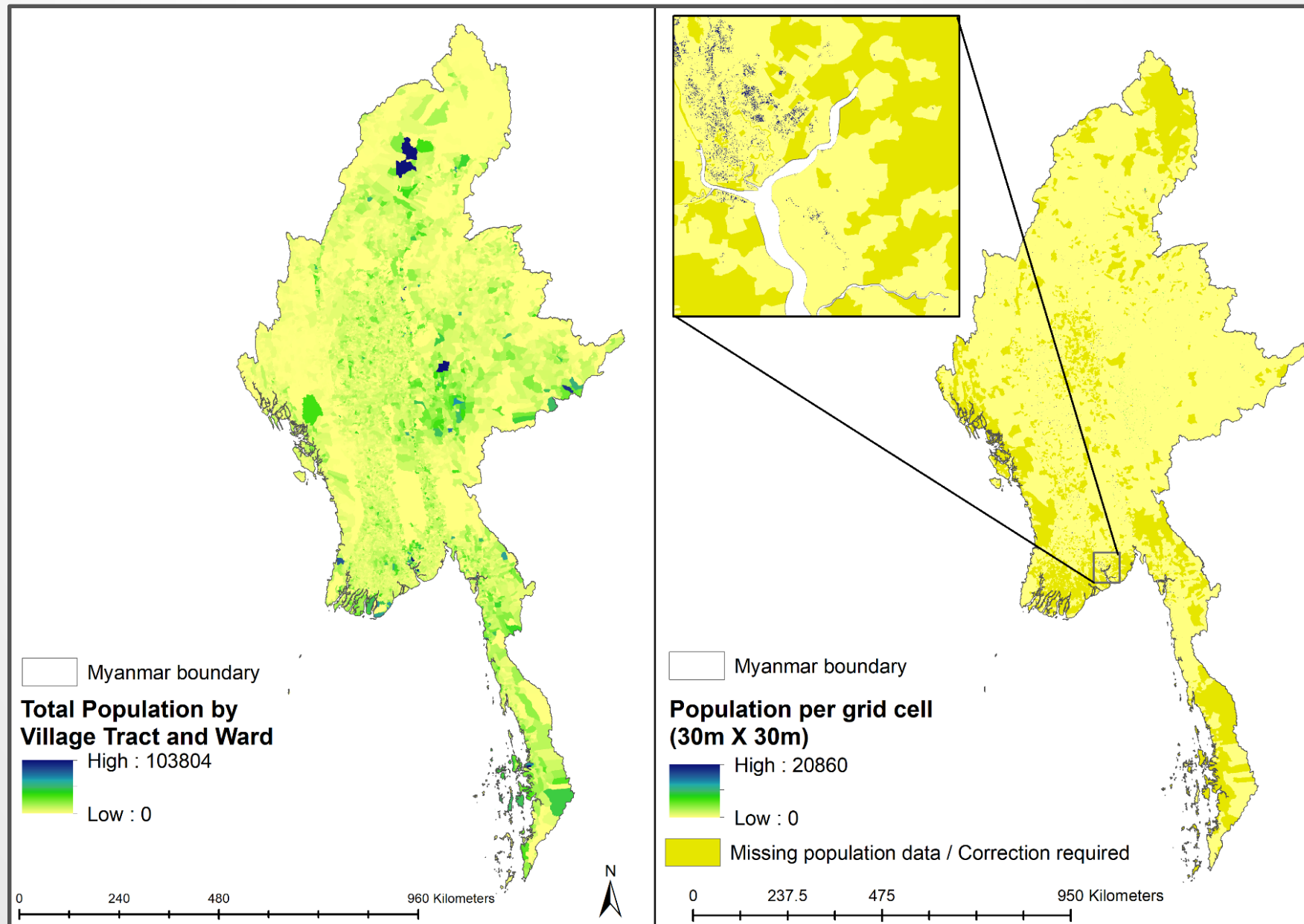
# MALARIA BURDEN POTENTIAL (MBP) NEW



# EXPOSURE: WHERE PEOPLE ARE

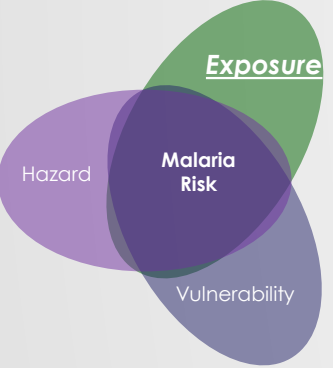


**NEW MODERATE-RESOLUTION  
(30 M) POPULATION  
DISTRIBUTION MAP FOR  
MYANMAR**

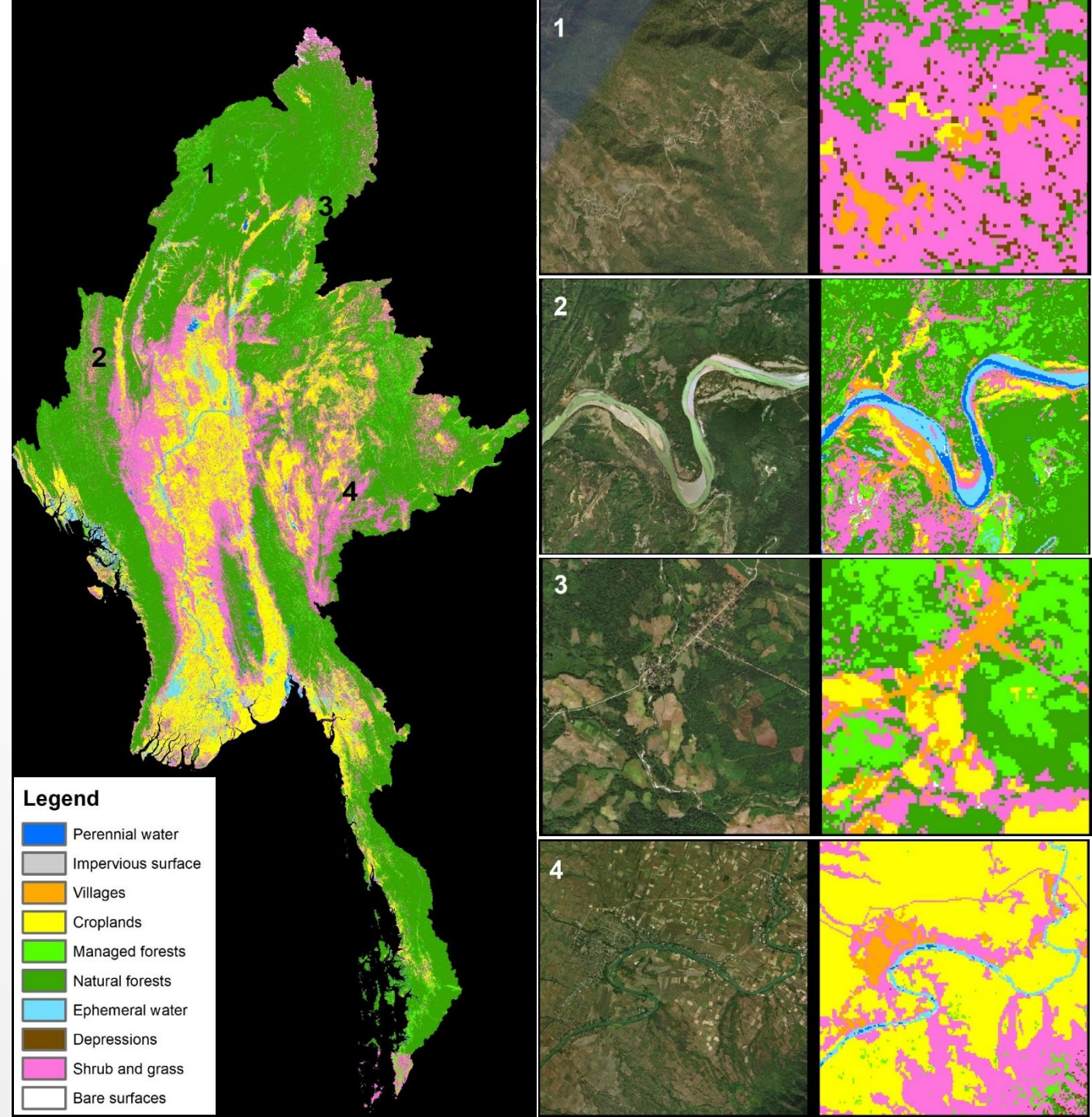




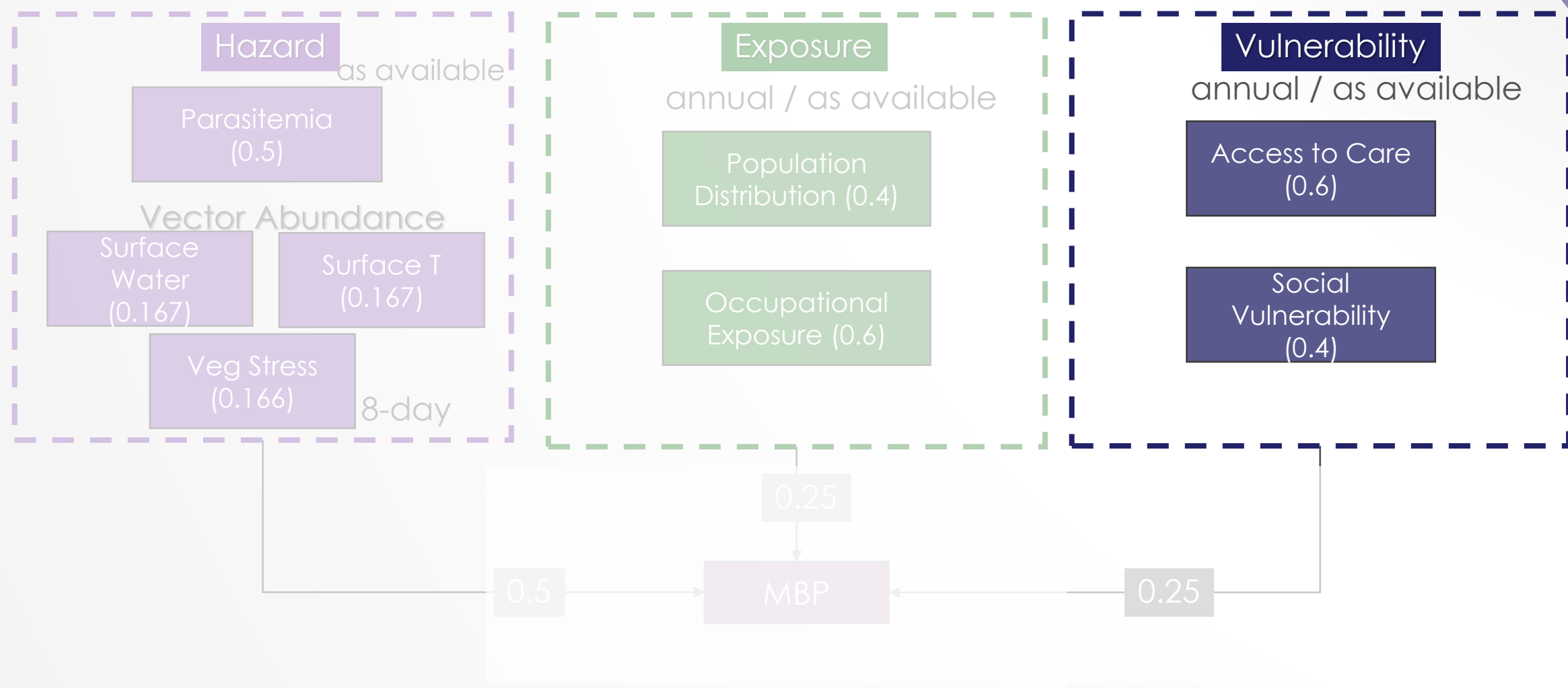
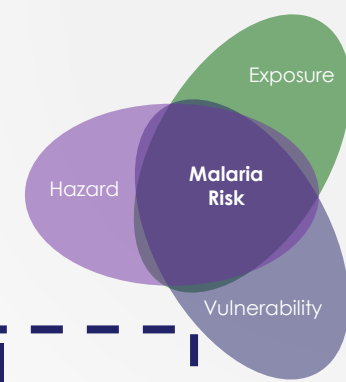
# EXPOSURE: WHAT PEOPLE DO



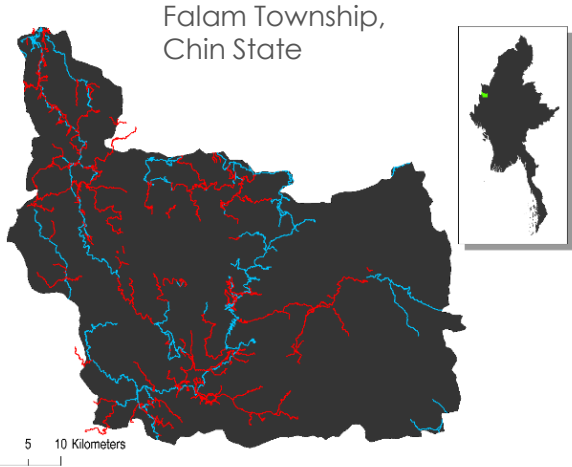
- Plantations/logging
- Mining
- Farming
- Fisheries
- Other forest activities
- Urban lifestyle



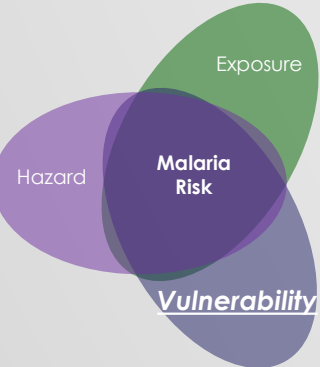
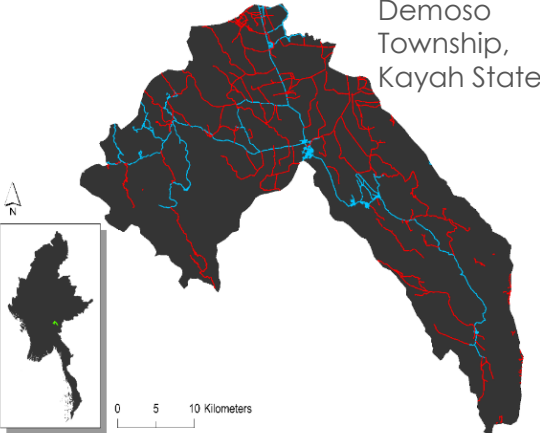
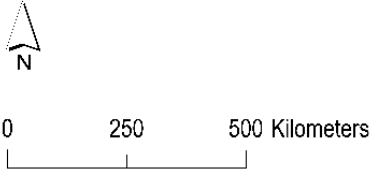
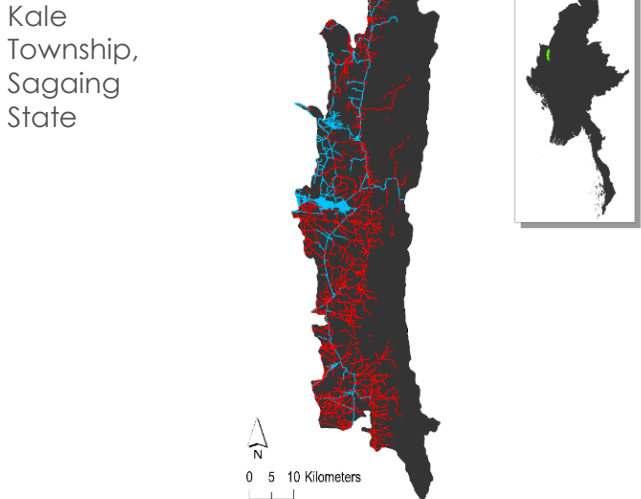
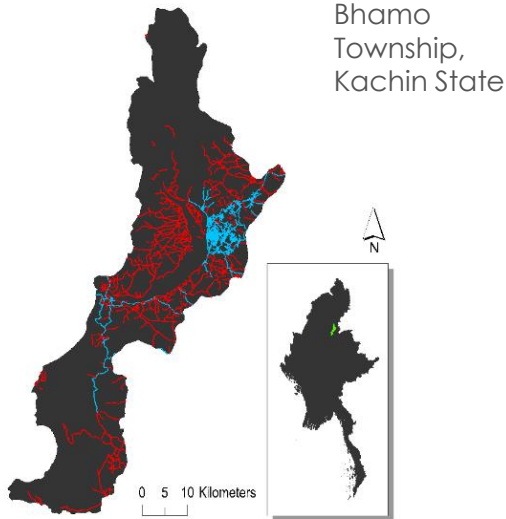
# MALARIA BURDEN POTENTIAL (MBP) NEW



# VULNERABILITY: ACCESS TO CARE

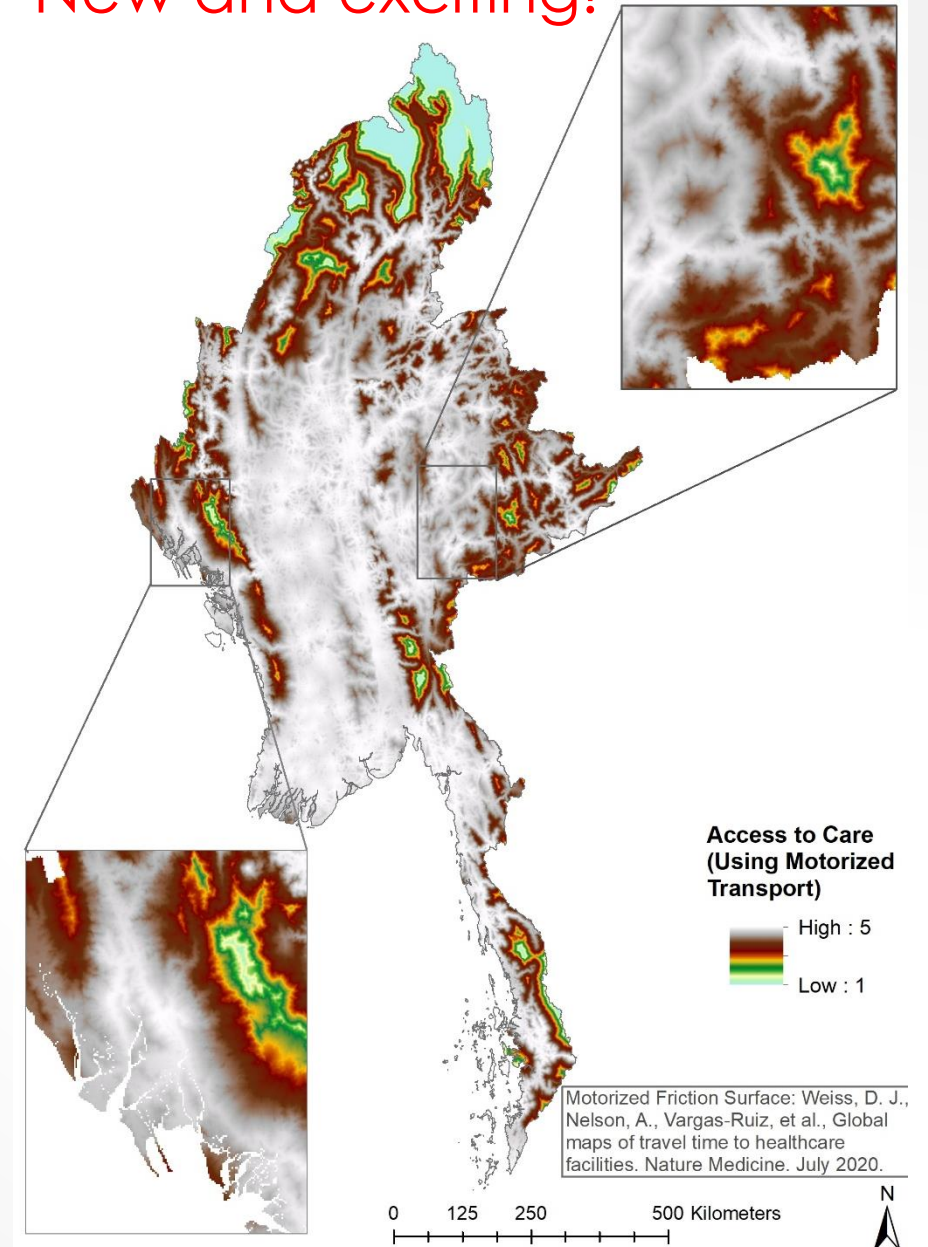
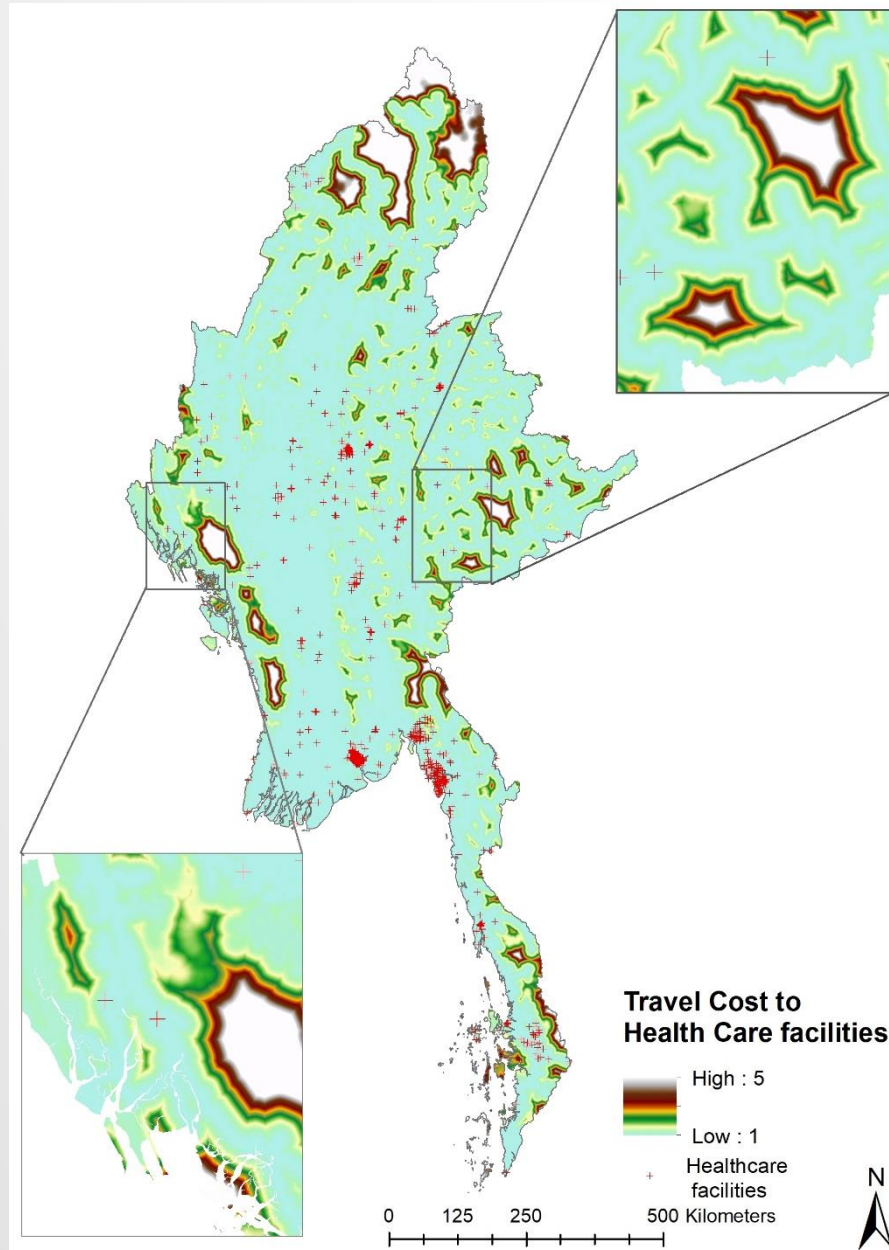
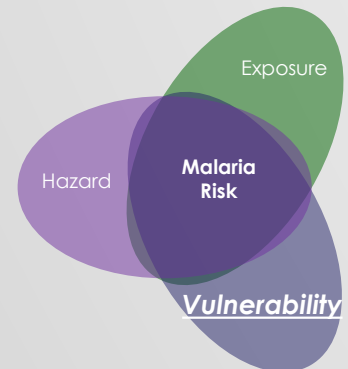


Existing roads  
Current effort

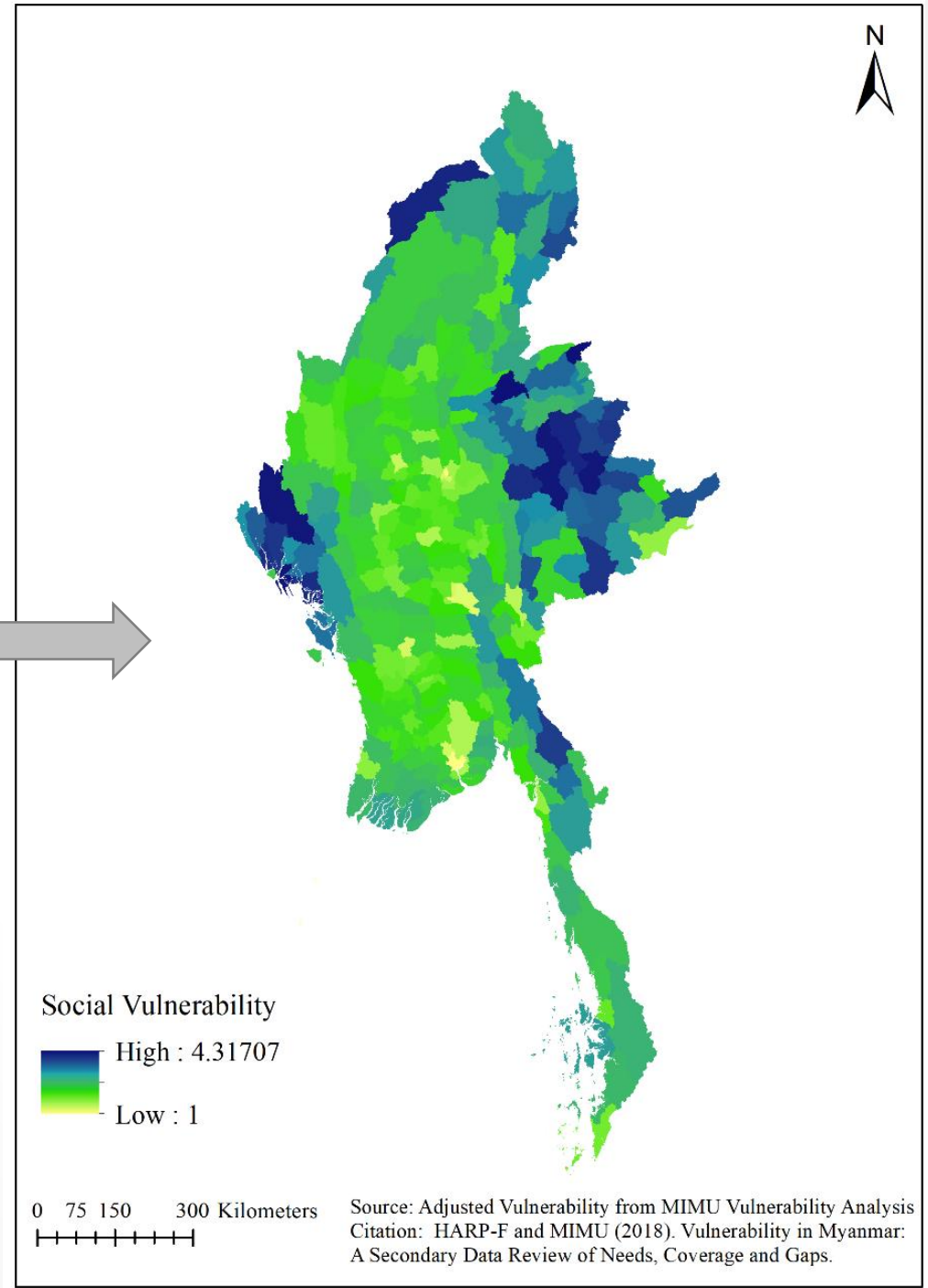
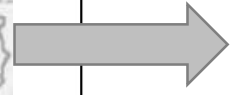
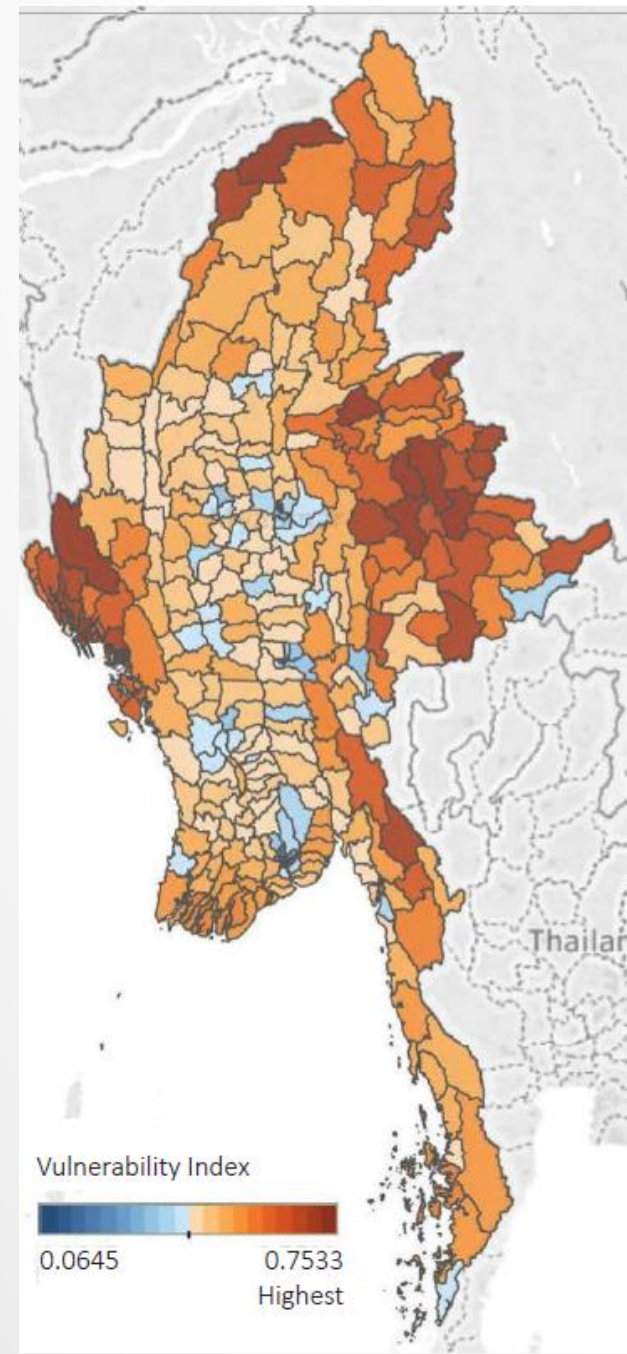
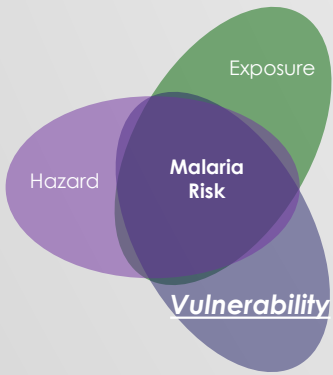
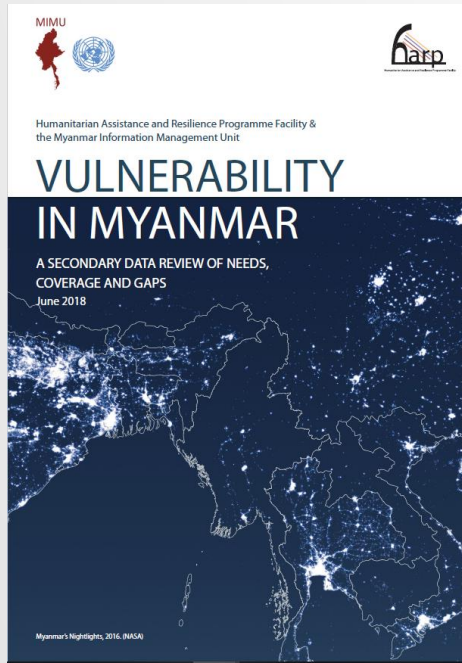


# VULNERABILITY: ACCESS TO CARE

New and exciting!



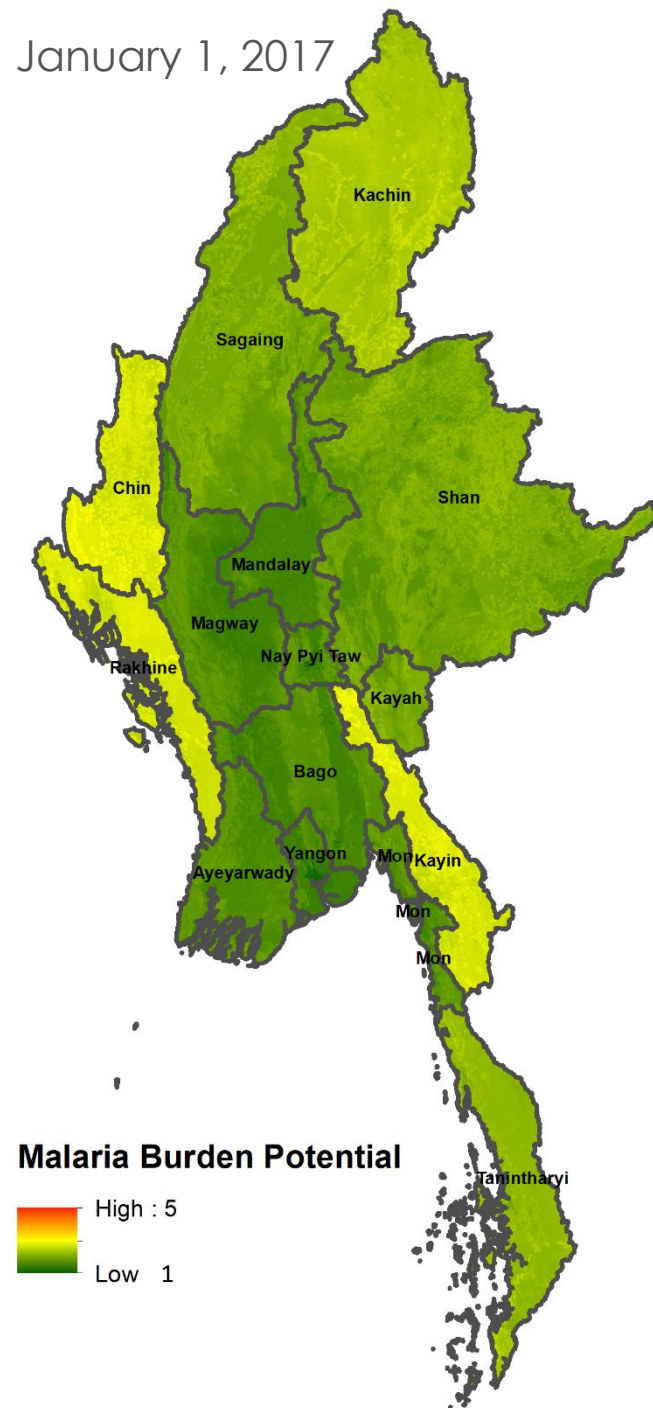
# VULNERABILITY: SOCIO ECONOMIC STATUS



January 1, 2017

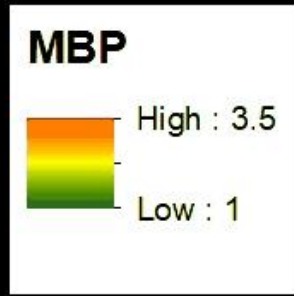
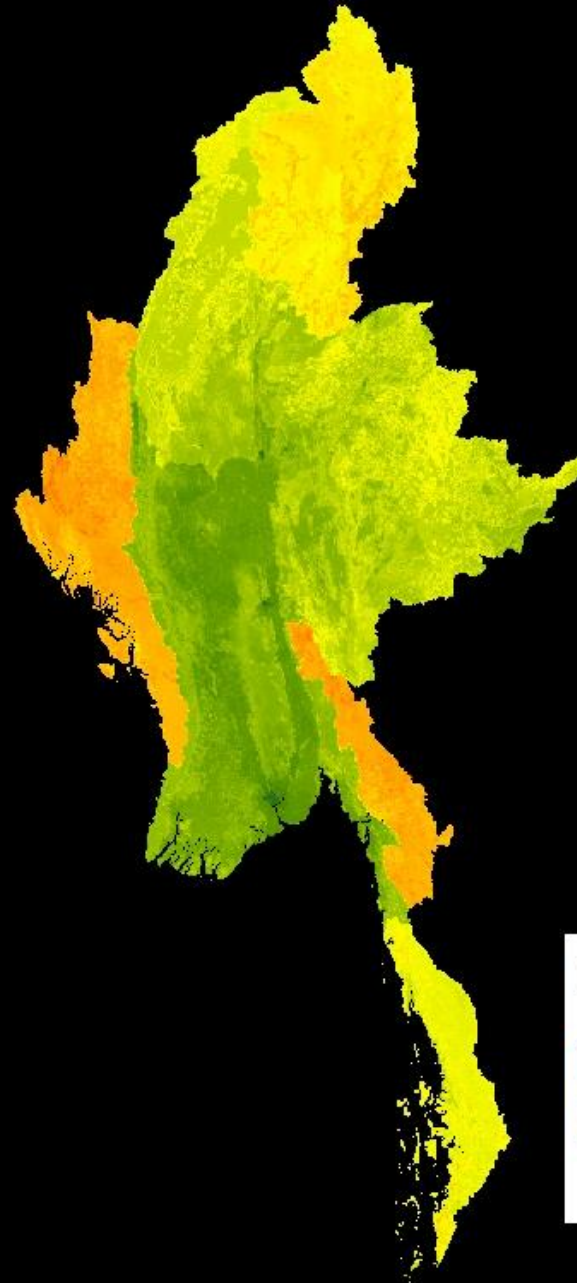
# MYANMAR-WIDE MBP MODEL

- Wall-to-wall model of Malaria Burden Potential
  - 30 m resolution
  - 8-day update
  - 1 – 2 months forecast
- Executed: 2017 and 2018
- In progress: 2014 – 2016, 2019, 2020



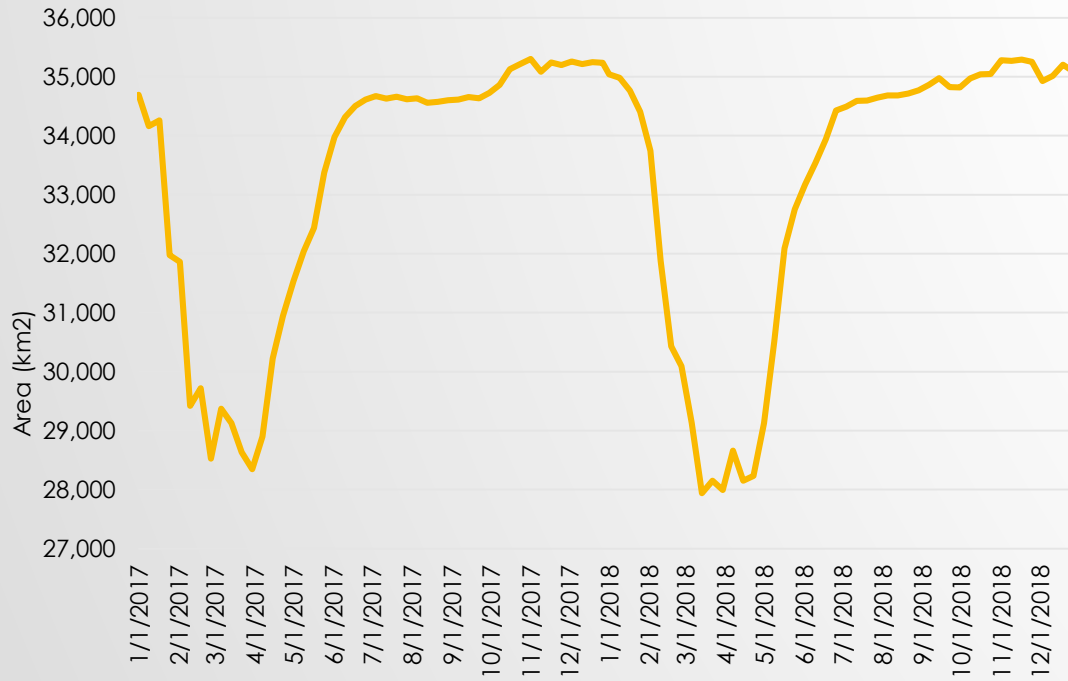
MBP

2017001

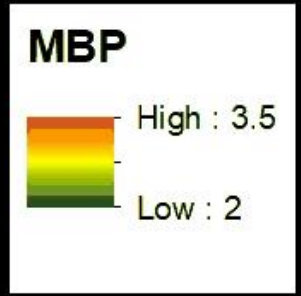
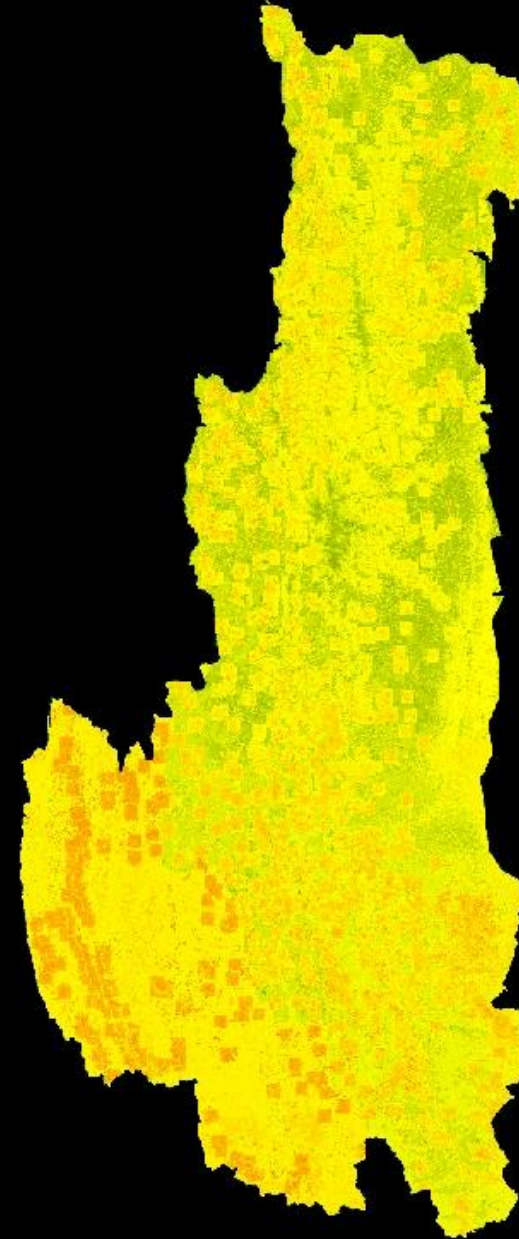


# MBP: HIGH RISK CHIN

Area under "Moderate (2.5 – 3.5)" risk



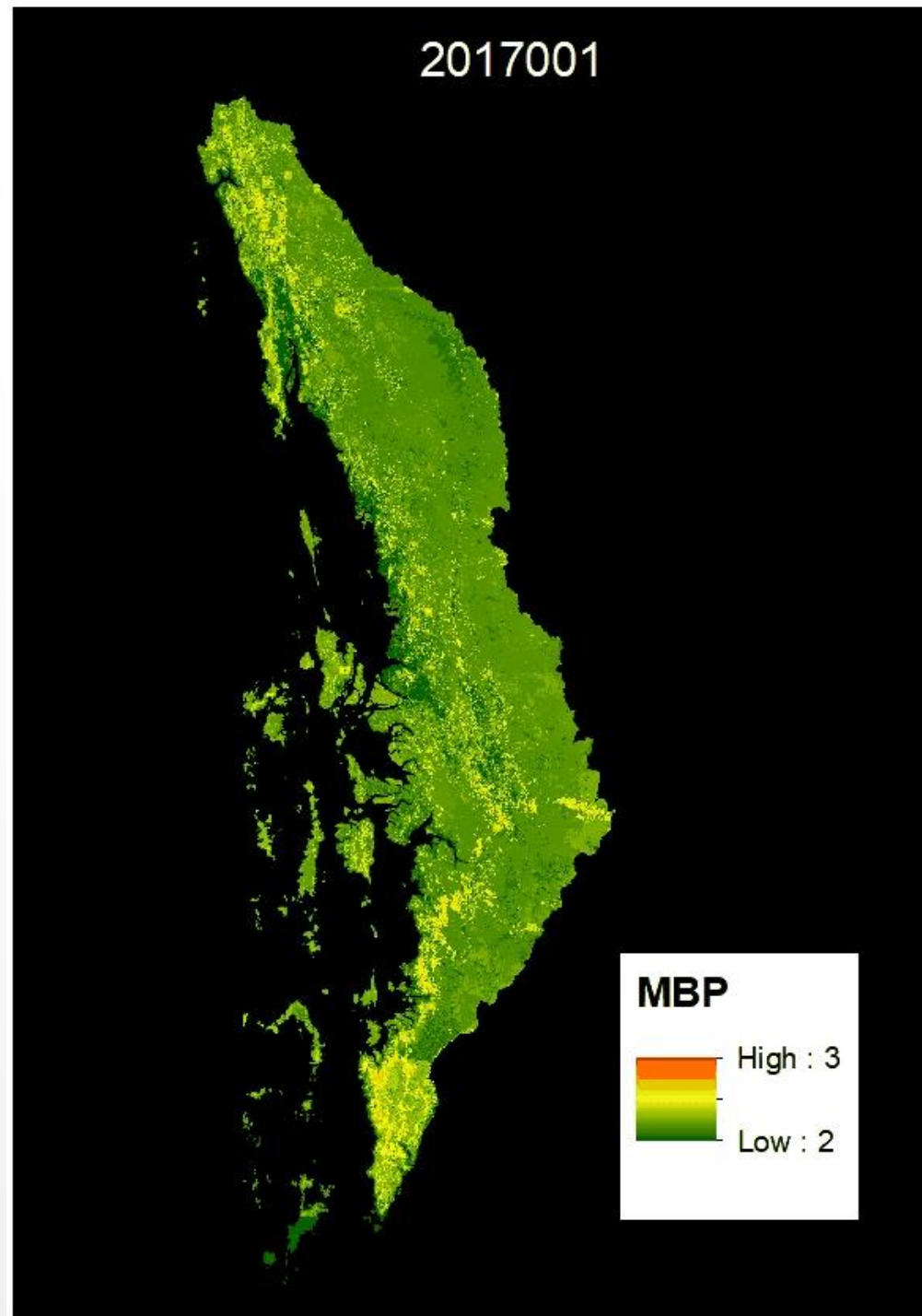
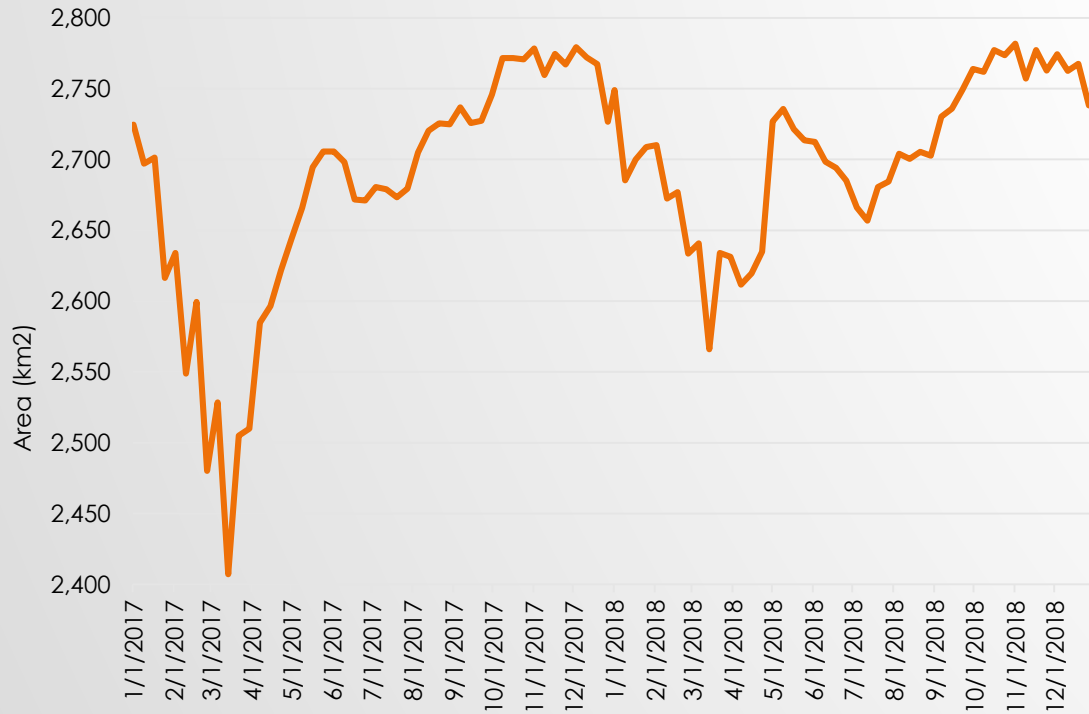
2017001



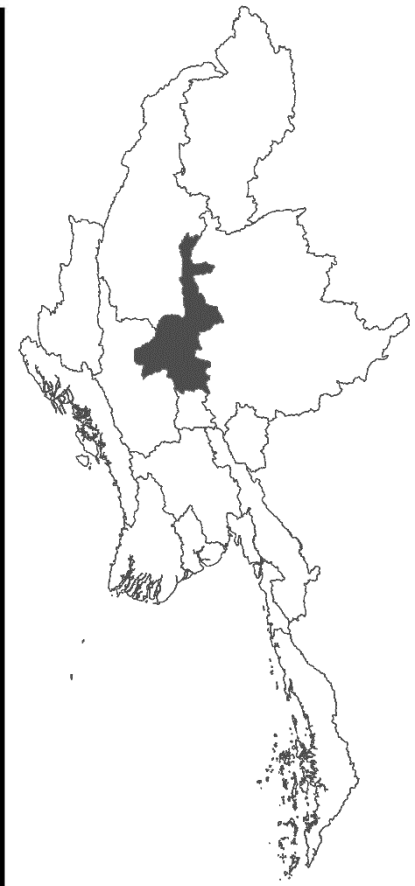
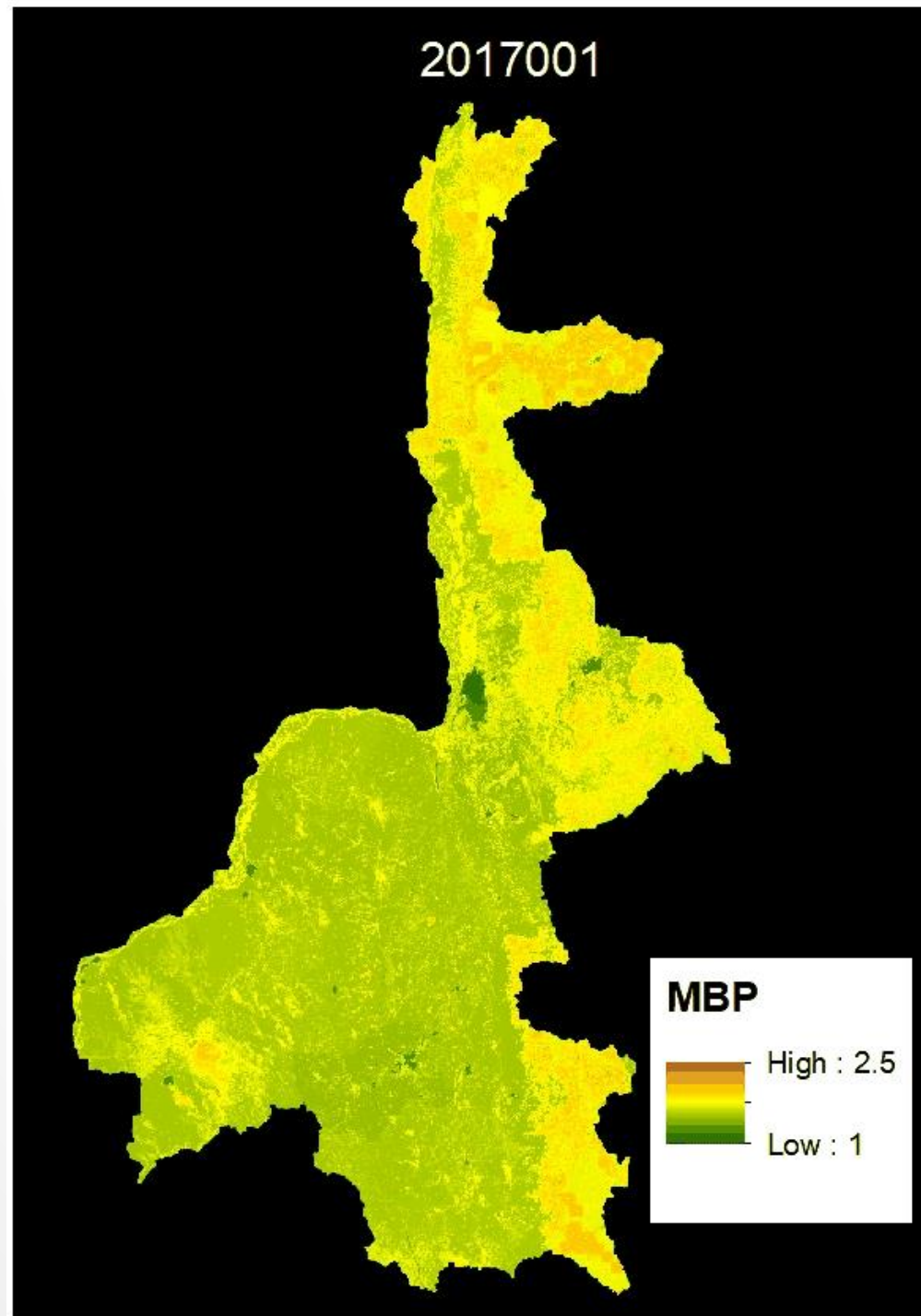
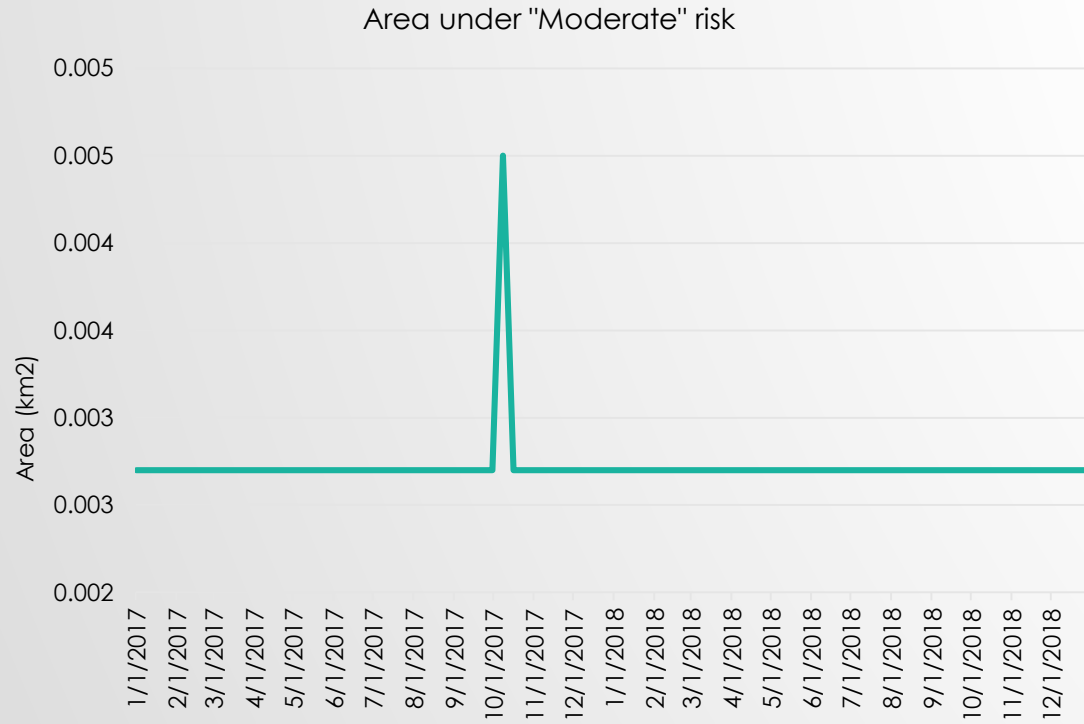


# MBP: MODERATE RISK TANINTHARYI

Area under "Moderate" risk

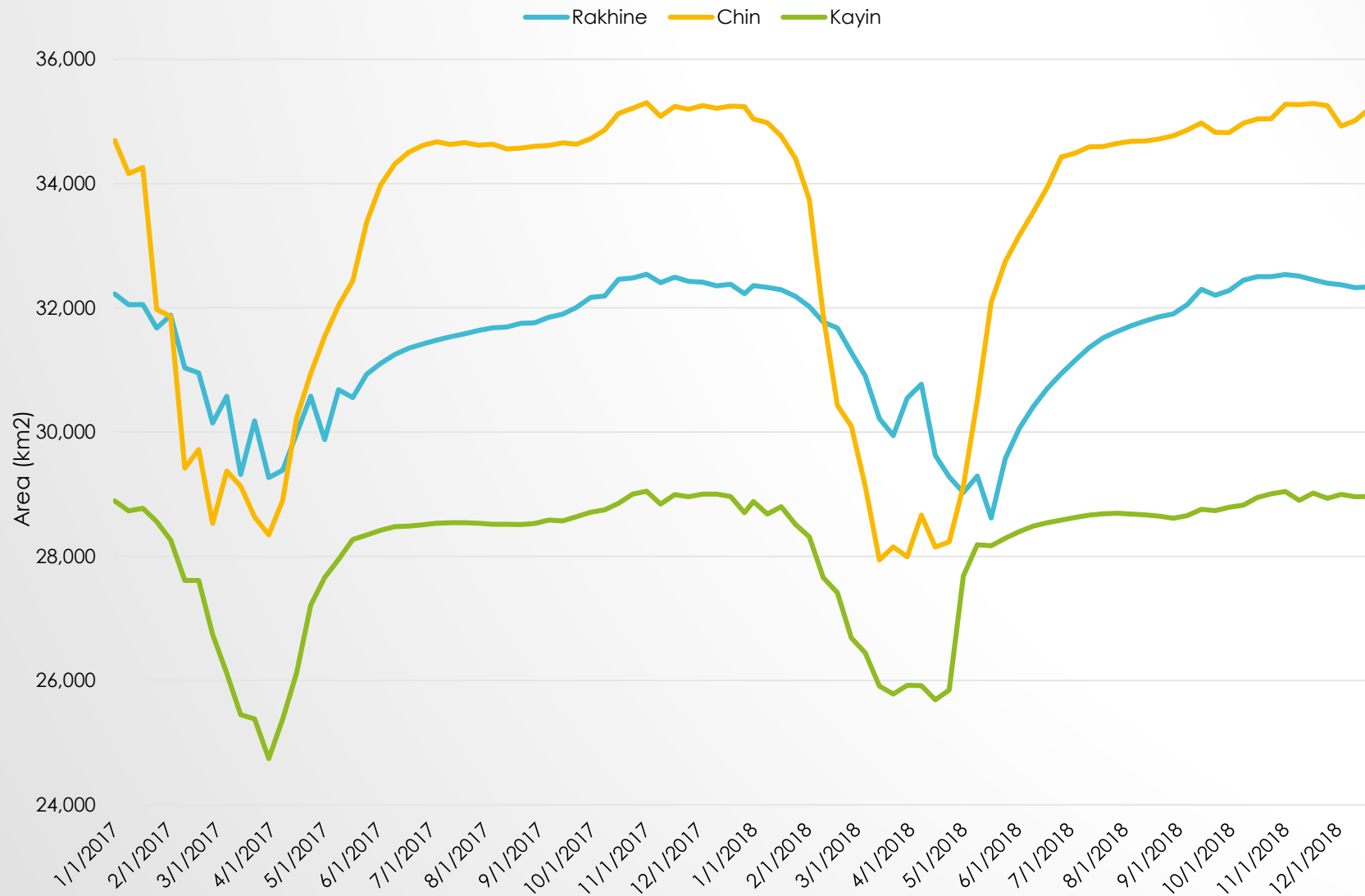


# MBP: LOW RISK MANDALAY



# TEMPORAL TRENDS

Area under "Moderate (2.5-3.5)" risk for 3 most malarious states



QUESTIONS?

