# ADB SECURE WEBMINAR #5

## "STRENGTHENING HEALTH SYSTEM RESILIENCE AGAINST CLIMATE CHANGE IN INDONESIA"

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# STRENGTHENING RESEARCH CAPACITY ON CLIMATE CHANGE AND HEALTH

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# OUTLINE

1. Notes for Indonesian Profile of CC & health – future prediction
2. Notes for vulnerability assessment for disease/s
3. Implication to health resilience or adaptation strategy & program development

# Profile of CC & health in Indonesia – future prediction

Basic & very important but lack of reliable data & evidences:

1. Evidence of CC and health should be based on long-term time series data
2. Disease outcome selected should be derived from analysis using epidemiology analogue and ecologic designs

Identifying disease-related CC (applying environmental epidemiology methods):

- Analogue design of the trends of CC's components to every single disease outcome.
- Ecologic design by time: a). Analyzing the association between CC's components and every single disease outcome using time-series data. b) Calculating prediction for the future trend.

# Methods of Assessing Potential Health Impacts of Climate Change

## Analogue studies

Empirical/statistical:

- *Analogue of a warming trend*. e.g. increased malaria in highland region correlated with a local trend in warming.
- *Analogue of extreme events*. e.g. assessment of the mortality impact of a heatwave.
- *Description of basic or recurrent climate/health relationships.* e.g. interannual variation in malaria correlated with minimum seasonal temperature using time series data.

## Predictive models

1. Empirical-statistical models:

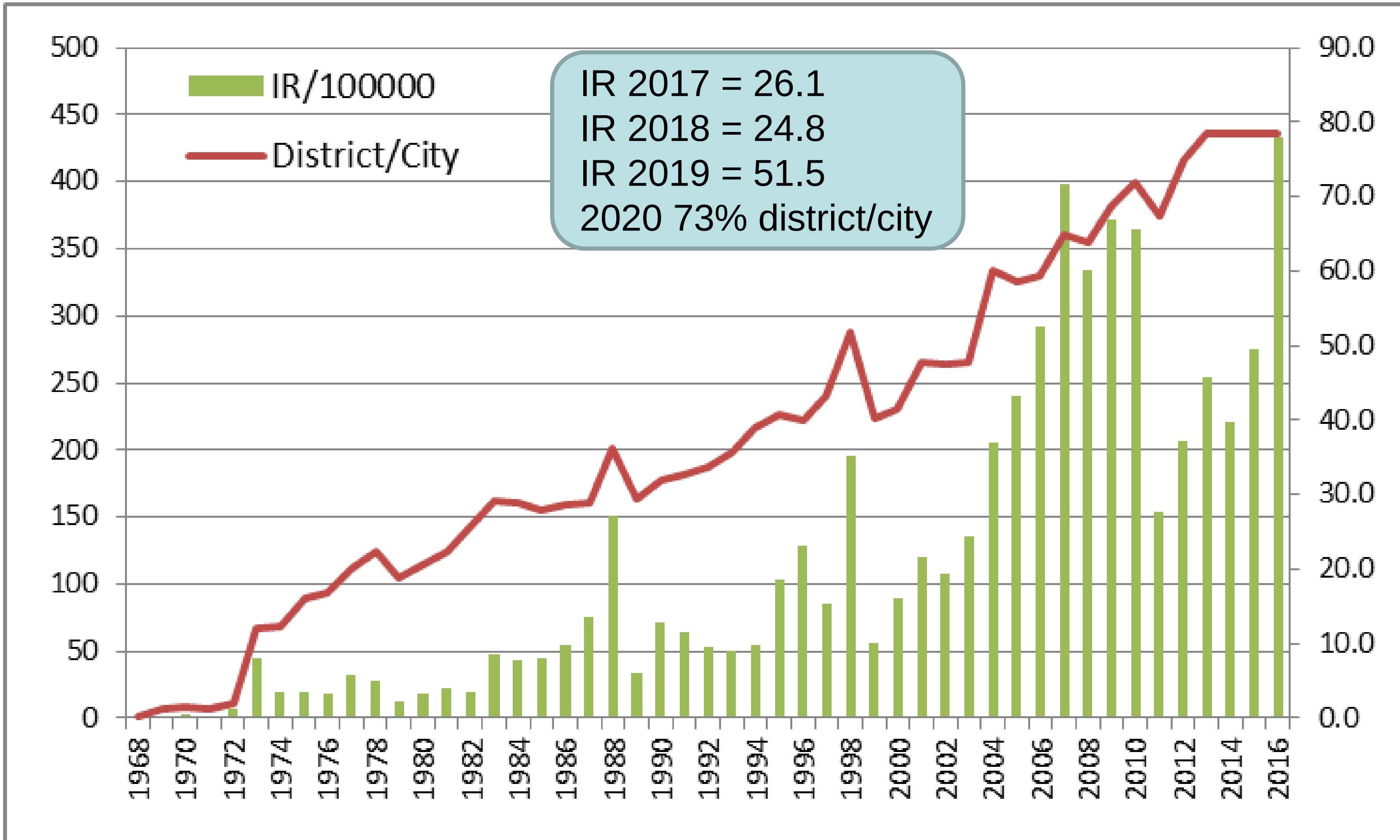
- *Extrapolation of simple climate/disease relationship using univariate* regression, e.g. daily temperature and mortality.
- *Extrapolation of climate/vector/disease relationship using mapping and statistical methods for use with spatially correlated data*. e.g. mapping tick abundance with climate and other variables.

## 2. Process-based or biological models:

- *Models derived from accepted theory can be applied universally.* e.g. forecasting changes in areas suitable for vector-borne disease transmission using a vectorial capacity model.
- Integrated assessment models *Multidisciplinary process-based and/or empirical-statistical models linked together horizontally or vertically.* e.g. impact of climate change on food supply and risk of hunger.

*Source: McMichael and Kovats, 2000a*

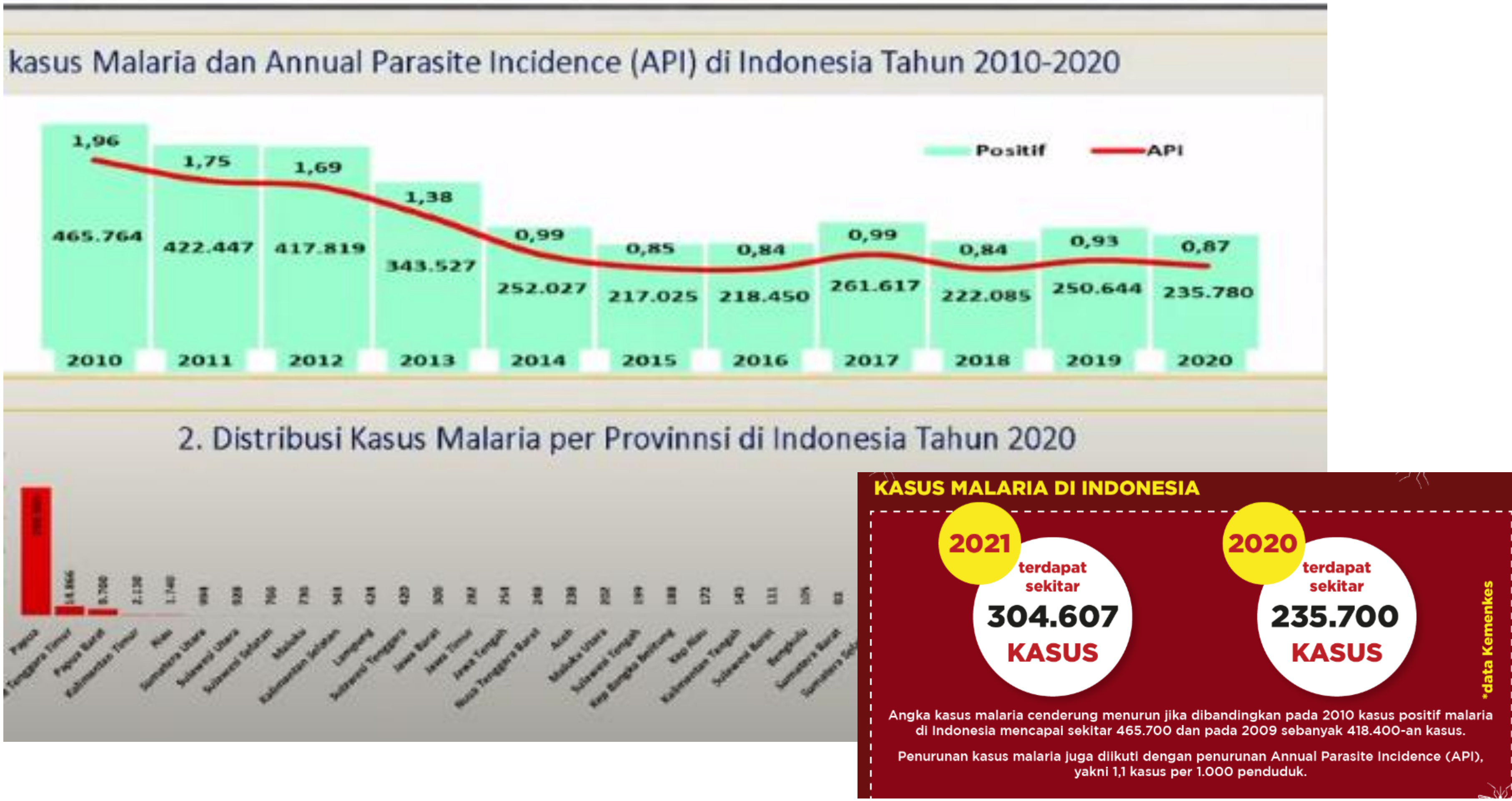
# Indonesia DHF's Incidence Rate per 100,000 population by district/city



# Effects of Temperature Rise on Dengue Transmission

- Shorten breeding cycle of mosquito
- Shorten viral incubation period in mosquito
- Increase frequency of mosquito feeding
- More efficient transmission of dengue virus from mosquito to human

# Trend of Malaria cases in Indonesia decreasing?




## **Malaria Elimination Target 2030 for Indonesia**

# Regression Model of Air Quality Concentrations and Related Diseases in Bandung, Palembang, and Jakarta 2014-2020

| Cities | Parameters ($mg/M_3$) | Diseases | Regression | | p-value | Regression Line equation |
|---|---|---|---|---|---|---|
| | | | r | $R^2$ | | |
| Bandung | $PM_{2.5}$<br>$SO_2$ | Pneumonia | 0.23<br>0.23 | 0.06<br>0.05 | 0.06<br>0.38 | Pneumonia = 742.3 - 4.3*$PM_{2.5}$<br>Pneumonia = 518.1 - 1.7*$SO_2$ |
| | $PM_{2.5}$<br>$SO_2$ | Bronchopneumonia | 0,26<br>0.19 | 0.07<br>0.04 | 0.04<br>0.47 | Bronchopneumonia = 1853.5 - 12*$PM_{2.5}$<br>Bronchopneumonia = 1197.2 - 5.3*$SO_2$ |
| | $PM_{2.5}$ | Asthma | 0.05 | 0.002 | 0.98 | Asthma = 2433.7 - 4.4*$PM_{2.5}$ |
| | $PM_{10}$ | ARI | 0.22 | 0.05 | 0.40 | ARI = 670.4 + 16.2*$PM_{10}$ |
| Palembang | $PM_{2.5}$<br>$SO_2$ | Pneumonia | 0.44<br>0.17 | 0.20<br>0.03 | 0.0001<br>0.29 | Pneumonia = 334.7 + 0.7*$PM_{2.5}$<br>Pneumonia = 332.9 + 0.03*$SO_2$ |
| | $PM_{10}$ | ARI | 0.44 | 0.19 | 0.0001 | ARI = 4401.3 + 11.3*$PM_{10}$ |
| Jakarta | $PM_{2.5}$<br>$SO_2$ | Pneumonia | 0.64<br>0.47 | 0.41<br>0.22 | 0.0001<br>0.0001 | Pneumonia = 4060.2 - 22.3*$PM_{2.5}$<br>Pneumonia = -477.5 + 90.5*$SO_2$ |
| | $PM_{10}$ | ARI | 0.32 | 0.10 | 0.03 | ARI = 20913.2 - 172.9*$PM_{10}$ |

# Air pollution-related diseases in Jakarta 2016-2021

- An increase per 10 $\mu g/m^3$ $PM_{2.5}$ was associated with a 5.7% increase of Pneumonia cases
- An increase per 10 $\mu g/m^3$ $SO_2$ was associated with a 6.7% increase of Pneumonia cases
- An increase per 10 $\mu g/m^3$ $PM_{10}$ was associated with a 1.4% increase of Acute Respiratory Infection cases

# Potential considerations in assessing impacts of health due to change of climate/weather:

- most diseases have multiple causes, and socio-economic factors are particularly important as they determine adverse environmental exposures;
- the great diversity in the types of disease: acute and chronic; infectious and non-infectious; physical injury and mental health disorders;
- the many uncertainties regarding the biological and physical processes by which climate or weather affects health;
- the long-term nature of the changes involved; and
- most epidemiological studies have been done on a local basis, and therefore application on a wider scale is difficult.

Source: WHO, 2000

# Vulnerability Assessment for Health Adaptation

**General vulnerability vs specific natural pathway of every single disease:**

1. Calculating vulnerability by place of CC for every single of disease outcome: a) Generating appropriate variables for: Exposure, Sensitivity, and Adapting Capacity. b) Defining scoring for each variable involved. c) Calculating vulnerability coping range index.
2. Mapping the area under study based on the findings of vulnerability index calculation.

# GENERAL VULNERABILITY

$$V = f(E \times S)/AC$$

E: Exposure, described as a physical aspect of vulnerability. Physical aspects of impacts due to climate change, such as level of population density, level of isolation of a settlement area and location, design, and the availability of material for important infrastructure construction (*Affeltranger, et al.*2006).

S: Sensitivity is defined as a potential level of ability to response to a kind of climate change condition, such as the spread of malfunction, structure and composition within an ecosystem (UNEP and WMO, 1996)

AC: Adaptation capacity is referred to as the potential capability of a system to adapt to an impact or influence due to climate change. AC is very much influenced by the vulnerability of the population/area impacted by hazards of climate change (Bohle *et al.*, 1994; Downing *et al.*, 1999; Kelly and Adger, 1999; Mileti, 1999; Kates, 2000).

# VULNERABILITY HEALTH'S VARIABLES FOR DHF

**Exposure:**

1. Land use: settlement, offices, business, schools, etc.
2. Population density
3. Climate components: temperature, precipitation, humidity, wind direction & velocity

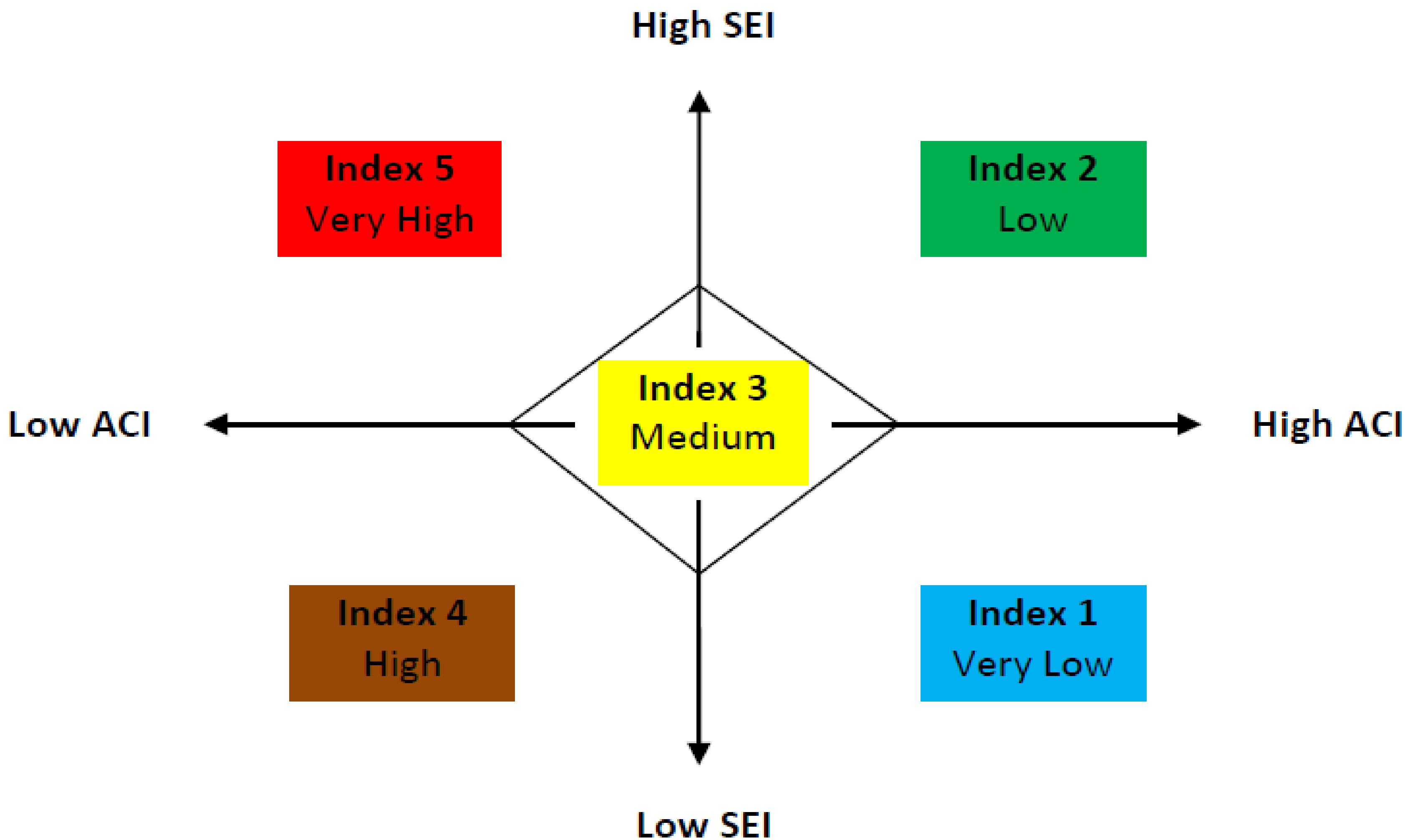
**Sensitivity:**

1. Breeding places and resting areas of Aedes mosquitos
2. Pupa and adult density
3. Incidence of DHF by sex, age, occupation, education address, etc.
4. Specific population mobility

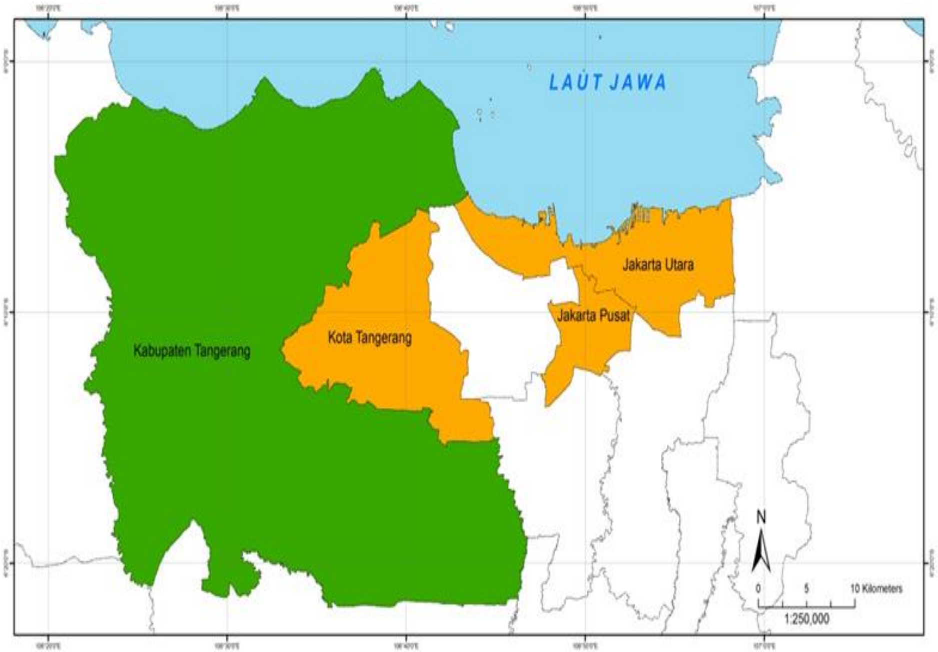
**Adaptive capacity:**

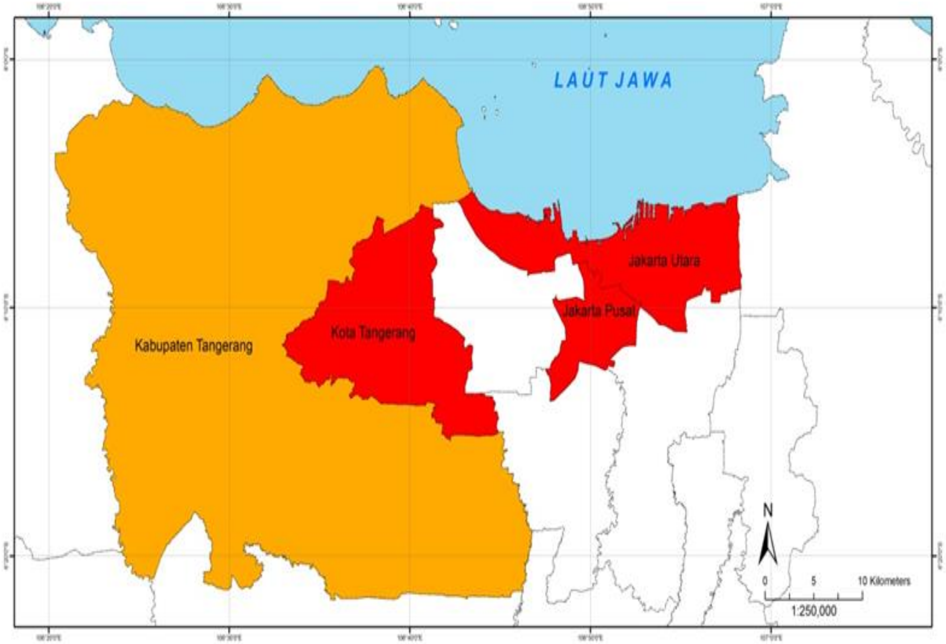
1. Availability of health services: hospitals, clinics, public health centers
2. Treatment management and skilled providers
3. Program implementation of DHF prevention
4. Community participation and involvement on DHF prevention program
5. Personal protection behavior

# VULNERABILITY COPING RANGE INDEX

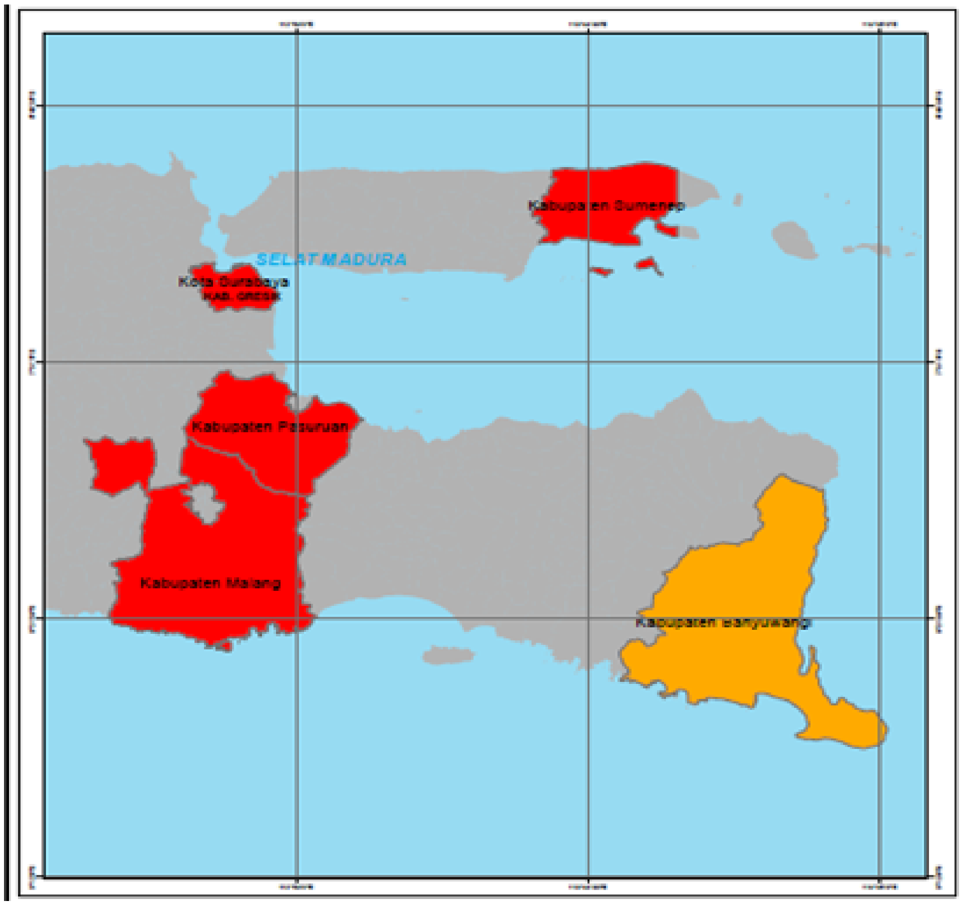


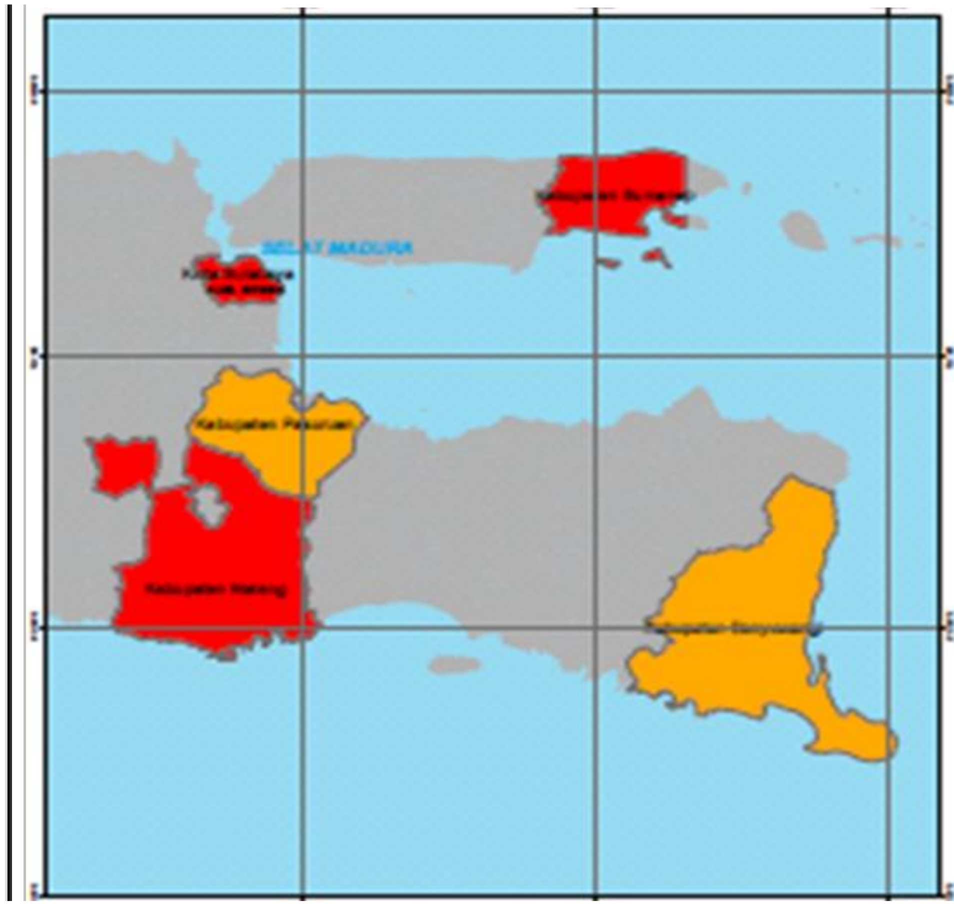
# Map of Coping Range Index of population vulnerability to DHF in Jakarta and Banten in 2011 and 2012



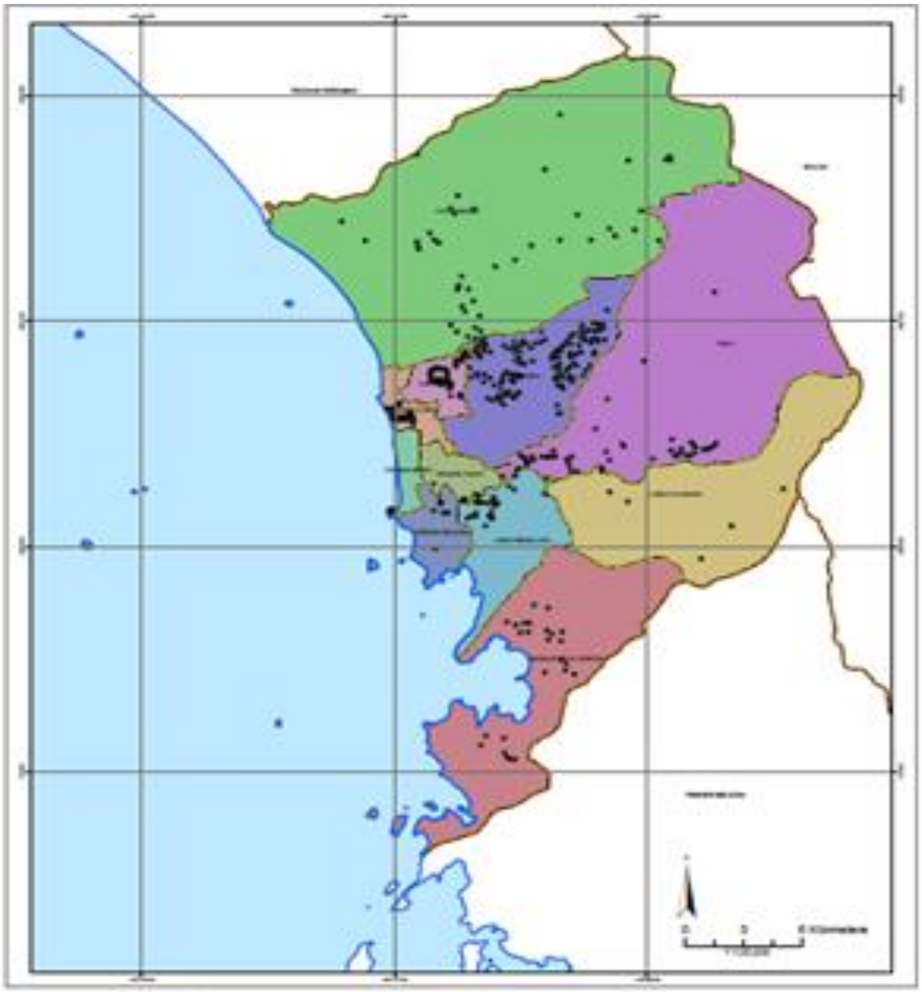



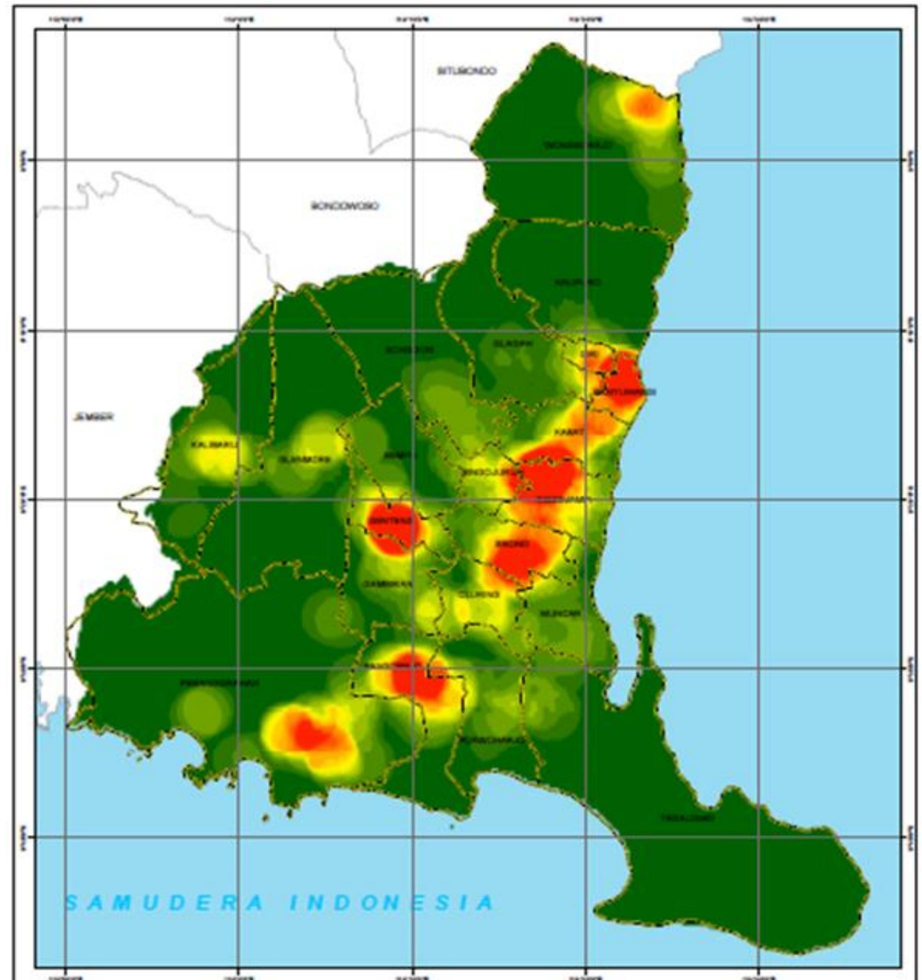
# Map of Coping Range Index of population vulnerability to DHF in East Java in 2011 and 2012



# Distribution of DHF cases in Padang and buffering risk area (200 M radius) in Banyuwangi 2006-2010





# Implication to health resilience or adaptation strategy & program development

- Identifying the existing control program of every single disease. Analyzing BAU of control program and the trend of disease outcome.
- Finding & analyzing the gap
- Develop program ideas: evaluating & revitalizing program, etc.

# CONCLUSION

1. Profile of CC & Health in Indonesia should be based on studies/evidences
2. Vulnerability assessment to health caused by CC should be generated for every single disease outcome
3. Research designs appropriate for CC & health are analogue, ecologic time trend, vulnerability by place for every single disease, and mapping for potential risk factors
4. Involving environmental epidemiologist & public health background by training & experienced would be beneficial for better & robust scientific approach

# THANK YOU

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