

Climate change, water resource development and malaria in Ethiopia

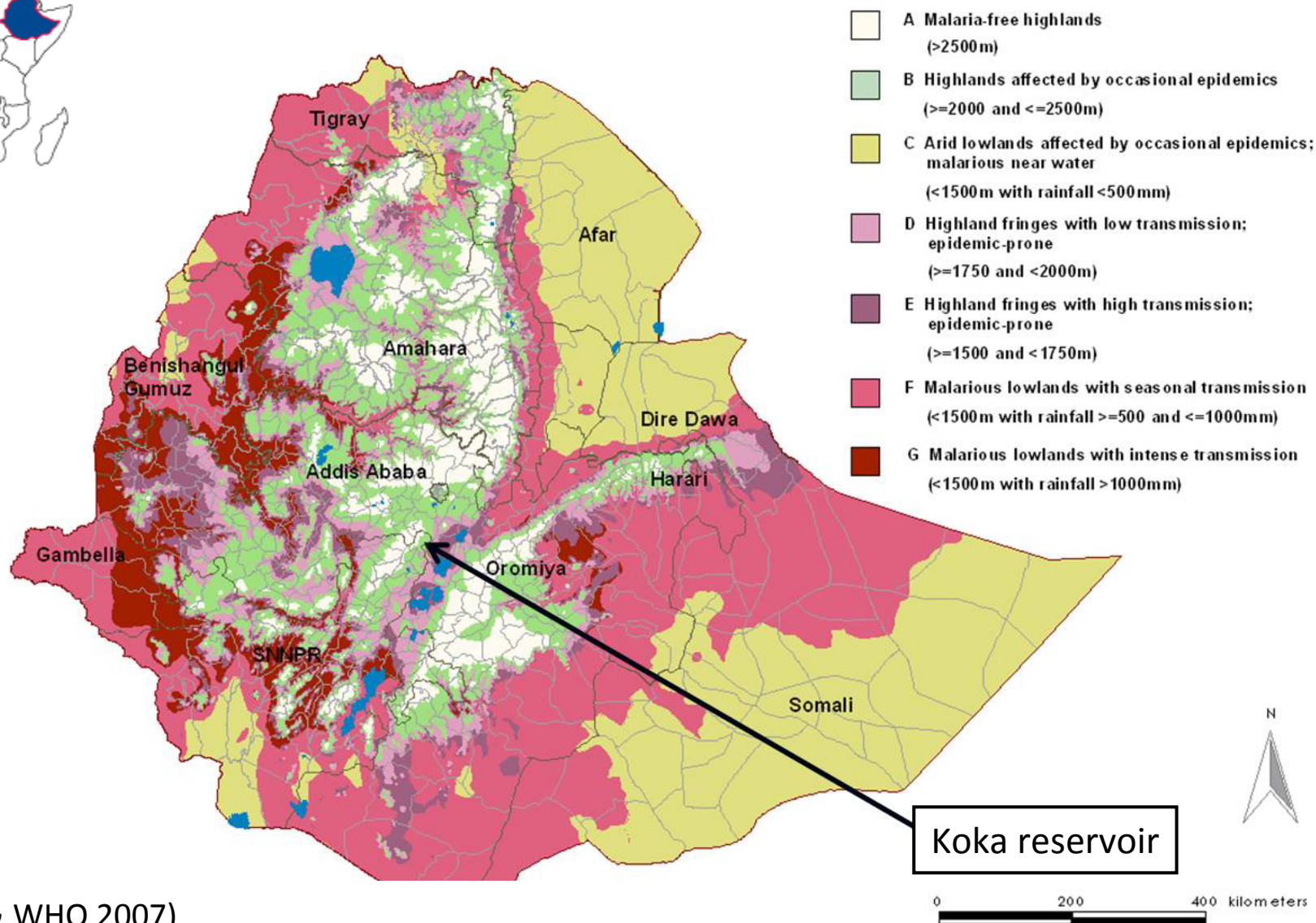
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Mekonnen Yohannes, Fitsum Hagos,
Jonathan Lautze, Solomon Kibret

Key message

**Climate change necessitates water storage,
which may increase health risks
that can be mitigated**



Malaria in Ethiopia as example



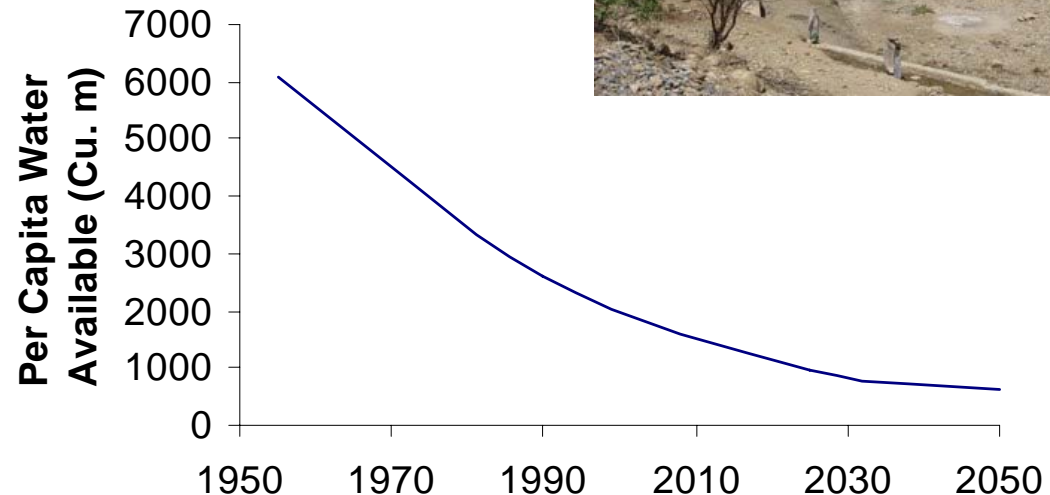
(Source: MoH & WHO 2007)

Impacts of climate change

- Increased variability of rain
- Reduced availability of water
- Reduced water & food security
- Need for water resources development
- Water storage has a role to play in adaptation to climate change
- Impacts on mosquitoes, parasites, transmission cycle

Water resources development in Ethiopia

- Per capita water availability declining
- Water Sector Development Program 2002-2016
- River diversion / irrigation systems
- Rainwater harvesting ponds
- Large multipurpose dams
- Small reservoirs
- DWSS



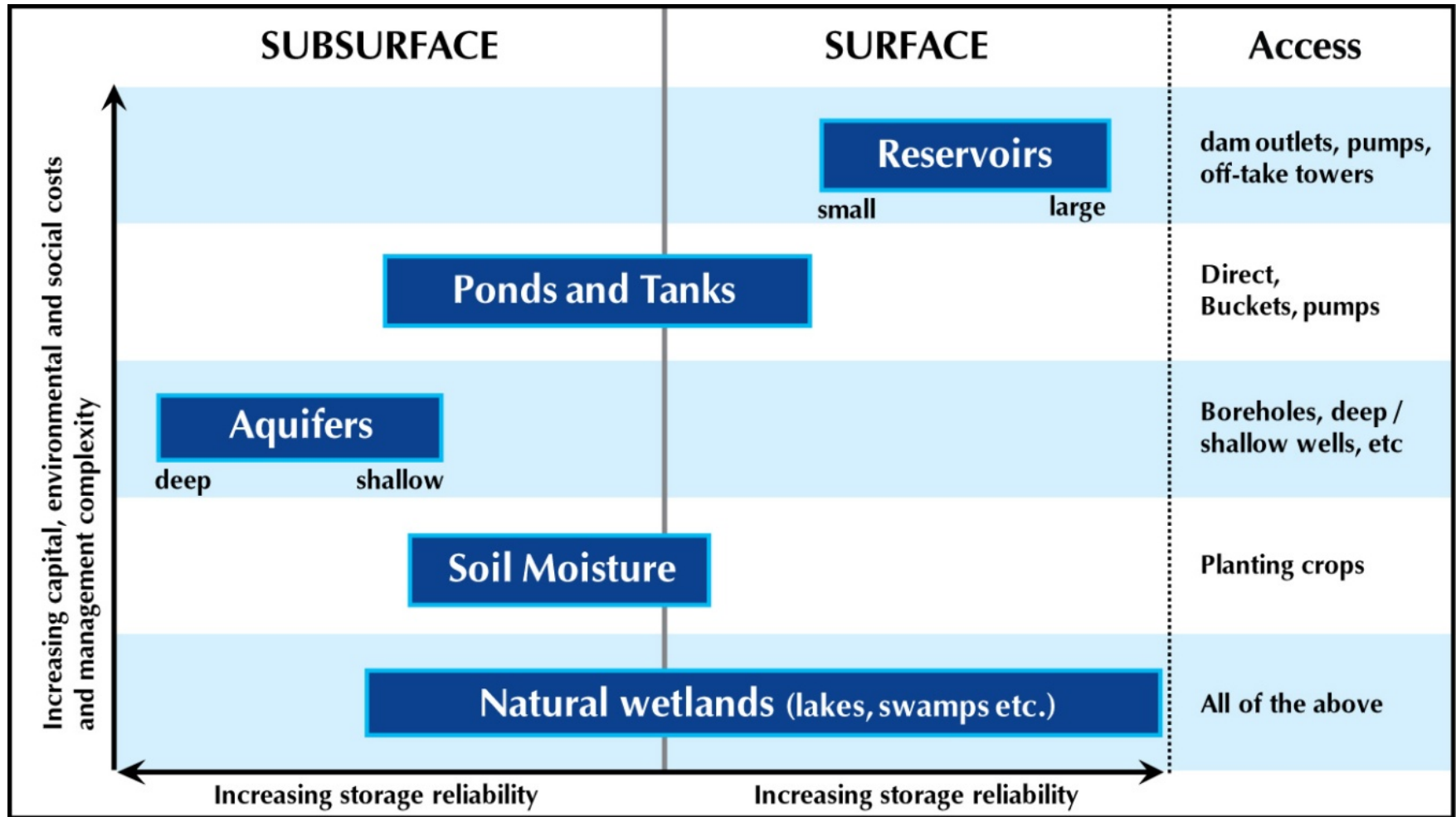
(Source: Awulachew et al. 2005)

Water storage

- Focus on water for agriculture, incl. livestock
- Integrated into most water systems
- Save water over time for access at critical periods
- Diverted from rivers, rainwater harvesting, aquifers
- High variety
 - Tanks, reservoirs
 - Groundwater
 - Large / small
 - Open / closed
 - Man-made / natural

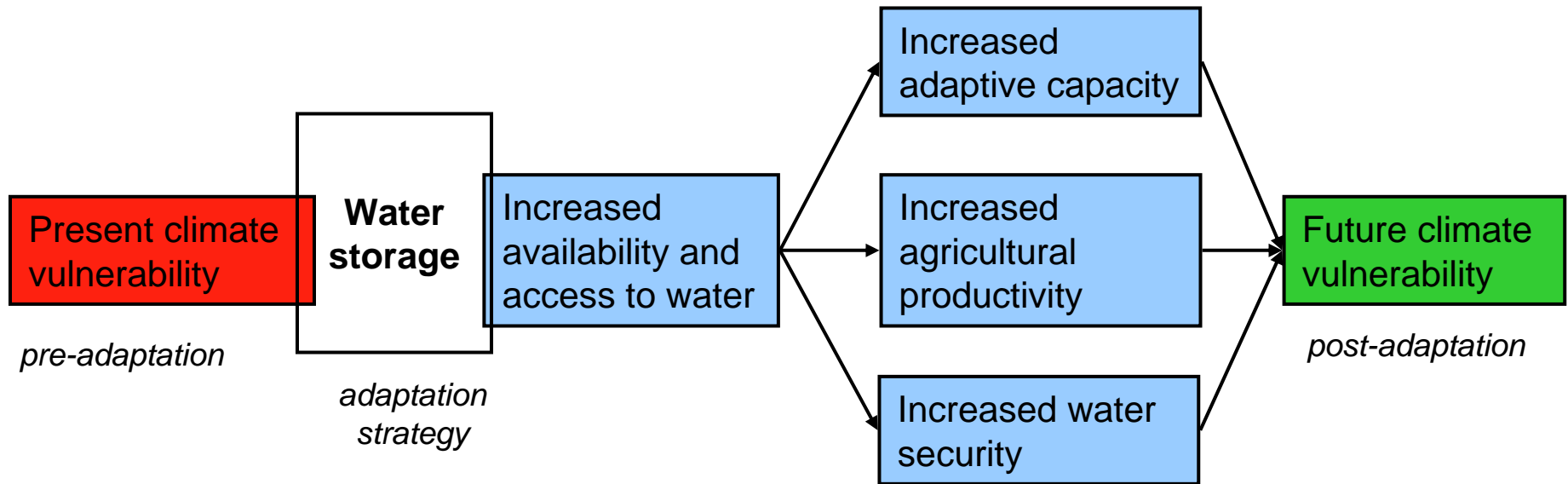


Water storage continuum



(Source: McCartney & Smakhtin 2010)

Reduced climate vulnerability



Future climate vulnerability < present climate vulnerability

(Source: McCartney & Smakhtin 2010)

Health risks of open water

- Expanded water surface for longer periods
- Drowning, water quality, vector-borne diseases
- Increased malaria transmission associated with
 - Small reservoirs < 100
 - Surface irrigation (estates & small-scale)
 - Rainwater harvesting ponds > 100,000
 - Increasingly higher altitudes
- Current control strategies insufficient
 - Bednets, house spraying
 - Shift in biting rhythm
 - Foreign currency, resistance

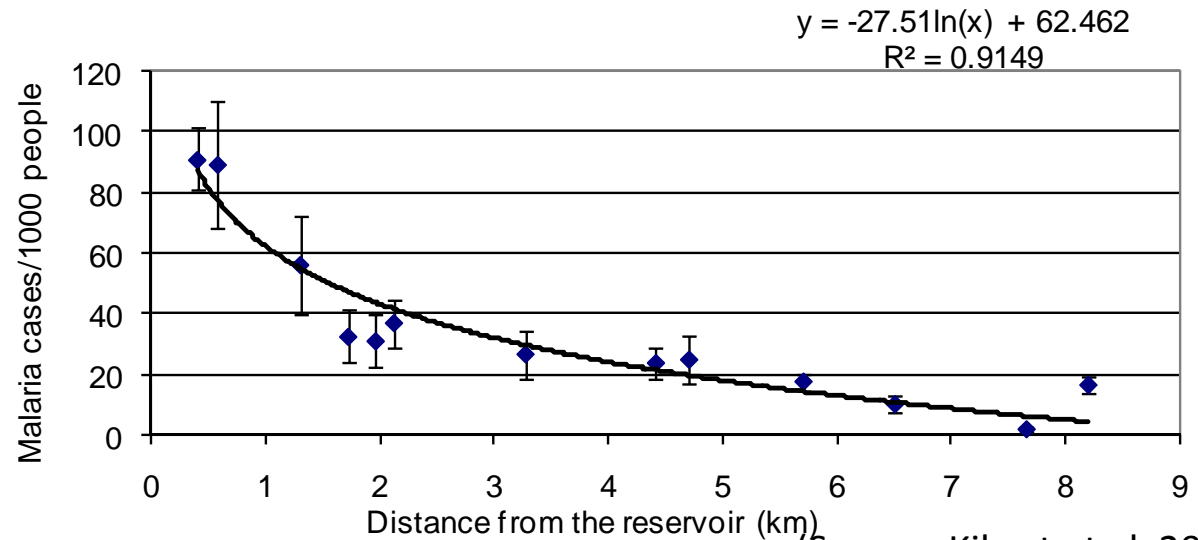
Malaria at Koka Lake, Rift Valley

- Increased transmission near lake
- Decision support for dam operation
- Potential for larval control by dam operation (water level fluctuation)

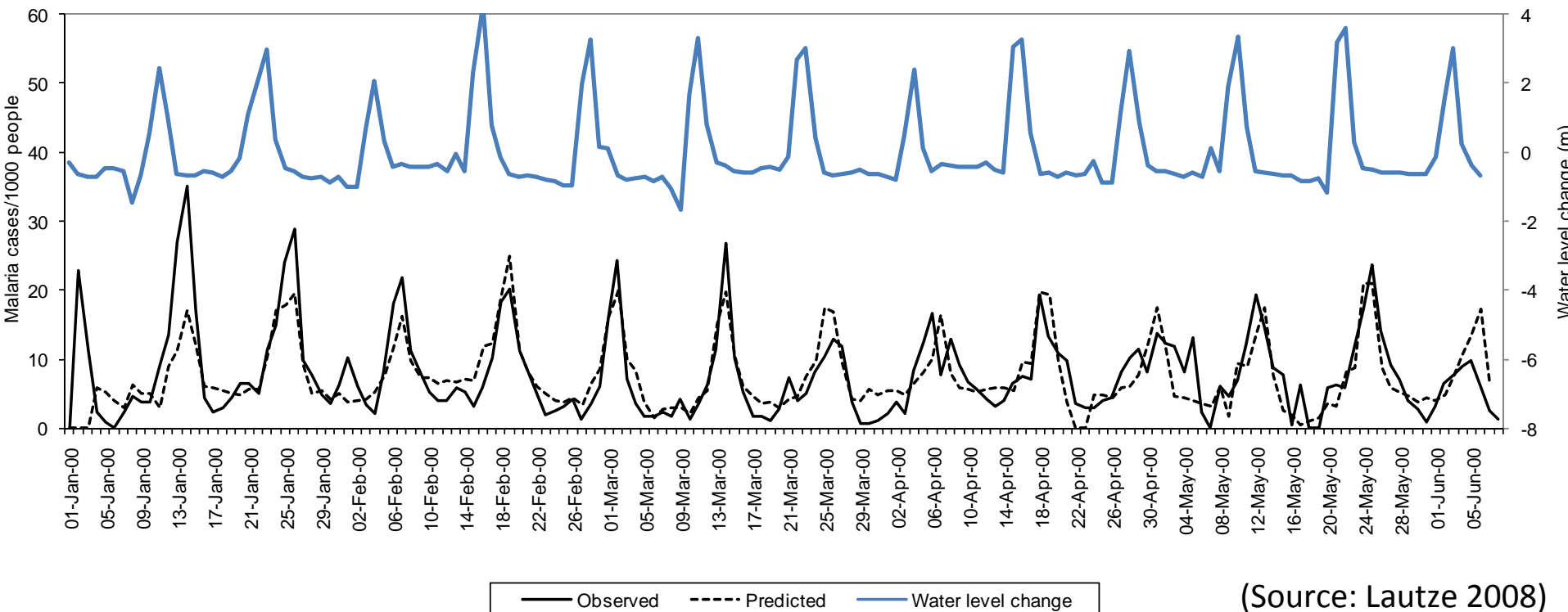


Koka

- Malaria cases correlate with
 - Distance from reservoirs
 - Water level fluctuations



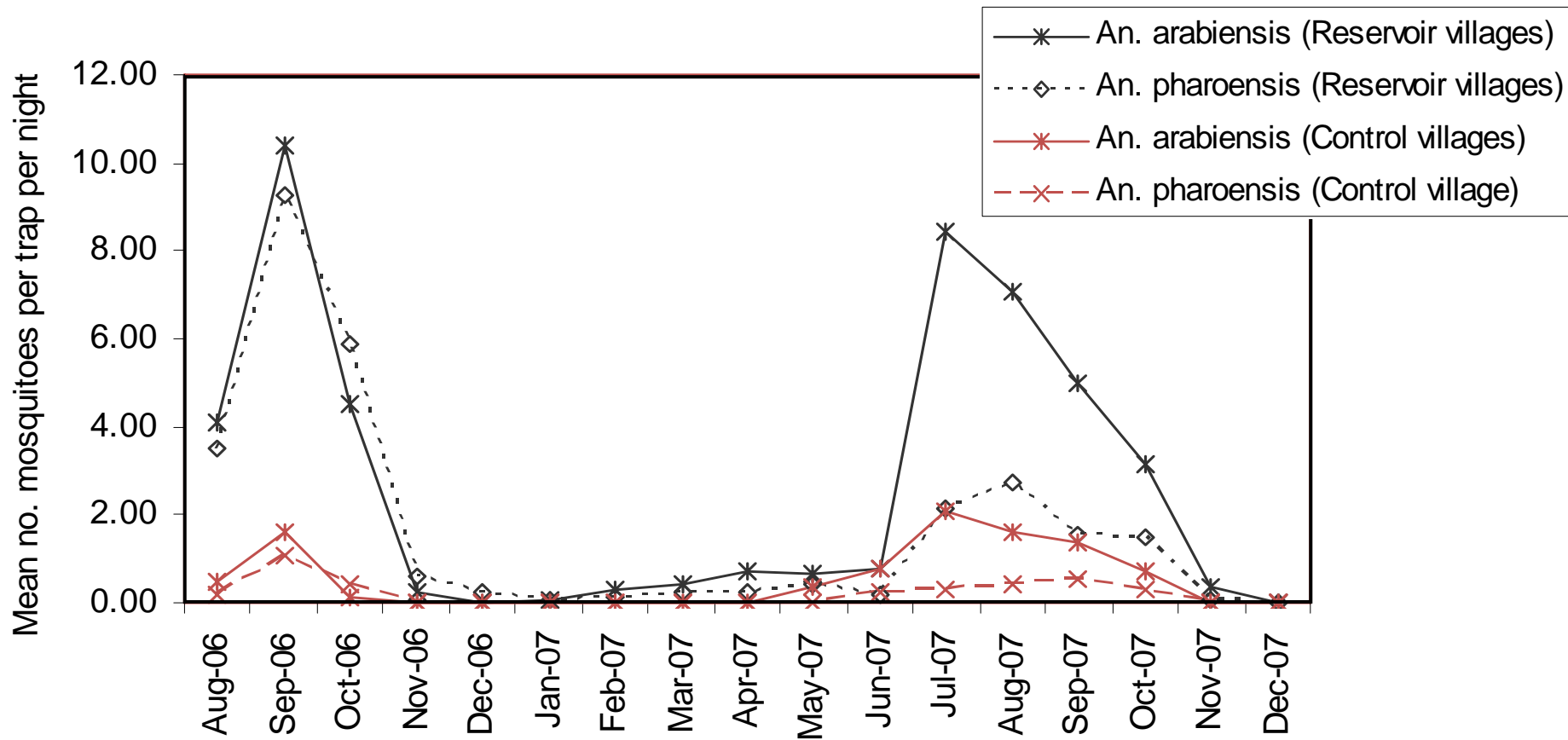
(Source: Kibret et al. 2009)



(Source: Lautze 2008)

Koka

- Adult *Anopheles* more abundant closer to reservoir
- More breeding sites near shore line, mainly in hoof prints



(Source: Lautze 2008)

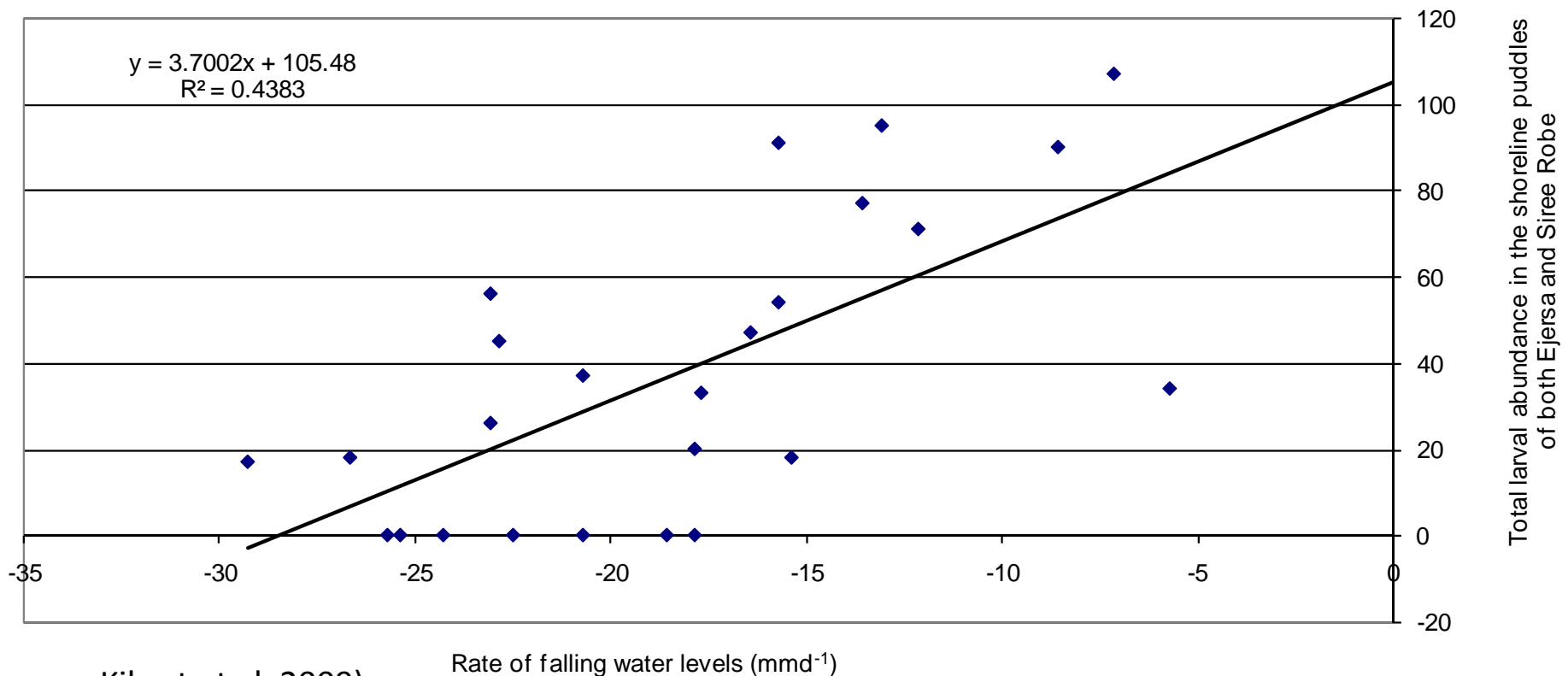
Koka

- Reservoir crucial for livestock watering



Koka

- *Anopheles* larval abundance related to drawdown rate
- Can malaria control be incorporated into dam management?



(Source: Kibret et al. 2009)

Small reservoirs, Tigray

- Mosquito breeding in seepage areas
- Increased transmission, year round, near microdams
- Limited impact on agricultural productivity



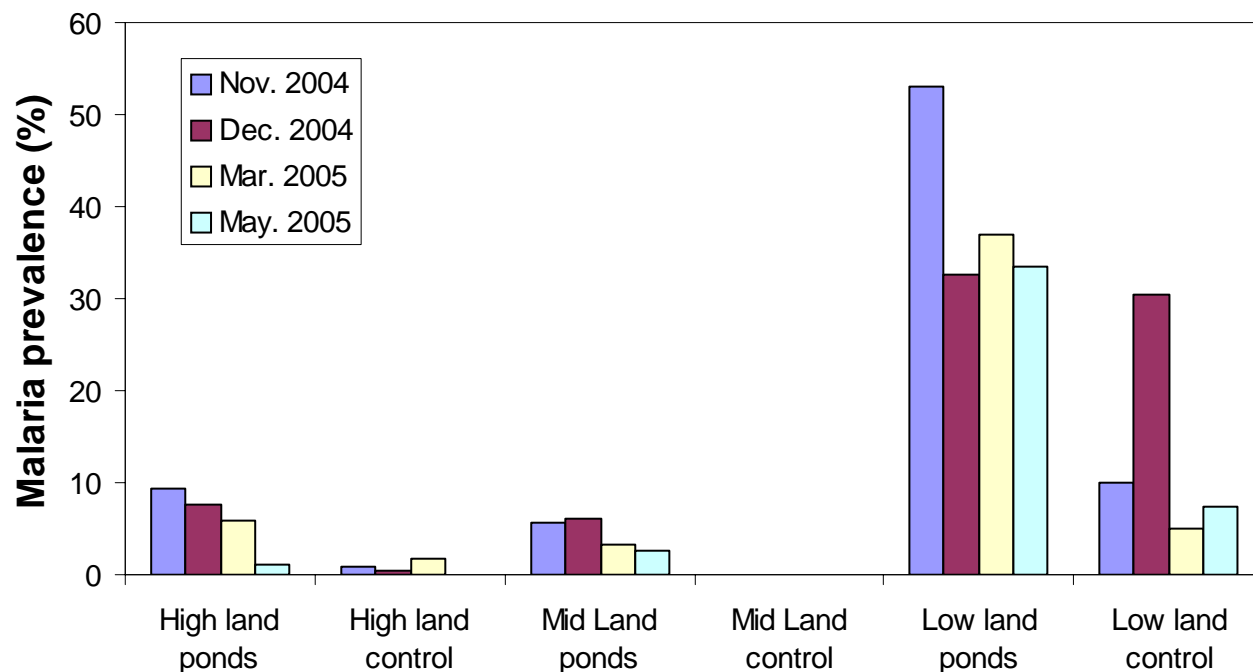
Water harvesting ponds

- Even tiny plots require labor at critical times



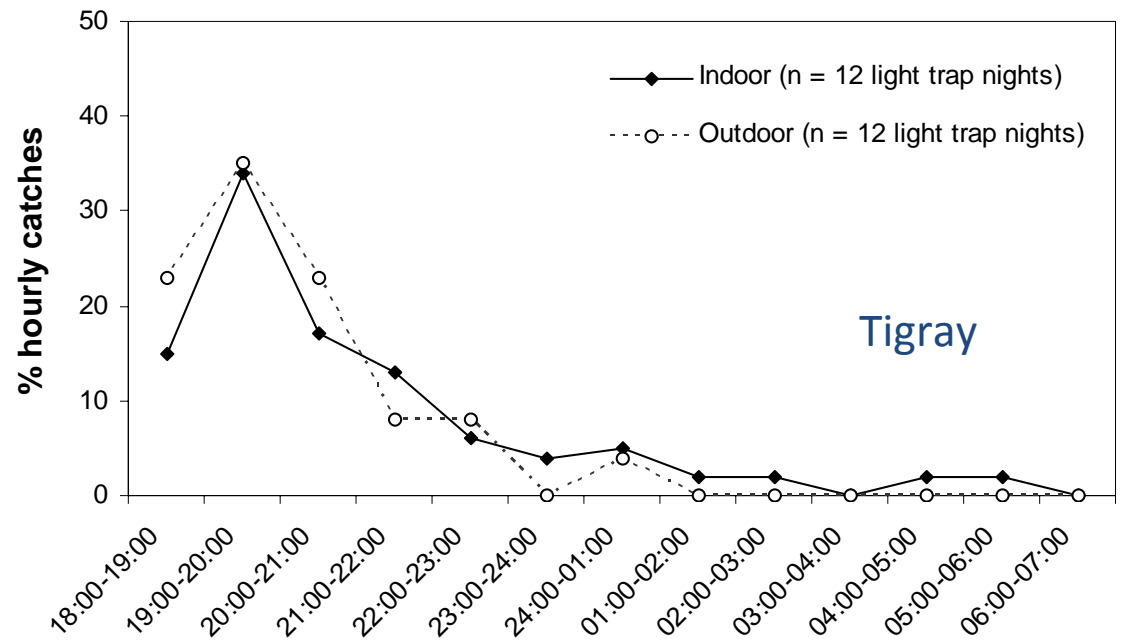
Water harvesting ponds

- Significantly more malaria near ponds
- Determinants of malaria
 - House type
 - Distance to wells
 - Toilets
 - Bed net
 - Season

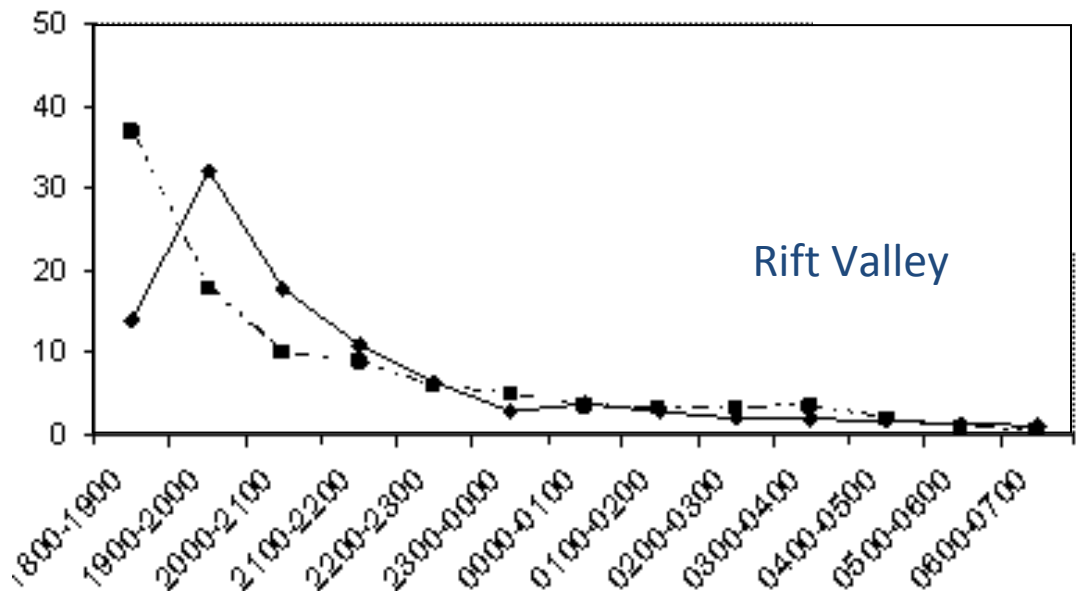


Shift in biting rhythm

- Main vector *Anopheles arabiensis*
- Peak in biting activity after midnight
- Change to early evening

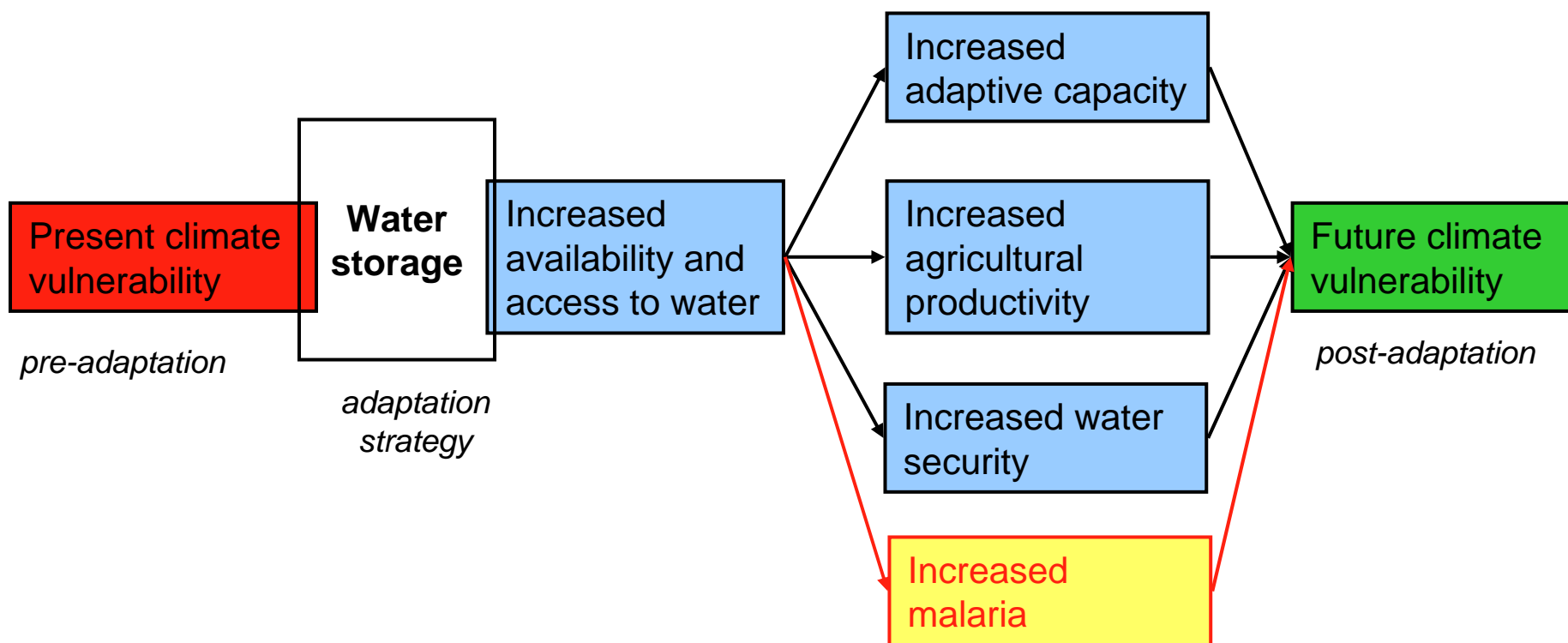


(Source: Yohannes & Boelee, in press)



(Source: Kibret et al. 2010)

Reduced climate vulnerability



Future climate vulnerability > present climate vulnerability

Way forward

- In Ethiopia
 - No additional small dams
 - Large hydropower dams <10
 - Upgrading and expansion of irrigation
 - Water harvesting: ponds and in situ
- No capacity for mitigating measures
- Try to influence policy, planning and design

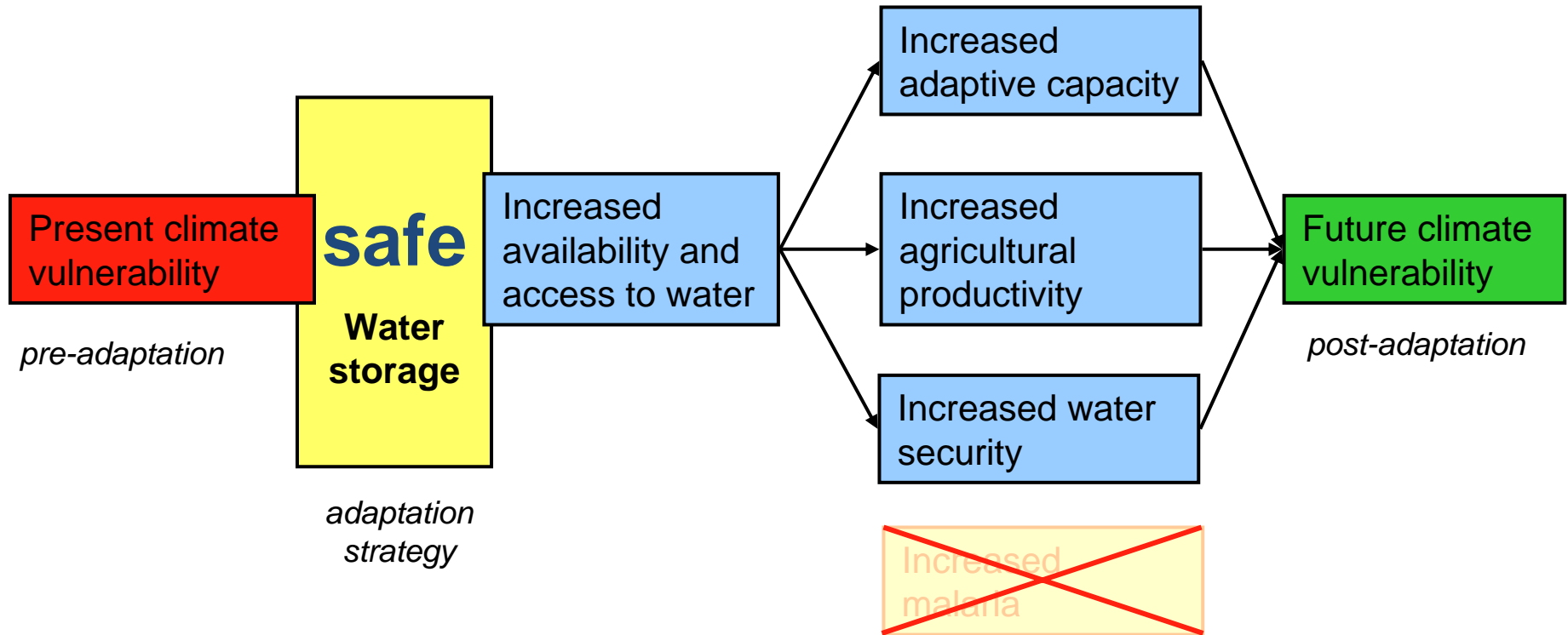


Intervention options

- Complementary to early diagnosis and treatment
- Transmission reduction
 - Zooprohylaxis?
- Source reduction
 - Participatory approaches
 - Engineering / agricultural measures
- Alternative water storage options
 - Aquifers
 - Soil moisture
 - Wetlands



Reduced climate vulnerability



Future climate vulnerability < present climate vulnerability

Key message

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Thank you!

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