Climate Change and the Environmental Challenges: health impacts on individual, community and civil society

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Introduction

- THE DIRECT IMPACTS OF CLIMATE CHANGE HAVE BEEN IDENTIFIED AS

- 1. CHANGES IN THE TEMPERATURE
- 2. CHANGES IN PRECIPITATION AND
- 3. THE OCCURRENCE OF HEATWAVES, FLOODS AND DROUGHTS.

Introduction

- CURRENTLY THERE IS CONSIDERABLE EVIDENCE TO SUPPORT THE FORECAST THAT HUMAN HEALTH IS SENSITIVE TO SHIFTS IN WEATHER PATTERNS AND OTHER ASPECTS OF CLIMATE CHANGE.

- THESE CHANGES WILL BE EXACERBATED IN LATIN AMERICA AND CARIBBEAN STATES (LAC) BECAUSE OF THEIR PHYSICAL GEOGRAPHY AND VULNERABILITY (COASTLINES EXPOSED TO STORMS, SEA-LEVEL RISE AND HURRICANES), POOR INFASTRUCTURE AND IN MANY CASES AN ECONOMY DEPENDANT ON TOURISM.

Introduction

- IN BOTH DEVELOPED AND LESS DEVELOPED COUNTRIES THESE CLIMATE RELATED FORCES AFFECT THE INDIVIDUAL, THE COMMUNITY AND CIVIL SOCIETY. THE FLOODING OBSERVED IN RECENT YEARS IN EUROPE, AUSTRALIA, USA, BRAZIL AND IN SMALL ISLAND DEVELOPING STATES (SIDS) AFFECTED URBAN, RURAL, RICH AND POOR COMMUNITIES ALIKE.

- ALTHOUGH THESE CHALLENGES ARE SOMETIMES EQUALLY DISTRIBUTED AMONG RICH AND POOR COUNTRIES, PAST AND RECENT HISTORY HAVE SHOWN THAT RICH COUNTRIES ARE MORE RESILIENT AND RECOVER MORE QUICKLY THAN POOR COUNTRIES.E.G. NEW ORLEANS, USA VS HAITI

Introduction

- WATER SECURITY IS IDENTIFIED AS A MAJOR CLIMATE RELATED ISSUE AFFECTING LAC COUNTRIES BECAUSE OF LOCAL CHANGES IN TEMPERATURE AND UNPREDICTABLE RAINFALL PATTERNS

Introduction

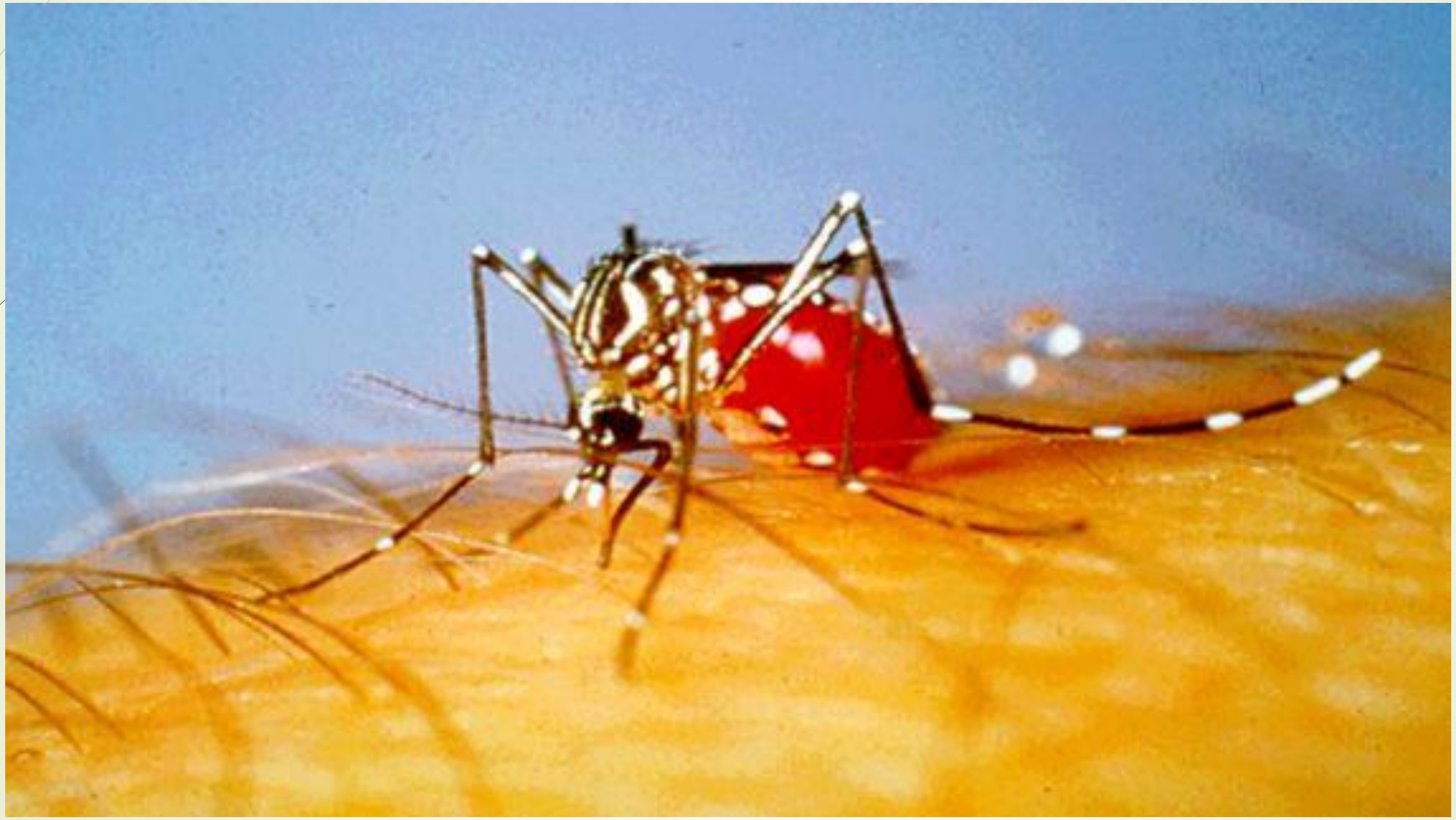
- THIS WILL ALTER THE DISTRIBUTION OF

a. VECTOR-BORNE DISEASES and THEIR VECTORS
b. REDUCE FOOD PRODUCTION OF VULNERABLE POPULATIONS (unable to work due to illness or heat)
c. AFFECT QUALITY OF ARABLE LANDS AND ECOSYSTEM SERVICES AND
d. INCREASE WATER-RELATED DISEASES SUCH AS DIARRHOEA DUE TO POOR WATER SUPPLY AND HYGIENE

WHAT ARE WE ALREADY EXPERIENCING- Individual and Community levels

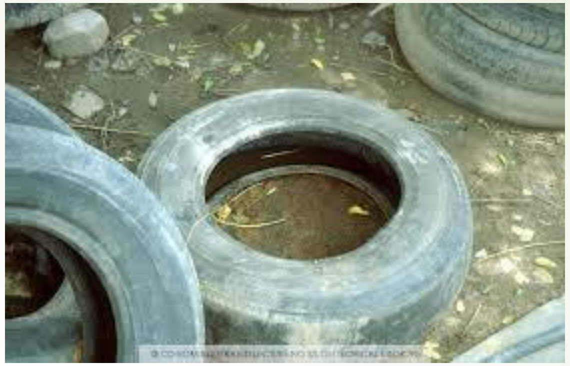
1. THERE ARE ALREADY SHIFTS IN RAINFALL PATTERNS IN LAC COUNTRIES AND <u>EXTENSIVE PERIODS OF DROUGHT</u> HAVE RESULTED IN WATER MANAGEMENT PRACTICES SUCH AS WITH WATER STORAGE IN TANKS AND ROOF-WATER HARVESTINGS
2. THESE HOT DRY CONDITIONS HAVE RESULTED IN <u>CHANGES IN THE BEHAVIOUR</u> OF THE VECTOR FOR DENGUE, YELLOW FEVER, CHICKUNGUNYA AND ZIKA VIRUSES – *AEDES AEGYPTI* MOSQUITOES*.

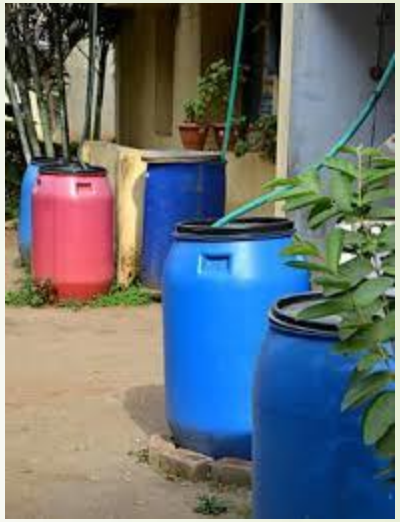
Mosquito vector: *Aedes aegypti*



Breeding Sites

- Traditional breeding sites for Yellow Fever Dengue fever, ChicV and Zika



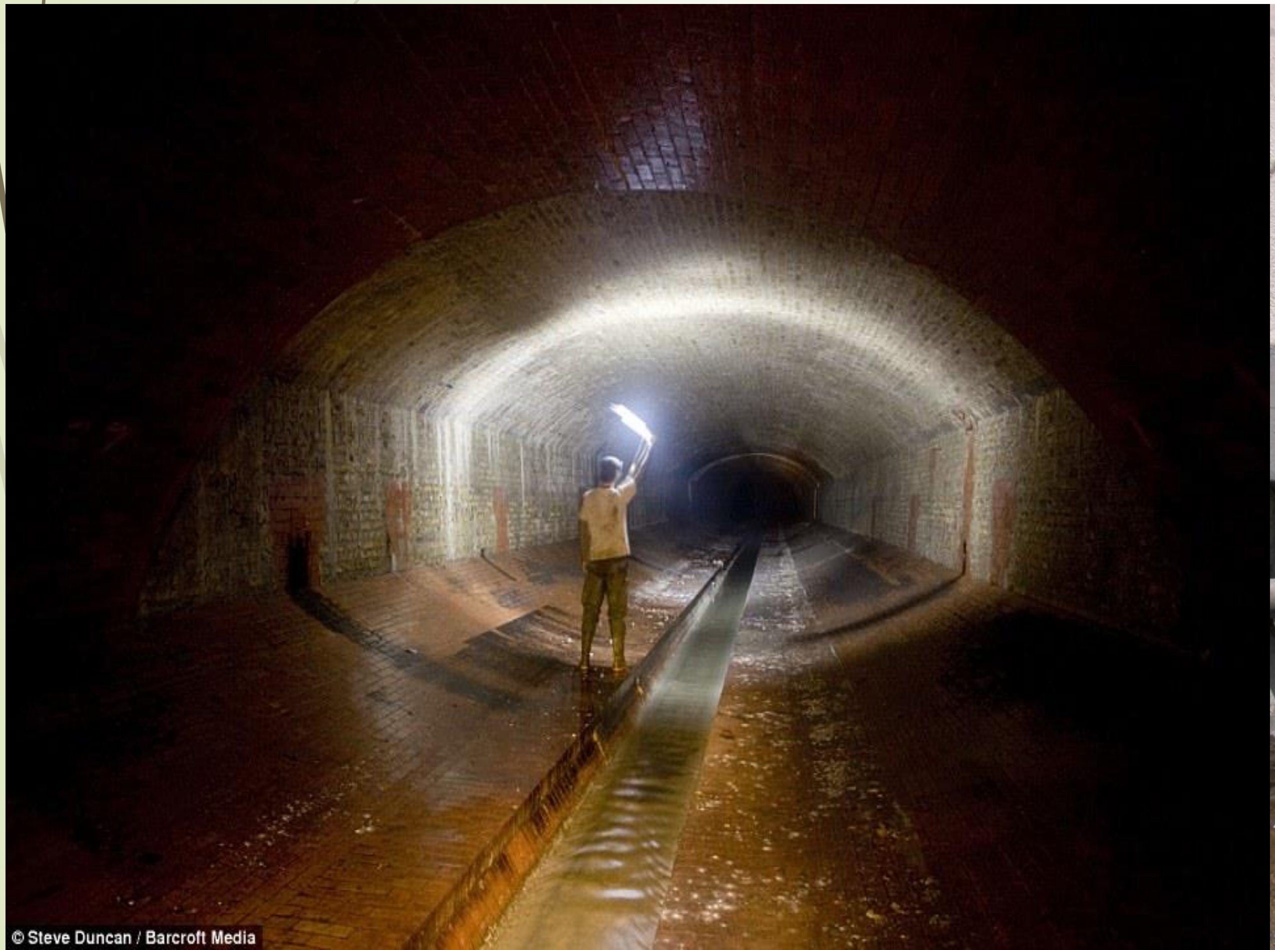


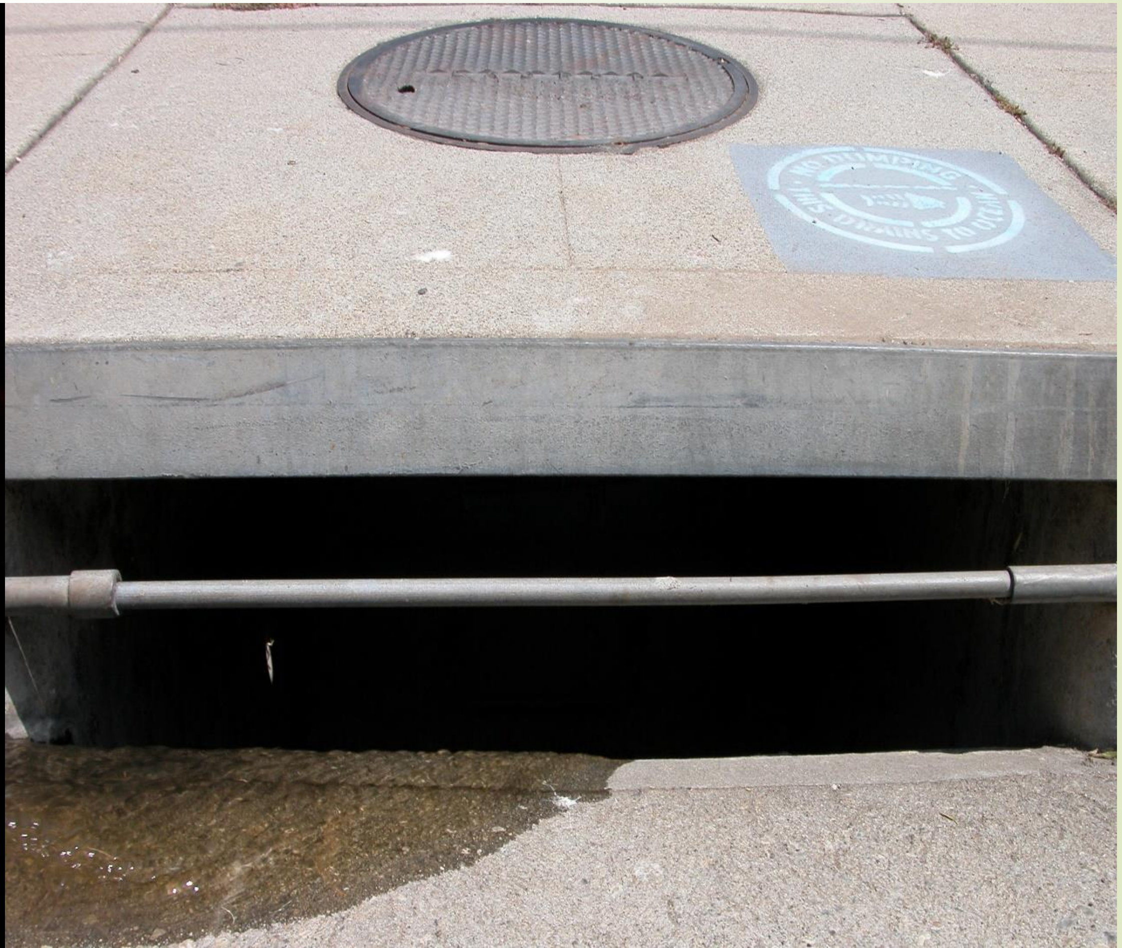
Since the 1950s *Ae. Aegypti has changed its breeding* habitats from natural to artificial and back to natural habitats (<u>Behaviour change</u>)

Habitats/Breeding sites	Suspected reason (anthropogenic?)	References
Tree holes in Trinidad	Insecticide pressure	Kellett and Omardeen 1957
*Eaves gutters in Suriname	Source Reduction and insecticide pressure	Tinker 1974
Rock-hole breeding in Anguilla	Retention of the ability to use both artificial and natural containers	Parker et al.1983.
Artificial and natural breeding containers	Insecticide pressure eliminated panmictic breeding, leading to inbreeding and rapid evolutionary changes	McClelland 1967
Bromeliads, coconut shells, papaya stumps, calabashes in Caribbean	Insecticide pressure, Source reduction	Tinker 1974, Chadee et al. 1998

Mosquito behaviour change and adaptation- underground breeding sites

- Studies in Puerto Rico and Trinidad and Tobago reported **large numbers of *Ae. aegypti* from septic tanks and drainage systems**





EFFECTS OF INCREASED TEMPERATURES ON AEDES AEGYPTI IMMATURE POPULATIONS- surface

- Breeding sites exposed to surface temperatures of >34^{0}C resulted in > 70% mortality
- The temperatures of breeding sites varied as much as 16^{0}C depending on composition of breeding site materials and extent of exposure to full sunshine/location

Results: EFFECTS OF INCREASED TEMPERATURES

Container types	Mean Temperature	Max Temperature	Min Temperature	Outcome
Exposed Drums (plastic)	29.7°C	34.9°C	24.4°C	Low mortality
Shaded Drums (plastic)	27.5°C	33.0°C	22.0°C	Low mortality
Exposed buckets	29.9°C	35.1°C	24.7°C	67% mortality
Shaded buckets	27.5°C	32.4°C	22.6°C	Low mortality
Exposed cups (plastic)	36.9°C	49.4°C	24.4°C	100% mortality
Shaded cups (plastic)	28.0°C	33.8°C	22.2°C	10% mortality
Exposed cups (metal)	31.5°C	38.2°C	24.8°C	100% mortality
Shaded cups (metal)	28.5°C	32.9°C	23.6°C	9% mortality
Exposed Brick-holes	32.6°C	41.9°C	23.3°C	100% mortality
Shaded Brick-holes	29.1°C	34.6°C	23.7°C	50% mortality

Impacts of Climate Change

- The IPCC 5th Report suggested that global temperatures will increase by 4°C but the temperatures recorded at mosquito breeding sites in the field, have far exceeded that figure- resulting in mortality of immature stages in small plastic cups and buckets etc.
- These results support field (Hemme et al. 2009) and laboratory studies (Mohammed and Chadee 2011) which found no immature stages in drums when temperatures exceeded > 34°C.

Impact of Climate Change on mosquito breeding sites in communities

- Mosquito breeding sites in hot exposed urban and rural environments may either decline due to lack of rainfall/ drought or increase due to water storage

- Experimental results suggest that *Ae. aegypti may have moved to* under-ground habitats due to a combination of climatic and anthropogenic factors: high temperatures, drought, as well as variable rainfall patterns.

- Studies in Puerto Rico, Colombia, Mexico, Trinidad and Australia also reported subterranean breeding sites

Recent changes in the *Ae. aegypti* habitats from artificial containers to underground sites

Habitats/breeding sites	Suggested reason : Climate variability?	References
Sewer drains in Cali, Colombia	Seasonal variations (dry season)	Gonzalez and Suarez, 1995
Wells, mine shafts, sewer manholes, septic tanks in Charters Towers, Queensland, Australia	Seasonal variations (dry season)	Russell et al. 1997; Kay et al. 2000
Septic tanks in Play/Playita, Puerto Rico	Seasonal occurrence (dry season) and vector control in the area	Barrera et al. 2006ab
Storm water drain/catch basins in Merida city, Mexico	Both wet and dry seasons	Arana-Guardia et al. 2014
Septic tanks and underground drainage sites in St. Augustine, Trinidad	Seasonal variations (dry season)	Chadee (unpublished)

Impact of Climate Change on mosquito breeding sites

- Living in dark conditions (sewer systems) reduced the fecundity but not longevity of *Ae. aegypti* females –
- Females live much longer - 49 days vs < 30 days on the surface

Impact of Climate Change on mosquito breeding sites

- Females become infectious after circa 18-20 days if the first blood meal is infective.
- Therefore females from underground have 19 days extra to vector disease DEN or CHIKV

Impact of Climate Change on the individual, community and civil society

- Mosquito populations will increase because they are being produced from two sites,
- Sector of the population affected by CC on the surface will be replaced by mosquitoes from underground.
- This will directly affect the individual, community and civil society as mosquito population densities will increase and will be difficult to control at these subterranean breeding sites.
- Therefore these long- lived *Ae. aegypti* females can be considered as super infectors of Dengue, ChikV and Zika

Impact of Climate Change on-individuals, community and civil society

- The evidence suggests that it is unlikely in the future that large *Ae. aegypti* populations will occupy or survive in surface habitats for long periods due to high temperatures and possibly drought conditions. The following survival strategies maybe adopted

Urban

- Septic tanks, Sewer drains, Storm- drains, Service man-holes, cemeteries, parks

Rural

- Tree-holes, Parks, Back Yard Gardens, Forested areas, basements etc.

Climate Change- community and civil society responsibility

- Therefore, underground breeding sites serve to maintain mosquito populations in the dry season in LAC countries. in the same way that populations are maintained over winter in temperate countries (USA and Italy)

- Underground breeding may ***become the norm in LAC countries and appropriate control strategies must be developed.***

Climate Change- community and civil society responsibility

- The epidemiological patterns may change with clusters occurring around or near sewer lines or in rural communities in close proximity to cooler woodlots or forested areas.

- Strategies should also be developed to control vector populations and DEN, CHIK V or ZIKA transmission from these locations

Conclusions- impact of climate change and health in LAC countries

- The current evidence suggests that *Ae. aegypti* mosquitoes may move to cooler underground breeding sites and /or ***return from urban habitats to cooler forested habitats in LAC countries*** and

Conclusions

- Therefore these behavioural changes will shift the balance of responsibility for mosquito and DEN or CHIK V control from the individual **to the community and civil society : in community spaces as well as in homes.**

- Thank you