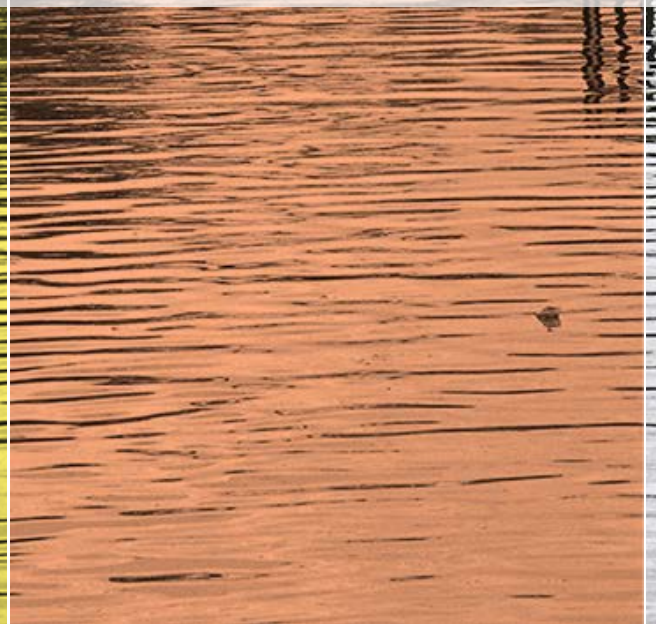


Transport System Adaptation to Climate Change in Ghana: Constrains and Opportunities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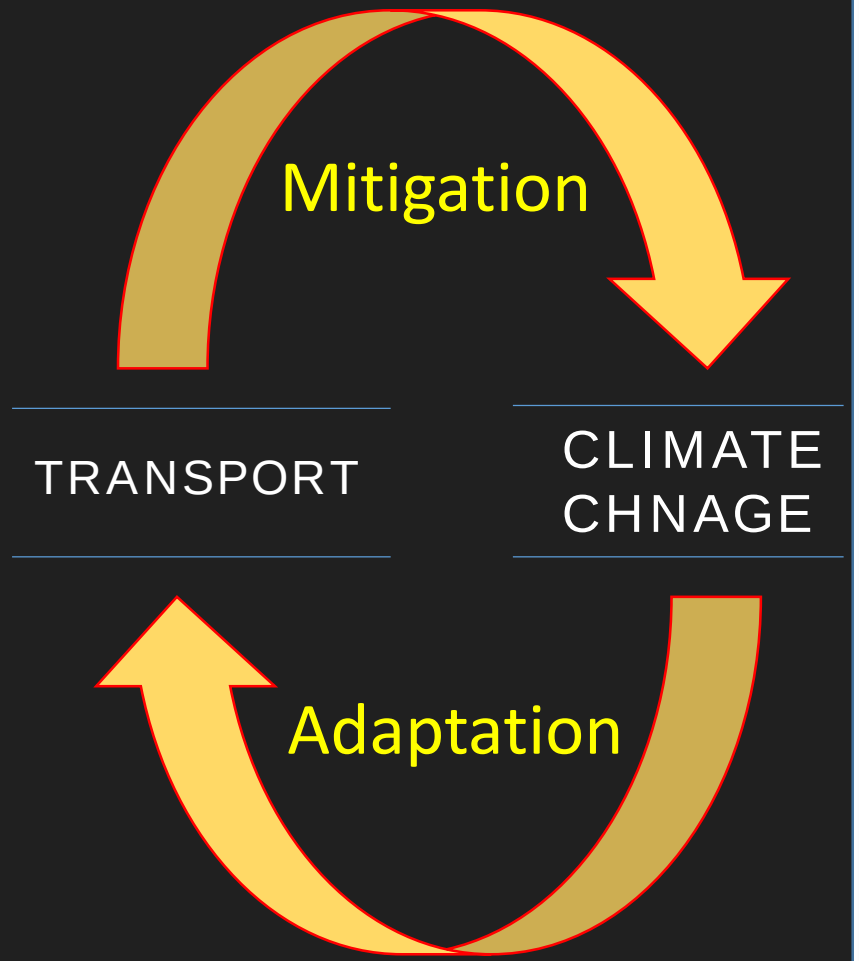
OUTLINE

- ✓ Study background
- ✓ Transport system sensitivity to climate change
  - Climate change in Ghana: Observed and projections
  - Transport system sensitivity (Mills & Andrey 2002)
- ✓ Transport system adaptation to climate change
  - The action theory of adaptation
  - Transport adaptation climate change: constrains and opportunities
- ✓ Conclusions and recommendations

STUDY BACKGROUND

- Transport systems can be considered among the most important lifeblood of modern society.
- Like all complex systems, the efficiency of the transport sector is a function of the interactions between its component parts.
- Therefore, any disruption in the interactions between the various elements of the transport system has the potential of derailing the system's wide performance, and enfeebling its contribution to economic development, and human livelihood in general.
- Climate change has emerged as a major threat to the transportation sector.



By virtue of Ghana's location in the tropics, the country is vulnerable to climate change risks (MEST 2010).

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Climate Change in Ghana

The projected trend of climate variability and extremes (See EPA 2015; World Bank, 2010) is likely to introduce several risks and uncertainties over the future of the transport sector

As a growing lower middle income country, modes of transport are expanding to meet demand. However, climate change is expected to derail these expansions.

Climate Change in Ghana

Considering the sector's crucial role in Ghana's development efforts and mobility prospects, 'does the current transport and climate related policies capture the adaptation of the sector to potential risks?'

This paper qualitatively explores the potential climate change risks, the constrains and gaps in existing policies, and the adaptation opportunities for Ghana's expanding transport system.

Climate change in Ghana: Observed and projections for Ghana

There are various studies on climate trends in Ghana. Though these studies use varied methods, there is a seemly general consensus that the climate will be more variable in decades to come, with implications for the frequency and severity of climate/weather extremes.

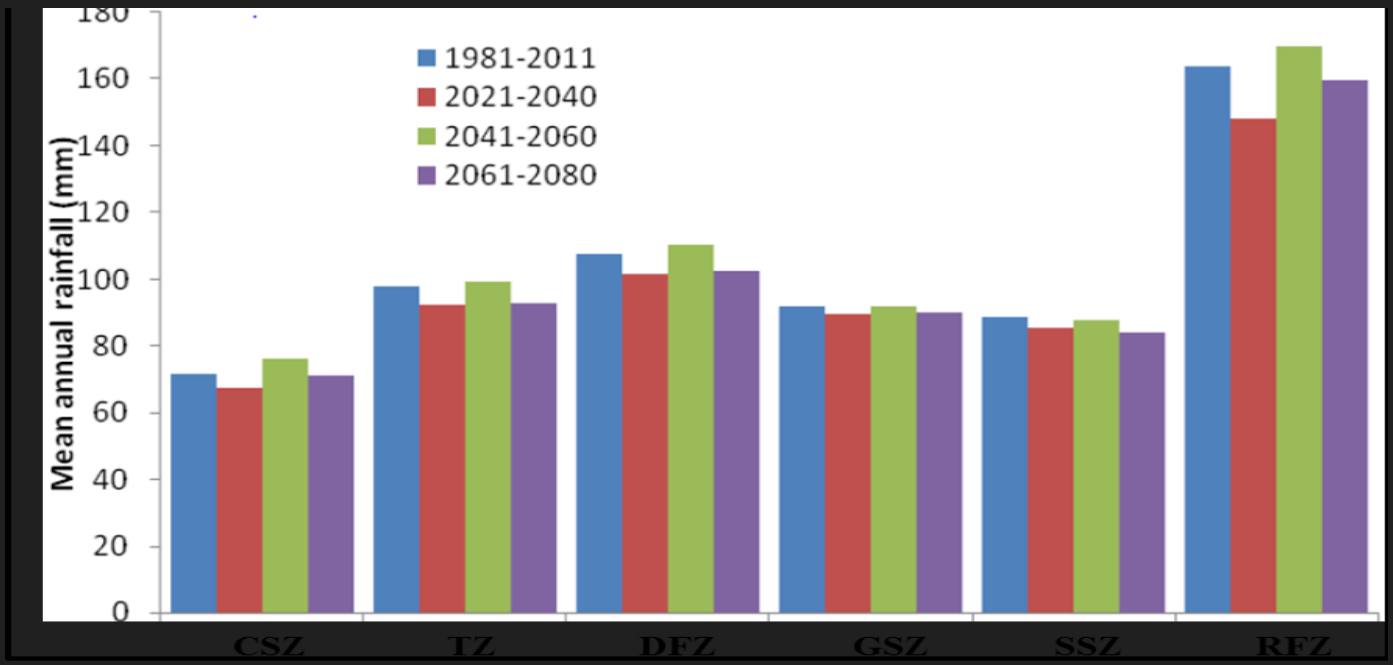

Figure 2: Trends observed and projections for mean annual rainfall (mm)

Climate change in Ghana: Observed and projections for Ghana

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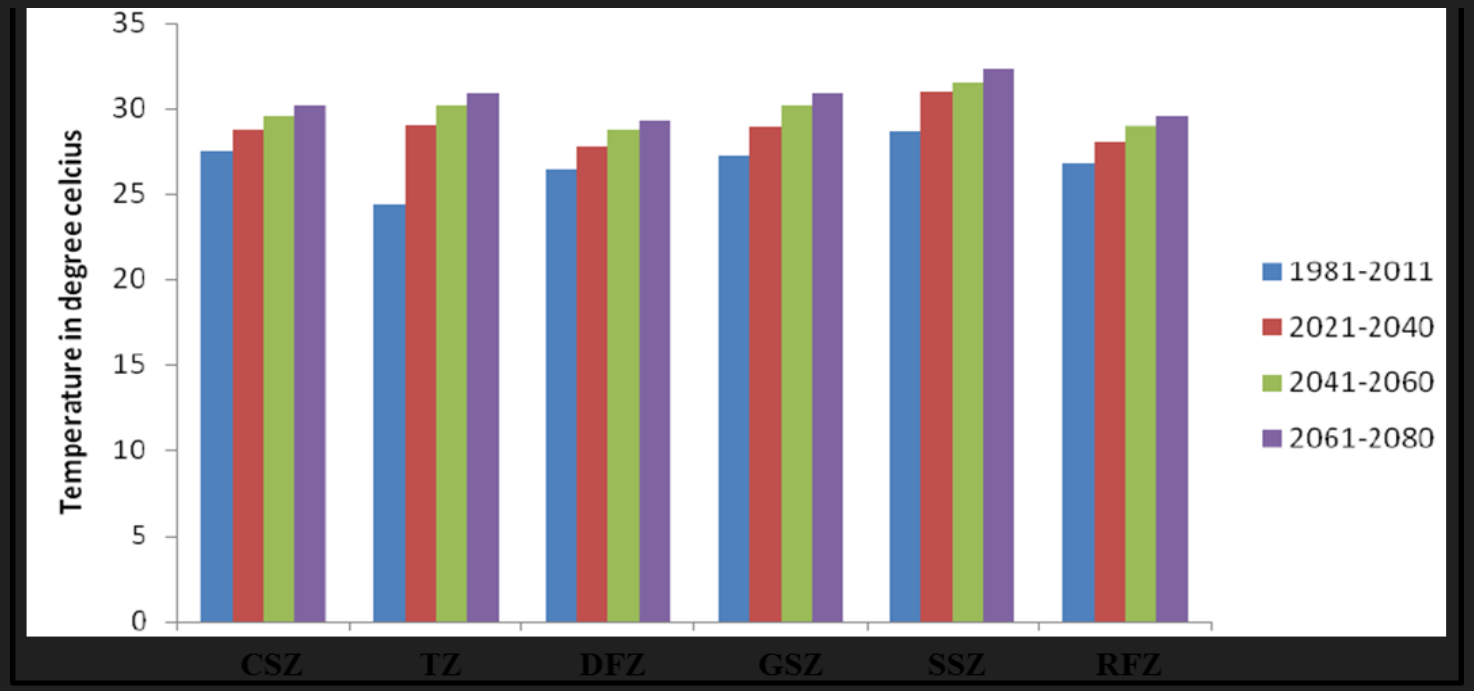

Figure 3: Trends and projections for annual mean temperatures (°C)

Climate change impact on transport systems

Transport system sensitivity (Mills & Andrey 2002)

- …sensitivity is used in this paper to highlight the susceptibility of Ghana's expanding transport system to climate stimuli

- Ghana's transport systems is a critical component in the country's supply chains and communications. Adopting the **transport sensitivity framework by Mills & Andrey (2002),** we illustrate the potential direct and indirect impacts by transport infrastructure, operations, and demand.

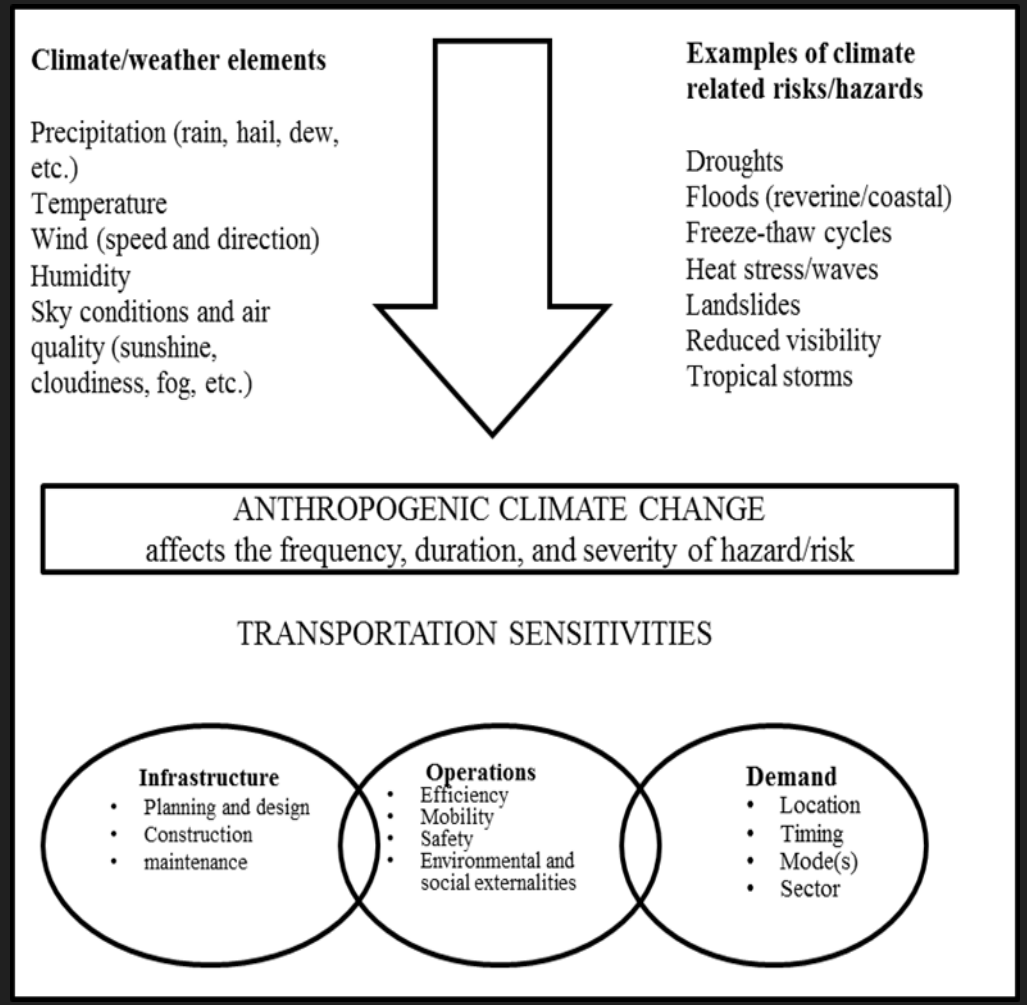

Figure 6: Aspects of transportation that may be sensitive to changes in climate.
Source: Adopted from Mills and Andrey (2002).

Climate change impact on transport systems

- Direct impacts are expected to include, but not limited to, faster deterioration and deformation of transport infrastructure, more frequent interruptions of transport operations and increased mortality and injuries.

- Apart from the direct physical impacts, it is also imperative to note that climate change-induced socio-economic changes could also considerably affect transport systems. Demand for transport infrastructure and services grow in line with the economy, trade, and population.

Potential climate related risks for transport operations and infrastructure

Climate factor	Potential risk for operators	Potential risk for infrastructure
Increase in mean temperatures/ Heat waves/ more hot days and more cold nights, droughts, hamattan	• Safety (passenger and freight e.g. derailing of trains, accidents on roads, false landing due to poor visibility) • Mobility efficiency (cost in terms of time lost) • Economic efficiency (increased transportation cost, increased maintenance cost)	• Asphalt deterioration • Rutting, potholes, waterlogging of roads • Thermal expansion of bridge joints, paved surfaces • Thermal expansion of bridges • Pavement integrity and softening • Deformation of rail tracks (buckling) • Deformation of air strips

Potential climate related risks for transport operations and infrastructure

Climate factor	Potential risk for operators	Potential risk for infrastructure
Increase in average precipitation, floods, frequent and intensive storms (coastal and inland),	• Safety (accidents e.g. false landing by aircrafts, collision on roads) • Mobility efficiency (e.g. Increase in weather related delays and disruptions, particularly road and air transport) • Economic efficiency (increased transportation cost, increased maintenance cost)	• Weathering/erosion of transport infrastructure • More frequent flooding of infrastructure in vulnerable areas (e.g. coastal and low-lying roads and tunnels) • Greater probability of infrastructure failure • Greater damage to port infrastructures

Potential climate related risks for transport operations and infrastructure

Climate factor	Potential risk for operators	Potential risk for infrastructure
Sea level rise	• Safety • Mobility efficiency • Economic efficiency **Example**: • More frequent interruptions of coastal low lying roads and rail transport • Increased maintenance costs at ports and facilities	• Corrosion rate and degradation of harbor and port facilities, coastal roads and rails • Erosion or accretion of beaches protecting port structures, roads, and rails. • Flooding and direct erosion of coastal transport infrastructure (e.g. rail, road and bridge).

Transport system adaptation to climate change

The Action Theory of Adaptation

- ✓ Adaptation, according to the IPCC, refers to "…initiatives and measures to reduce the vulnerability of natural and human systems to actual or expected climate change effects" (IPCC 2007).
- ✓ According to the UNFCCC (2006), sectoral adaptation refers to "…the adjustments by individual sectors of a socio-ecological system (SES) in response to climate change risks".
- ✓ These adaptive adjustments require actors, intentions, and means to achieve the desired outcomes.
- ✓ The basic tenet of action theory of adaptation is that adaptation is a 'collective action'.

The Action Theory of Adaptation

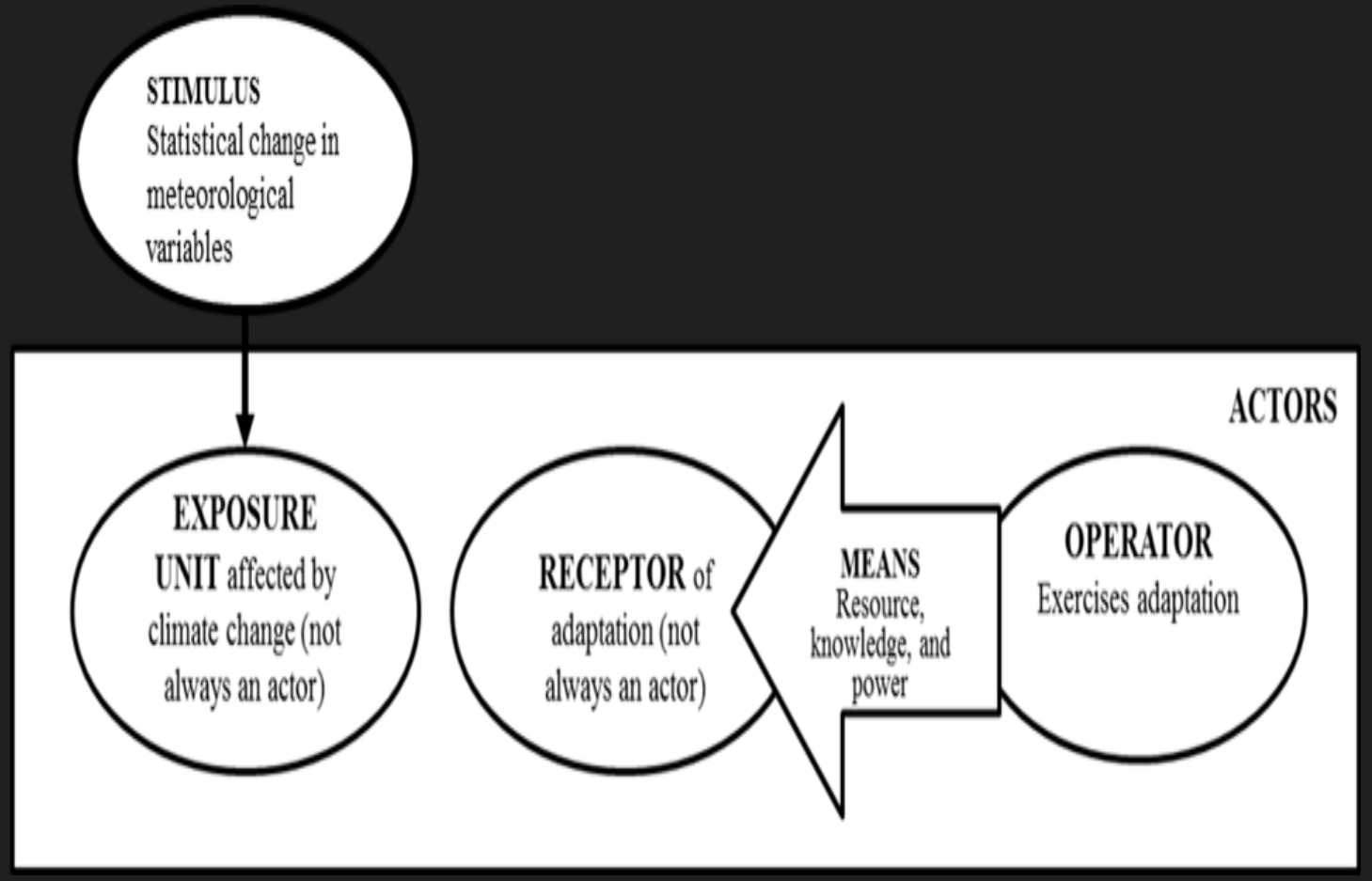

Figure 2: **Schematic representation of some core concepts of the action theory of adaptation.** Note: Exposure unit, receptor and operator can be actors. They are not necessarily identical. **Source**: Eisenack & Stecker (2012)

The Action Theory of Adaptation

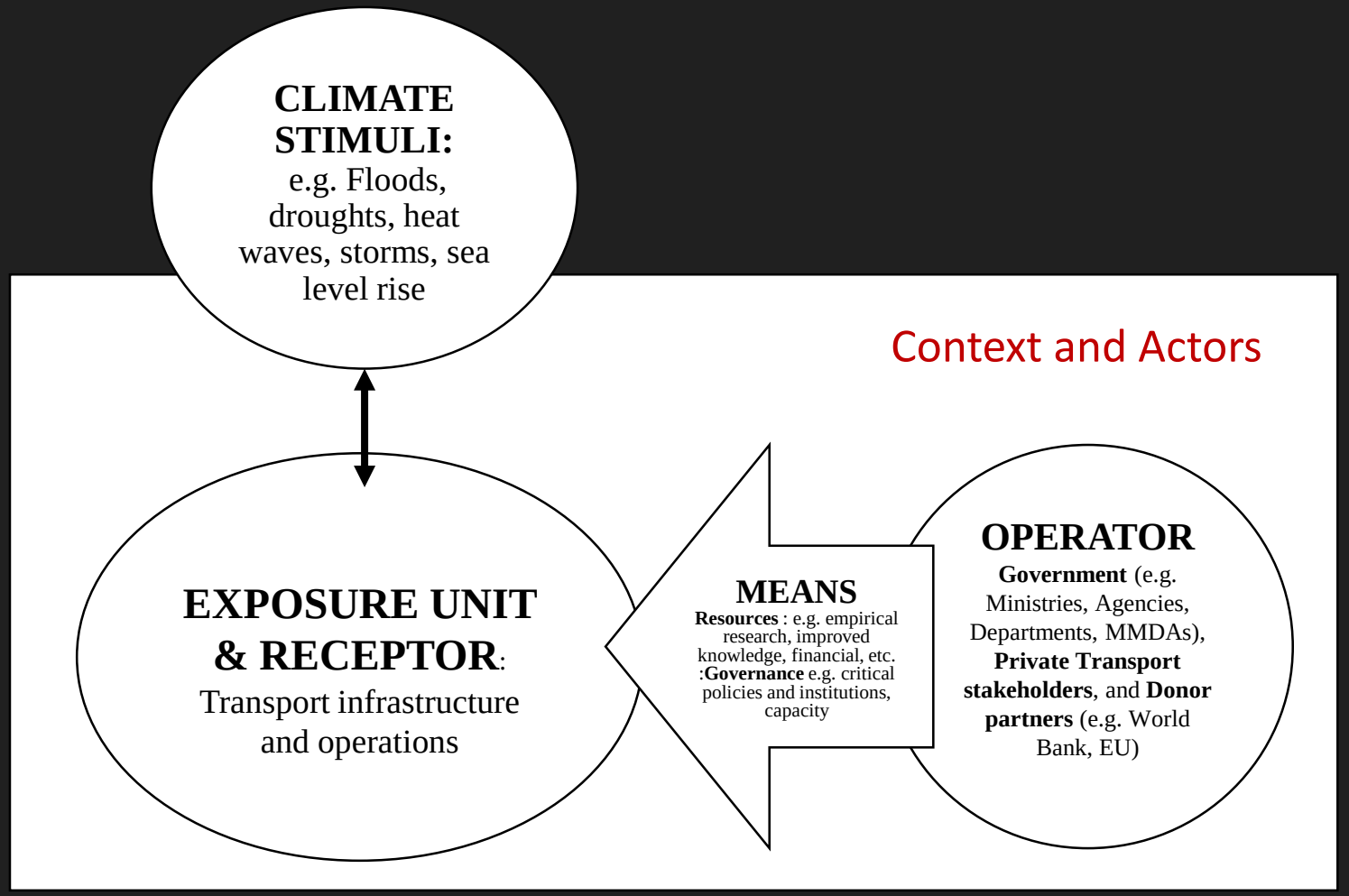

Figure 3: Application of the action theory of adaptation to Transportation system in Ghana. **Note:** The exposure unit is the same as the receptor of adaptation. Context refer to the prevailing socio-ecological conditions. **Source**: Adapted from Eisenack & Stecker (2012)

Adaptation target by sensitive area:

Infrastructure
- Planning and design
- Construction
- maintenance

Climate Stimuli

Roads, Airports, harbours, bridges, canals,

Exposure unit or receptor

Means

- Empirical research
- Power and commitment
- Adaptation policies and mainstreaming
- Institutional capacity building
- New knowledge dissemination, capacity building of institutions
- Funds (WB, IMF, EU, Road Fund, Cacao Roads fund etc.)

Operator

MoT, MoRH, Town and country planning, Ghana Civil Aviation, Ghana Ports and Harbours Authority, civil engineering companies, Donor partners, Contractors, MMDAs

Adaptation target by sensitive area:

Operations

- Efficiency
- Mobility
- Safety
- Environmental and social externalities

Climate Stimuli

All transport operators (e.g airlines, shipping companies, road transport operators unions)

Exposure unit or receptor

Means

- Empirical research
- Power and commitment
- Enforcement of regulations
- Adaptation policies and mainstreaming
- Institutional capacity building
- New knowledge dissemination, Funds (WB, IMF, EU, Road Fund, Cacao Roads fund etc.)

Operator

MoT, MoRH, Ghana Civil Aviation, Ghana Ports and Harbours Authority, Ghana shippers Authority All transport operators National road safety commission, MTTDirectorate of the police, GEPA,

Adaptation target by sensitive area:

Demand
- Location
- Timing
- Mode(s)
- Sector

Climate Stimuli

All transport operators (e.g airlines, shipping companies, road transport operators unions)

Exposure unit or receptor

Means
- Empirical research
- Power and commitment
- Enforcement of regulations
- Adaptation policies and mainstreaming
- Institutional capacity
- New knowledge dissemination, Funds (WB, IMF, EU, Road Fund, Cacao Roads fund etc.)

Operator

MoT, MoRH, Ghana Civil Aviation, Ghana Ports and Harbours Authority, Ghana shippers Authority, Ghana export promotion council and authority, All transport operators (public & private).

Thank you