Sustainable Urban Development Planning

LECTURE 6

Mitigation and Adaptation to Climate Change
Outline

I. Climate Change: key concepts
   - Mitigation
   - Adaptation
   - Adaptive capacity
   - Vulnerability
   - Risk
   - Resilience
   - Sustainability
   - Mitigation & Adaptation summary: Climate change actions & principles flowchart

II. Cities as actors on climate change

III. Urbanization and climate change

IV. Mitigation and adaptation at urban scale

V. Case studies

VI. Global perspective: international climate change agreements

VII. Financing city climate action
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

I) Climate change Key Concepts
Climate change key concepts

Mitigation

• Is a human intervention to reduce the sources or enhance the sinks of greenhouse gases.

• Examples include:
  – using fossil fuels more efficiently for industrial processes or electricity generation
  – switching to solar energy or wind power
  – improving the insulation of buildings
  – expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere.

Source: http://unfccc.int
Climate change key concepts

Mitigation (Cont´d)

• Example of mitigation actions: Fuel Switch

Gasoline to Biodiesel
Outcome: GHG Emissions Reduction

Image source: http://www.symbols.com/gi.php?type=1&id=778&i=1
Climate change key concepts

Adaptation

- Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change (UNFCCC definition)

Source: http://unfccc.int/focus/adaptation/items/6999.php
Climate change key concepts

Adaptation (Cont’d)

- Example of adaptation: Reforestation
Climate change key concepts

Adaptation (Cont´d)

- Example of adaptation: Infrastructure change

Flood risk

Elevated community houses

River
Climate change key concepts

Disaster Risk

Disaster Risk is the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

\[
\text{Disaster Risk} = \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Adaptive Capacity}}
\]

Climate change key concepts

Vulnerability

• Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change

• The three components of vulnerability are:
  • exposure
  • sensitivity
  • adaptive capacity

Climate change key concepts

Vulnerability (Cont’d)

• Example of Vulnerability

Climate change key concepts

Risk

- Is the final outcome of the overlap of three different but inter-related factors:
Climate change key concepts

Risk

• Is the final outcome of the overlap of three different but inter-related factors: Hazards, Exposure and Vulnerability

Climate change key concepts

Disaster Risk Reduction

• The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Examples of DRR include:
• Improving early warning
• Improving institutional and community capacity to respond to disasters
• Improving infrastructure (e.g. evacuation routes, signs, and embankments)
• Improving land and ecosystem management

Climate change key concepts

Risk (Cont’d)

- Example of Risk identification

- Flood risk
- Landslide risk
- No immediate risk
Climate change key concepts

Adaptive capacity

• Capacity of a society/system to adapt to its changing surroundings (environment)
• Includes indicators of behaviour, resources (natural and financial) and technology.
Climate change key concepts

Adaptation (Cont’d)

Example of adaptive capacity

- No technical capacity
- No financial capacity
- No material capacity

Low Adaptive capacity

- Technical capacity
- Financial capacity
- Material capacity

High adaptive capacity
Climate change key concepts

Resilience

- The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Summing up Mitigation & Adaptation: Climate actions and principles flowchart
II) Cities as actors on Climate Change
Cities as actors on climate change

- Major urban settlements are drivers and recipients
- Cities demand an intensive material flow (Including energy and goods)
- The type of influence/hazards of the city on/from climate change is determined by certain criteria such as:
  - Geographical conditions (Coastal, Highland, Flatland etc.)
  - Main activity of the city (Industrial, commercial, Touristic)
  - Weather conditions (Summer, Winter)
  - Natural development of the city (City planning)
  - Number of inhabitants
Cities as actors on climate change

- Urban areas account for between 71% and 76% of CO₂ emissions from global final energy use and between 67 – 76% of global energy use.

- The anticipated growth in urban population will require a massive build-up of urban infrastructure, which is a key driver of GHG emissions across multiple sectors.

Source: IPCC, AR5, WG3, Chapter 12
Cities can be part of the Solution

- Most investments to reduce GHG emissions and adapt to climate change take place at the sub-national and local levels:
  - 50 to 80 percent for mitigation and
  - up to 100 percent for adaptation.

Source: UNDP, National/Sub-national Strategies
Cities can be part of the Solution

• Local governments (LG) usually have roles and mandates that are crucial for the delivery of climate mitigation policies, programs and projects

• Typical LG mandates:
  – 75% have direct control over their transit system
  – 80% have control over roads
  – 80% control residential waste collection
  – Most cities have control over building codes
  – Many can mandate energy efficiency standards

Source: V-NAMA project factsheet, GIZ, 2014
Cities can be part of the Solution

- Examples of strategies and instruments which cities can use for climate change mitigation and to avoid locking-in energy and carbon intensive infrastructure and uses:
  - Target setting (GHG, RE, EE, etc.)
  - Regulation, codes and standards (e.g. Building codes, vehicle access, etc.)
  - Finance and incentives (taxes, waivers, etc.)
  - Integrated urban and energy planning (e.g. district heating systems)
  - Integrated urban and transport planning (e.g. transit oriented development)
  - Green procurement policies (products, services and projects)
  - Local service delivery and operation (e.g.: deployment, user charges, ...)
    - demonstrate new solutions (e.g. Renewable energy technologies, ICT systems, etc.)
    - Local energy utilities to enhance use of renewable energy
  - Capacity building and awareness raising
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

III) Urbanization and climate change
Urbanization and climate change

- Economic activities, land use patterns and GHG emissions on urban areas are determined by economic, political and social conditions.
- Non technical Urban expansion takes over carbon sinks (green areas when existing).
- Even without occupying existing green areas (e.g. a desert) urbanization demands energy and goods which generate emissions.
Urbanization and climate change (cont'd)

Increase of urban areas = Increase of GHG emissions

Decrease of GHG sinks = Increase of climate change
Impact of urbanization on forest (carbon sinks) – San Antonio Texas (1991-2010)

Urbanization and climate change

• Compact cities
  – Reduce green field development
  – Reduce capital and operational costs of urban infrastructure (energy, transport, street lighting, water supply, waste management, etc.)
  – Reduce travel demand with potential multiple benefits for households (less travel cost and time) with consequences on emission of air pollutants, GHG emissions and quality of life

• Spatial and urban planning strategies to promote compact cities include:
  – Urban confinement
  – Transit oriented development
  – Urban infill development
Urbanization and climate change

Source: Litman, 2015
Urbanization and climate change

• Low carbon neighborhoods
  – District energy systems (heating and cooling)
    • Reduce energy consumption by at least 10-15% in comparison with multiple individual building systems
    • Enable use of efficient or renewable energy technology options which might not be viable at single building-scale (e.g.: combined heat and power, heat pumps, renewable energy, use of industrial waste heat, energy cascading, etc.)

• Strategies to make district energy viable include:
  – Urban planning: zoning and density bonus
  – Building codes: district energy ready buildings
Urbanization and climate change

• Buildings
  – Passive house standard can reduce energy consumption in buildings by around 80-90%
    • Bioclimatic architecture (orientation, natural light, ...)
    • Building envelope (insulation of floor, roof, walls, ...)
  – Renewable energy (solar thermal, biomass, etc.)

• Strategies to promote near zero energy buildings include:
  – Building codes: requirements on building envelope and building energy systems
  – Energy performance standards
  – Energy monitoring and awareness raising
Decisions made today can lock-in emissions for many years to come

- Urban infrastructure: 50-150 years
- Buildings: 50-100 years
- Central boiler: 15-30 years
- Large appliances: 10-20 years
- Small appliances: 2-10 years
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

IV) Mitigation and adaptation at urban scale
Mitigation and adaptation at urban scale

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Combined approach</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Energy efficiency</td>
<td>• Increase of urban green areas</td>
<td>• Landslide prevention</td>
</tr>
<tr>
<td>• Renewable energy</td>
<td>• Building isolation</td>
<td>• Flooding prevention</td>
</tr>
<tr>
<td>• Fuel change</td>
<td>• Green architecture</td>
<td>• Relocation of vulnerable settlements</td>
</tr>
<tr>
<td>• Waste management</td>
<td>• Urban agriculture</td>
<td>• Identification of invasive species</td>
</tr>
<tr>
<td>• Fuel efficiency</td>
<td>• Sustainable habits</td>
<td>• Air quality monitoring (SLCP)</td>
</tr>
<tr>
<td>• Energy Management system</td>
<td></td>
<td>• Water management</td>
</tr>
<tr>
<td>• Low emission zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Transit management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

V) Case studies
Mitigation at urban scale

Case studies: CO₂ neutral city (multiple approach)

Copenhagen

- CO₂ neutral by 2025
- Copenhagen has adopted a strategy to set up more than 100 wind turbines
- 37% of all citizens commute by bicycle and 50% ride their bike every day
- The City has decided only to buy electric and hydrogen electric cars from 2011 on
- One in every ten food purchases in Copenhagen is organic
- It is official municipal policy in Copenhagen that all citizens must be able to reach a park or beach on foot in less than 15 minutes by 2015
- Power production in one of the two primary power plants in the city is based on biomass
- Green Purchasing Regulations have been in place since 1992
Mitigation at urban scale
Case studies: Sustainable Transport

Belo Horizonte
- Political will and serious work: Belo Horizonte was the first Brazilian city to develop a mobility plan – the PlanMob-BH – that was aligned to the National Urban Mobility Policy.
- Outlines the future expansion of transport and sustainable urban development.
- Today, it carries 480,000 passengers daily on two corridors.
- Reduces car demands, hence, fuel demands expressed in reduced CO₂ emissions.
Mitigation at urban scale
Case studies: Waste management

Seoul

- GHG emission will be reduced by 6% from 17,263 MTCO$_2$/day in 2009 to 18,330 MTCO$_2$/day in 2021.
- Includes separation at source, recycling, composting, mining, re-use and energy recovery
- It is estimated that GHG emission is reduced by source reduction, reuse, material recovery and landfilling and increased by recycling of food wastes and incineration
- The number of job could be increased by 17% from 11,195 in 2009 to 13,074 in 2021.
- The number of job will be 3.35/annual thousand tons-MSW in 2021.
Adaptation at urban scale
Case studies: Climate resilient city

Tshwane Metropolitan Municipality (incl. Pretoria)

• “Tshwane Vision 2055” contains the city’s ambition to become a low carbon, resource efficient, climate resilient city.
• Tshwane conducted a baseline GHG inventory and a vulnerability assessment as first steps towards achieving its vision.
• The city passed an innovative Green Buildings by-law (1st in the country) and collaborated with the private sector on several projects to achieve sustainability and resilience to climate change impacts.
• The city is working towards a full-fledged Sustainability Financing Mechanism Strategy - which will put climate change adaptation in financial terms.

Source: Wikimedia Commons
Adaptation at urban scale
Case studies: Climate resilient city

Barisal, Bangladesh

- Flooding is a major threat to Barisal compounded by socio-economic factors, resource degradation, challenges providing basic services.
- Barisal followed a participatory approach, including community members and city council stakeholders to conduct a vulnerability assessment.
- The identified impacts were prioritized according to the level of perceived risk, and interventions were identified for each risk.
- An outline of actions was used for developing the city’s first “Urban disaster risk reduction plan,” which Barisal City Council has committed to.
- The participatory approach used, increased community ownership and awareness.

Source: Wikimedia Commons
Adaptation at urban scale
Case studies: Urban agriculture

Ekurhuleni Metropolitan Municipality

- Ekurhuleni is a water-scarce region grappling with the effects of climate change on rainfall and food security for the poorer communities.
- As part of its response, it has developed the **Ekurhuleni Community Driven Urban Agriculture** project.
- Land owned by the municipality will be made available for an at-risk community to develop an urban agriculture project.
- The surrounding houses will be retrofitted to collect rainwater, and the surface run-off will be directed to a flood attenuation collection point.

- Produce grown in the gardens will be sold at the regional market, and education on economic development will be provided.

Source: Wikimedia Commons
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

VI) Global perspective: International Climate Change Processes and Cities
International Climate Change processes

- United Nations Framework Convention on Climate Change (UNFCCC)
  - International agreements: Kyoto Protocol, historical Paris Climate Agreement (COP21, 2015)

- United Nations Office for Disaster Risk Reduction (UNISDR)
  - 2015: Sendai Framework for Disaster Risk Reduction 2015-2030 (aka HFA2)

- Other related processes/agreements/events:
Local and subnational governments in international climate processes

Local Government Climate Advocacy

- United Nations Framework Convention on Climate Change (UNFCCC)
  - **Local Government Climate Roadmap**: recognize, engage, empower
  - COP21 Paris Climate Agreement (2015): Cities and regions have been recognized, engaged and empowered, as the Local Government Climate Roadmap (LGCR) has strived for.
Achievements of Local Government Climate Advocacy

Recognize
- Local and subnational governments as „governmental stakeholders“ (Cancun COP16)
- Role of cities and subnational authorities in raising pre-2020 ambition (Warsaw COP19)
- Paris Package (Paris Agreement preamble para.15 + COP21 Decisions as Non-Party Stakeholder)
- ADP Technical Examination Process on Urban Environment
- Compact of Mayors, Compact of States and Regions, Covenant of Mayors etc.

Engage
- Special UNFCCC badges for Political Leaders of Local/Subnational Gov.
- Lima-Paris Action Agenda (LPAA) - NAZCA Platform, including carbon Climate Registry as data partner – Friends of Cities
- 50% of INDCs focusing on action at local and subnational level
- Cities and regions contributing funds to Green Climate Fund and GEF
- New resources (e.g. GEF Integrated Action Programme on Sustainable Cities)

Empower
Cities Climate Finance Leadership Alliance (CCFLA) and Transformative Actions Programme (TAP)
- 2030 SD Agenda; Sendai-Disaster, Addis Ababa-Finance, SDGs (including Goal:11)
The Paris Climate Package

**Paris Agreement**
- Defines the course of future global climate action
- Has to be ratified by national parliaments, legislative bodies or executive orders by Heads of States
- Enters into force in 2020, upon ratification by at least 55 Parties & representing 55% of global GHG emissions

**Content**
- Commitment to keep global temperature increase from pre-industrial levels to 2 degrees
- Aspiration for 1.5 degree limit
- **Mitigation** – reducing emissions fast enough
- A transparency system and global stock-take
- **Adaptation** – strengthening ability to deal
- Loss and damage – strengthening recovery
- **Support** – including finance, for nations to build clean, resilient futures

**COP21 Decision**
- In effect immediately after Paris
- Lays the foundation and clarifies implementation details of the Agreement as well as the actions/processes to be implemented before 2020

**INDCs**

**Independent Nationally Determined Contributions**
- „Bottom-up“ process
- Climate action plans contributed by 188 countries
- Nationally determined contributions (NDCs) to be updated every 5 years

**Content / Outcomes**
- 50% of INDCs focusing on action at local and subnational level
- All INDCs added up will only keep increase to approx. 3 degrees

**Content**
- 140 paragraphs in 6 Sections (Adoption of Paris Agreement, and Administrative)
- **INDCs, Independent Nationally Determined Contributions**
- Decisions for Agreement
- Pre2020 Ambition
- Non-Party Stakeholders (NPS)
Local and subnational governments in international climate processes

Local Government Climate Advocacy

• UNISDR
  – Sendai Framework/ HFA 2 (2015): Strong references to the empowerment and capacity building of local authorities; convening local platforms in addition to national platforms; the concept of “Build Back Better”, which enables synergy with ecosystem and community based adaptation; and more.

• SDGs, 2030 Agenda for Sustainable Development
  – SDG 11: “Making cities and human settlements inclusive, safe, resilient and sustainable”
INTRODUCTION TO SUSTAINABLE URBAN DEVELOPMENT PLANNING

VII) Financing city-level climate action
Financing local climate action

The Urban Climate Finance Gap and Challenge

• **Gap**: Infrastructure investment needed to keep up with projected urban growth via low-carbon and climate resilient pathways: **$4.8 – $5.4 trillion annually**. Estimated tracked global finance for climate mitigation and adaptation (urban and non-urban) reached just **$331 billion in 2013** (CPI in CCFLA, 2015)

• **Challenges**: closing the gap AND making available funds accessible at the *local* level - existing frameworks for international climate finance primarily focus on the national rather than municipal level.
Financing local climate action

Efforts and solutions, examples:

• Global Environment Facility (GEF): Sustainable Cities Integrated Approach Pilot program

• **Cities Climate Finance Leadership Alliance (CCFLA)** to catalyze and accelerate additional capital flows to cities, and maximize investment in low-carbon and climate-resilient infrastructure.

• Leveraging private funds, and linking with insurance sector, e.g. Global Infrastructure Basel (GIB) SuRe grading tool for Sustainable and Resilient Infrastructure

Own initiatives by cities/ city networks, examples:

• Mobilizing domestic funds, existing assets, and local revenue streams, e.g.: Local green bonds (e.g. Gothenburg), road or water taxes (e.g. Copenhagen), green funds

• Transformative Actions Program (TAP) by ICLEI (tap-potential.org)
Key Reading


- Overview of the UNFCCC process: http://unfccc.int/essential_background/items/6031.php


References


- ICLEI, 2015, Towards the New Urban Agenda. ICLEI Briefing Sheet. ICLEI World Secretariat, Bonn. Available at: www.iclei.org/briefingsheets


References


- UNFCCC Glossary, http://unfccc.int
