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21 Conclusion

21.1 From the State of the Art to the Book Approach

Scientific literature and manuals on climate change (CC) characterisation and planning in the urban areas is, by now, monumental, as we are reminded by the bibliography of the 5th Assessment report drawn up by the IPCC Working Group II (2014).

To what extent does this knowledge impact on CC mitigation and adaptation planning?

To find out, we chose two climate areas: subtropics and tropics. Within these, we identified 368 large cities. We then identified how many of these large cities have a climate tool, which included mitigation, adaptation and emergency plans, strategies and policies.

The analysis of 82 planning tools adopted by the subtropical and tropical large cities (Tiepolo and Cristofori) highlighted a gap between the characterisation of CC and knowledge summarised in the 5th IPCC Assessment report. With regard to planning, this seemed to be influenced by a variety of limits.

Only 24% of large cities have a climate plan. Those cities that do not have a plan are not unaffected by CC: quite the contrary. The large cities south of the Sahara (almost all of which are without a plan despite being repeatedly hit by natural disasters) are the most resounding examples.

A large part of climate planning is funded, often entirely, by donors. Aid is not aimed at those countries that are completely lacking resources, nor those where CC has the most influence. So much so that until today (December 2014), none of the 20 large cities of the Least Developed Countries has a climate plan, despite these being human settlements among the most hit by CC.

Having clarified that climate plans barely cover a quarter of the large cities and not those most in need, let us summarize here how the existing plans are made.

Forty percent of the tools are emergency plans. A quarter of the tools are mitigation and/or adaptation plans. The rest are master plans, sustainability plans, or local development plans.

Few emergency plans characterize CC, identify the areas at greatest risk, practice scenario planning or are well linked with national emergency planning (Ponte).

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Usually these plans focus mainly on short-term measures. We can understand how this indispensable form of planning is nevertheless an insufficient solution to CC.

Climate planning usually only considers the main capital municipality, despite the fact that most large cities in the subtropics and, particularly in the tropics, consist of many administrative jurisdictions. Coastal areas are rarely planned.

Emergency or adaptation plans are mainly aimed at protecting large cities from flooding. Drought, heat waves, and dust storms are rarely characterised and subject to specific adaptation measures. Furthermore, the hot spots on which to focus the adaptation measures are not identified because there is a lack of risk mapping.

With the mere exception of some members of the Organization for Economic Co-operation and Development (OECD), the implementation of large cities' climate plans remains imprecise, in costs and programming. These aspects have to do with the operational quality of plans. We have investigated this important character of climate planning with three simple indicators regarding the cost of planning, the measures and the origin of the resources necessary to fund the latter. As these three aspects almost always remain imprecise, we can conclude that the operative quality of the plans is rather low. So low that in the majority of cases, climatic planning seems more like a politically correct compliance to the requests of the international community, the donors, and the international conventions signed by the individual countries than a set of measures driven from the local stakeholders and which find a place in the municipal budget.

Having found these discrepancies, half of the case studies included in the book regard Least Developed Countries (LDCs): Dar es Salaam (Tanzania), Méké (Senegal), Nawalparasi and Pragatinegar (Nepal), Niamey and its hinterland (Niger), Tabarre (Haiti), Gaza province (Mozambique).

The book also provides CC analysis and tools for decision making in contexts characterised by scant information on the climate and hydrology.

21.2 Lessons Learned from Case Studies

The book aimed to increase the knowledge of four aspects that have been insufficiently investigated so far: comparative analysis of similar cities, joint analysis of city and hinterland, climate characterization and adaptation planning, and methodologies adapted to the needs of local governments.

Similar cities. At least a quarter of subtropical and tropical large cities (Tiepolo and Cristofori) have climate plans. Despite the impulse in the adoption of climate plans over the last three years, the large cities of LDCs continue to lack climate planning tools. Exceptions aside, the quality of the climate analysis and, more generally, of planning remains low, even in the case of specific human settlements such as coastal cities, where demographic density increases the amount of people and goods prone to natural hazards (Ponte).

City and hinterland. Since 2008, Niamey has been flooded every year, as have many other rural municipalities several kilometres away (Tiepolo and Braccio). These have also been affected by drought (Bacci and Tarchiani). In such cases, CC is manifested with a delay in the onset of rainy season (which often causes a false start in sowing by farmers) as well as an early end. Temporary exodus by those peasants who have lost their harvest due to drought is an extreme adaptation measure. The nearest destination is Niamey. Once in city, places where it is cheap to settle are often those most at risk of flooding. Similarly, the North coastal region of the State of São Paulo, which comprises the municipalities of Caraguatatuba, São Sebastião, Ilhabela and Ubatuba, is one of the Brazilian areas most prone to flooding and debris flow deposition, owing to hydrological extreme rainfall events usually coupled with extreme tidal levels. Events such as the catastrophic scenario of Caraguatatuba on 18th March 1967, which resulted in one of the most serious natural disasters in Brazil, fosters discussions about probabilities of heavy rainfall and causal events, as well as the rise in the sea level in coastal areas (Sakai *et al.*).

Integration of climate analysis and planning. Many chapters contribute to knowledge on this topic. What causes flooding? It depends on the type of water course (flash flood, riverine flood). In the absence of daily river discharge and daily rainfall records from meteorological stations, planners can rely on other, specific information. Three-hourly rainfall (TRMM) is a useful source in these cases. Furthermore, they show that the majority of rainfall that causes flooding happens at night, when people are less ready to react to the event (Bacci).

Sometimes, cities are exposed to a contextual hazard: river flooding and sea level rise (Sakai *et al.*) or pluvial and river flooding (Tiepolo and Braccio).

Early warning is one of the first measures to adapt to CC. This is always provided with climate plans.

The identification of a correlation between local drought and global phenomena, such as the El Niño Southern Oscillation cycle, could permit early warning on a local scale, such as in the case of the Paraguayan Chaco, where impacts differs according El Niño or La Niña (Pezzoli and Ponte).

In large countries such as Mozambique, early warning in the event of heavy rains would not generally be launched, except in those areas most at risk: along the river and where population is most dense (Cristofori *et al.*).

Reducing groundwater salinization in Dar es Salaam leads to reducing the demand for water and to increased infiltration (Sappa and Luciani). This would require measures of water conservation, rainwater harvesting and awareness on a local scale (Shemdoe *et al.*).

The alteration of the micro climate is due also to the settlements' physical configuration and to the distribution of large infrastructures, such as in the case of sea-spray dynamics along the shoreline (Piazzola and Tedeschi).

Methodologies adapted to local government needs. The mainstreaming of natural resources local monitoring, local committees and pilot projects may be adapted to various contexts, such as in the case of Dar es Salaam (Macchi and Ricci).

In Nepal, we can ascertain which basic administrations (village development committees) are most vulnerable to drought under both financial and human aspects (Giri).

In Senegal, vulnerability to drought must be managed on the local community scale (Biconne).

Examples are also given directly from local administrations, such as is the case of Catalonia (Prohom and Puig), Piedmont (Franzi *et al.*) or Zurich (Ronco *et al.*), where CC is monitored and the risk of flooding is mapped by application of the European directive FD 2007/60/EC. Mapping the flood risk and measuring it through indicators allows us to focus the adaptation in specific sectors and hot spots.

21.3 Recommendations to Make Climate Planning More Incisive

Recommendations are aimed at ensuring that large cities are less prone to natural disasters through the adoption of plans managed by competent local structures. Cities need to act quickly, using snapshot as well as incremental geographical information systems that start from preliminary risk mapping, to allow decision makers to identify (and implement) measures for hot spots. We have identified six recommendations for donors, local administrators and planners:

1. Co-funding climate plans in LDCs and large cities most exposed to CC. It is good to combine the drawing up of plans and local planning capacities strengthening. This recommendation may seem banal, but how often are climate plans the product of temporary international consortiums that do not really strengthen local capacities, but rather supply a "turn-key" plan that is then not applied locally?
2. Characterising high temperatures, dust storms and droughts. Also in this case, it is good practice to mobilise and strengthen local capacities, especially those of the national weather services.
3. Consider metropolitan core, belts and rural hinterland of LDCs. The outcome is two-fold: (i) having better knowledge of the impact of CC on urban areas, especially in the terms of climatic migrations from the hinterland towards those urban areas exposed to the risk, and (ii) identifying the jurisdictions requiring adaptations that are not necessarily those in which floods, drought and heat waves occur.

4. Establishing or strengthening the local GIS data on CC. Each case study collected in this book demonstrates the importance of local databases on climate, hydrology, flooded areas, damage, and vulnerability over the longest possible period of time, without which it is impossible to characterise the hazard, identify hot spots and provide accurate adaptation solutions.
5. Producing preliminary risk maps through high resolution remote sensing, and investigate poverty and adaptation. The aim is to identify the hot spots requiring priority measures.
6. Increase the implementation of mitigation and adaptation measures. Usually in the subtropics (OECD countries), a majority of the mitigation and adaptation is carried out by individual citizens when asking for permission to build. In the tropics, this is not possible due to the cities' unregulated physical growth. Donors may address the infrastructure support (e.g. Millennium Development Goals 7c) on adaptation hot spots. However, it's time to improve local taxation, as the large cities can have great problems, but also have great resources, starting with their vacant lands (Tiepolo and Braccio 2014).