Urban Planning for Climate Change – Position Paper of FIG Working Group 8.1

Frank FRIESECKE, Sophie SCHETKE and Theo KÖTTER, Germany

Key words: Adaptation, Cities, Climate Change; Energy; Governance; Land Management, Mitigation, Sustainable Development; Urban Planning.

SUMMARY

Urbanisation and climate change are among the most complex challenges of our century. This position paper outlines innovative urban concepts and planning approaches to successfully tackle impacts of climate change in cities. The outline is to trigger a broader discussion. At the same time, it constitutes the starting point of a series of contributions between 2012 and 2014 to FIG Working Group 8.1 on successful urban planning strategies to deal with climate change.

The position paper addresses a broad range of tasks and targets which emerge internationally in urban planning facing climate change and its challenges for citizens and decision-makers. The authors see an enormous potential in a successful interplay between different stakeholders and the connection of different planning strategies within the broad field of urban planning. Climate change and strategies of mitigation and adaptation are to a high degree intertwined with a variety of different aspects of urban planning. This is mirrored in the character of the following urban concepts and planning approaches presented in this paper.

Consequently, the authors will highlight specific fields of urban planning which hold enormous potentials to successfully promote new planning strategies and concepts facing mitigation and adaptation of climate change in urban areas. These are:

- energy concepts and new governance structures,
- climate change and civic participation,
- climate-proof planning and land use planning as a tool for mitigation and adaptation of climate change,
- climate protection and transportation in cities,
- urban renewal and new means of climate protection,
- sustaining urban ecosystem services as contributions to climate protection in urban areas.

To summarise the different strategy fields, some conclusions and guidelines will be elaborated in form of a final report for the FIG World Congress in Kuala Lumpur in 2014. Therein, the authors will demonstrate that a surveyor can play a significant role as an urban planner and land manager, establishing, quantifying, and managing climate change. In this way Working Group 8.1 supports FIG Task Force on Surveyors and the Climate Change, but concentrating on urban planning strategies.

Urban Planning for Climate Change – Position Paper of FIG Working Group 8.1

Frank FRIESECKE, Sophie SCHETKE and Theo KÖTTER, Germany

1. INTRODUCTION

"We must put cities on the front line of the struggle to adapt to climate change and reduce the risk of natural disaster… Many cities are already building climate change risks into urban planning and city management."
Robert B. Zoellick, President of the World Bank at the C40 Sao Paulo Summit on June 1, 2011.

In the past decades, the effects of urbanisation and climate change are converging in dangerous ways that seriously threaten the world's environment, economic and social stability (Clos, in UN-HABITAT 2011). Considering the high density and the large number of inhabitants, especially megacities and urban agglomerations in coastal zones run highest risk in case of reduced rainfalls and droughts, extreme heat waves, intensive rainfalls and windstorms, and sea-level rise.

Because of the fact that climate change threatens all countries, with developing countries the most vulnerable, an international and multipartner approach towards climate change action is needed.

The International Federation of Surveyors (FIG) supports national governments and other partners (e.g. FAO, UN-HABITAT, World Bank) to implement climate change mitigation and adaptation strategies by examining the engagement and role that surveyors can have in contributing to climate change policies and programmes. To give an example, an important contribution of the surveying profession can be made by measuring climate change and monitoring its impacts (e.g. with geodetic measurement techniques, earth observation satellites, and geographic information systems), but also by political commitment and institutional development (e.g. implementing land use planning, legal and regulatory frameworks). As Holger Magel (2005) already had postulated, surveyors play a manifold role as enablers for local people, community-based and non-governmental organisations, mediators between citizens and authorities as well as advisors to politicians and state institutions.

Against this background, during the term 2011 - 2014 Commission 8 and especially FIG Working Group 8.1 Planning Strategy for Urban Development and Regeneration had two objectives: to identify the impacts of climate change in urban areas and to develop urban planning policy and implementation guidelines to assist sustainable climate change mitigation and adaptation.

Mitigation	Adaptation
Technological change and substitution that reduce resource inputs and emissions per unit of output. Mitigation means implementing policies to reduce GHG emissions and enhance sinks.	Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Table 1: Difference between Mitigation and Adaptation (Source: UN-HABITAT 2011:5).

2. URBANISATION AND CLIMATE CHANGE

The article argues that urbanisation and climate change are closely connected with each other.

Urbanisation as the process of transition from a rural to a more urban society is increasing rapidly and will continue during the next decades, especially in many developing countries. According to the United Nations World Urbanization Prospects - The 2011 Revision, between 2011 and 2050, the world population is expected to increase from 7.0 billion to 9.3 billion. At the same time, the population living in urban areas is projected to gain 2.6 billion, passing from 3.6 billion in 2011 to 6.3 billion in 2050. In fact, the world urban population is expected to rise from 52 per cent in 2011 to 67 per cent in 2050. Related to this development, the number of megacities, usually defined as metropolitan areas with a total population of 10 million or more people, is increasing worldwide (cf. figure 1). And as a result, the rural population is projected to start decreasing in about a decade.

Figure 1: Spatial distribution of the world's megacities 2015 (Williamson et. al 2010:201, Courtesy of Frank Friesecke).

While in developed countries urbanisation has mainly taken place in the second half of the 19th century, developing countries are now in the middle of their urban growth. The highest growth will mainly occur in the cities of Asia and Africa, in areas that are now more than two-thirds rural and by 2050 will be two third urban. Never before has urban population expanded so fast, due to the ongoing progress in agriculture, nutrition and medicine.

Undoubtedly, the convergence of the described rapid urbanisation with climate change can be very dangerous. Urban areas, with their high concentration of people, industries and infrastructure, are likely to face the most severe impacts of climate change. These impacts are a result of the following climatic changes (UN-HABITAT 2011):

- Warmer and more frequent hot days and nights,
- Fewer cold days and nights,
- Frequency increases in heat waves,
- Increased frequency of heavy precipitation events,
- Increase in areas affected by drought,
- Increases in intense tropical cyclone activity, and
- Increased incidence of extreme high sea levels.

One problem is that some of these effects are reasonably predictable (e.g. changes in global temperature, sea-level-rise), while others are not (e.g. frequency and magnitude of extreme weather events, cf. example in figure 2). For urban areas, perhaps the most obvious increased risk comes from the unpredictable weather events such as heavy rainstorms, cyclones or hurricanes. Coastal regions will be doubly at risk; the biggest danger is that climate change is causing sea levels to rise increasingly rapidly (FIG 2010:10). For any city, the scale of the risk from these extreme weather events is also much influenced by the quality of housing and physical and social infrastructure in that city and the level of preparedness among the city's population and key emergency services (Satterthwaite et al. 2007:17). For that reason, urban areas in developing countries, where the poorest and most marginalised residents live, will be especially threatened with climate impacts.

As described below, the two major global challenges, urbanisation and climate change, require a new emphasis on the planning of urban settlements and a new partnership between the different actors – national and local authorities, enterprises, civil society organisations, households and individuals. It is obvious that the challenges associated with the process of urbanisation will complicate responses to climate change. On the other side, urbanisation will also offer opportunities to develop climate change mitigation and adaptation measures. As a recent Organisation for Economic Co-operation and Development (OECD) paper states: 'Cities are part of the climate change problem, but they are also a key part of the solution' (Kamal-Chaoui and Robert 2009:3).

Figure 2: Christchurch (New Zealand), flooded areas after earthquake (Author: New Zealand Defence Force, http://en.wikipedia.org/wiki/2011_Christchurch_earthquake (last access: 2011-04-09).

3. THE NEED OF THE SURVEYING PROFESSION IN DEALING WITH CLIMATE CHANGE – URBAN PLANNING STRATEGIES

3.1 Contribution of the Surveying Profession

The surveyor can play a significant role, establishing, quantifying, and managing climate change.

With his specialised skills he can substantially contribute to helping mitigate and adapt climate change and to reduce climate-related risk. Requirements are not only engineering know-how but also the surveyors' variety of skills and knowledge in urban and rural planning; land management and development; building and land law; real estate and business administration as well as social competence. Among other things, the surveyor as an urban planner and land manager:

- engineers tools to monitor climate change processes (e.g. via geographic information systems, satellite-based systems),
- develops effective land use concepts that are necessary for a sustainable urban development,
- coordinates and directs the complex procedures of land consolidation, land registration and land reallocation,
- creates sustainable infrastructural, economic and ecological conditions for developing urban areas and solving land use conflicts,

- coordinates public-private agreements in order to use land in an economic, ecological and social way, and
- undertakes damage assessment of the destroyed or harmed buildings and public facilities in the aftermath of a climate-related disaster.

However, it is not the surveyor alone, who contributes to the adaptation and mitigation of climate change with special regard to urban planning and land management. Land management and land use planning are interdisciplinary tasks that shift the responsibility for the described strategies and measures on to various occupational groups.

The following sections describe a wide range of urban climate change mitigation and adaptation strategies. These are not alternative strategies, but complementary ones that need to be pursued together:

1. **mitigation** – to reduce greenhouse gas emissions (chapter 3.2),
2. **adaptation** – to adapt to the climate change we cannot avoid (chapter 3.3),
3. **governance** – to examine the role national governments, non-governmental organisations etc. can play to promote mitigation of, and adaptation to climate change (chapter 3.4).

3.2 Urban Climate Change Mitigation Strategies

Mitigation strategies are a highly diverse field and cover a broad range of "sectors responsible for greenhouse gas (GHG) emissions" (Barker et al. 2007:27). Following the fourth assessment report of the Intergovernmental Panel of Climate Change (Barker et al. 2007), these are (a.o.):

- Energy supply
- Transport and its infrastructure
- Residential and commercial buildings
- Industry
- Agriculture
- Forestry
- Waste management

Moreover, climate change mitigation strategies are also divided into short and medium term covering the next 20 years and long term mitigation strategies for the time after 2030 (IPCC, 2007: Summary for Policymakers, p.2).

Within this paper, the authors will put a condensed focus on mitigation strategies in the two selected fields *i)* Energy and *ii)* Settlement development. Undoubtedly, urban planning plays a crucial role in realising climate change mitigation and adaptation strategies. It transfers targets related to new energy-efficient structures and systems as well as sustainable settlement structures into the spatial dimension. According to the German Institute of Urban Affairs[1] (2011:33f.), the following four fields can be highlighted:

[1] Deutsches Institut für Urbanistik (DIFU)

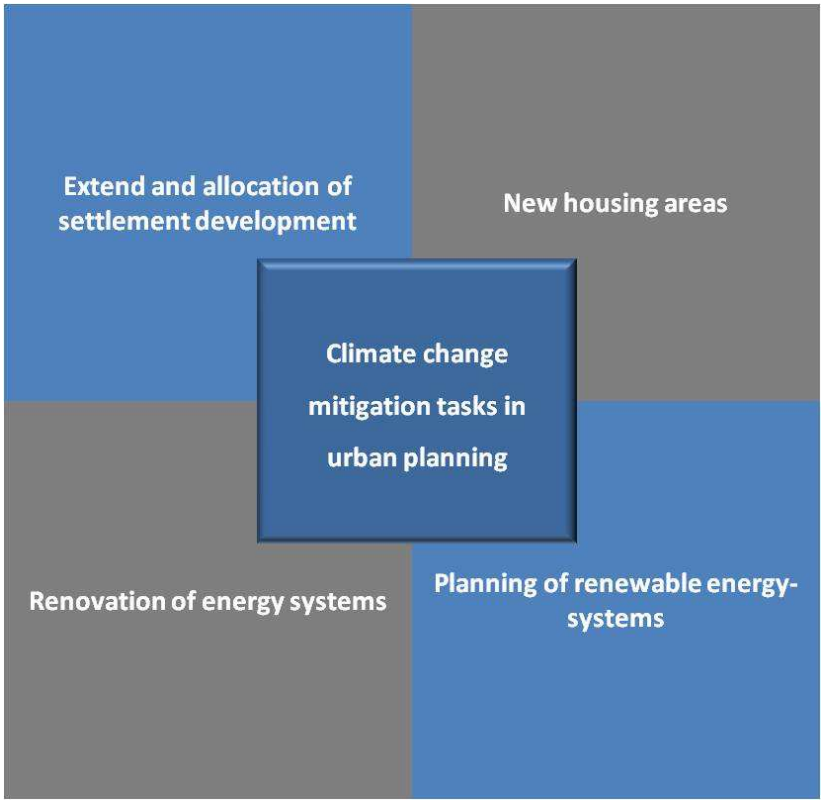

Figure 3: Climate change mitigation tasks in urban planning (according to German Institute of Urban Affairs 2011:33f.).

These four mitigation tasks are frequently entitled "energy-efficient urban planning" (Sustainability Center Bremen 2009: 8) or climate-change relevant tasks (German Institute of Urban Affairs 2011: 33) and cover far more than only the sector energy. Therefore, the following paragraphs also exemplarily consider settlement structures, settlement expansion as well as new energy-systems. They comprise the most important fields of urban planning and climate change mitigation and will be shortly explained.

Extent and allocation of settlement development: The spatial dispersion of settlements has been under discussion ever since (a.o. Couch & Karecha, 2006; Siedentop 2005). But facing issues such as climate change, the dimension of limited sprawl and tendencies towards more congestion and spatial bundling of settlements gains new importance. The goals are a compact and energy-efficient settlement structure in hand with reduced demands for traffic and transportation (German Institute of Urban Affairs 2011: 33) as well as mixed use settlement structures (www.mbv.nrw.de). The German sustainability strategy aiming at a reduced land consumption from currently approx. 100 ha per day towards 30 ha per day in 2020 (www.umweltbundesamt.de/rup/flaechen/index.htm) together with a fostered infill development are examples for those aspirations. But it goes without question that those more or less abstract goals need to be flanked with additional mitigation measures in the housing, energy and transportation sector. Taking a long and critical debate on urban densification and infill development into account, which also highlights negative effects on local climate conditions (a.o. Siedentop 2005 referring to Breheny 1992; Tyrväinen et al. 2007), we see that

the arena of climate change mitigation is larger than expected. Complex, concerted actions and strategies are need despite of single measures.

New housing areas: New housing areas offer a broad range of measures for climate mitigation. In terms of construction, the distance between and orientation of building towards each other offers possibilities for compact settlement development, reduced land consumption and enhances the use of renewerable energies or thermal energy (German Institute of Urban Affairs 2011¸ Sustainability Centre Bremen, 2009).

Beside the possibility of new energy forms in newly constructed areas also the physical aspect of building construction can play an essential role. According to the Sustainability Centre Bremen (2009), optimisation procedures for the passive use of solar energy offer new possibilities for the heating of newly constructed buildings. Insolation on southern oriented buildings and therefore heating of a building´s surfaces such as roofs, windows and walls and the selection of suitable materials can have an essential positive contribution on the heating requirements (ibid.), cf. figures 4 and 5.

According to Levine et al. (2007) there are many technical options for an effective use of solar energy and "[...] can involve extensive sun-facing glazing, various wall- or roof-mounted solar air collectors, double-façade wall construction, airflow windows, thermally massive walls behind glazing and preheating or pre-cooling of ventilation air through buried pipes." (Levine et al. 2007: 396).

Renovation of energy systems: The consideration of existing housing stocks plays an essential role for a climate proof urban planning facing impacts of climate change and the demand for its mitigation. According to the German Institute of Urban Affairs (2011:61) the following measurements need to be taken into account on the individual building level:

- Isolation of walls, roofs, ceilings,
- Renovation of windows,
- Construction of ventilation systems, and
- Replacement of old heating systems.

Beside technical replacement of heating systems, the following innovative heating systems should be taken into consideration with the renovation of energy systems in existing settlement structures: local heating networks, combined heating and power stations, use of solar cells for heat supply or use of geothermal plants (German Institute of Urban Affairs 2011:61).

Planning of renewable energy-systems: In direct addition to the above standing paragraph, urban planners are demanded to provide the respective planning and legal conditions for the supply and effective use of new energy systems. This comprises the provision of areas for renewable energies and the solution of use conflicts (German Institute of Urban Affairs 2011:34).


Figures 4 and 5: Energy efficient buildings in existing settlement structures in Germany (Source: die STEG Stadtentwicklung GmbH).

3.3 Urban Climate Change Adaptation Strategies

According to the definition of the International Panel on Climate Change (IPCC), adaptation to (human-induced, or 'anthropogenic') climate change is understood to include all actions to reduce the vulnerability of a system (e.g. a city), population group (e.g. a vulnerable population in a city) or an individual or household to the adverse impacts of anticipated climate change (Parry et al 2007, see also the definition in table 1). Adaptation can avoid negative impacts of climate change considerably, but generally, it cannot remove all adverse effects. Especially most of the urban areas in developing countries need not only a climate change adaptation programme, but a development programme – meeting already existing deficits in physical infrastructure, such as transportation, energy and communications infrastructure, and social infrastructure, such as health, governmental and educational services (UN-HABITAT 2011:129). Urban areas cannot make infrastructure climate-proof that is not there.
As described in more detail later, possible adaptation measures are:

- Managing urban growth in climate sensitive areas through zoning and regulation,
- Revising, renewing and enforcing building codes to take account of changing climatic conditions,
- Developing and implementing climate change-proof infrastructure and design standards,
- Making constructions more resistant against climate impacts (e.g. hurricanes),
- Building infrastructure to protect communities (e.g. construction or improvement of levees and dykes against increased flooding),
- Relocating buildings (e.g. to higher ground in case of flooding, cf. figure 6), and
- Developing climate change adaptation maps at the national, regional and local level.

However, there are great limits what adaptation can achieve. Adaptation is made difficult by the fact that modifications to urban infrastructure and the built environment are expensive, technically unfeasible and/or occur incrementally over long periods of time. For instance,

transportation and flood control infrastructure can be built to withstand a wide range of extreme weather events, but such infrastructure generally lasts decades, heightening the need to incorporate extreme climate scenarios into current infrastructure design and planning (Kamal-Chaoui and Robert 2009:52). Another fact is that especially in developing countries local governments are often too weak or ineffective to reduce climate change risks and impacts at the urban level.

Figure 6: Floodplain building relocation in Illinois, USA (Source: http://www.lakecountyil.gov/Stormwater/LakeCountyWatersheds/BMPs/PublishingImages/building_relocation.jpg).

Example of community-based action to build resilience to extreme weather-related events (here: flooding and sea-level-rise)

Concerning the strategies and measures for flood protection and flood management, there exist a lot of approved adaptation interventions worldwide. Long-term sustainable spatial and urban planning to prevent flooding or to reduce its effects based on the selected strategies listed in table 2.

As shown in the table flood risk can only effectively be reduced if, in addition to technical measures, spatial and urban planning regulates land-use in flood-prone areas. Sustainable urban planning based on promoting building development outside of the flood-prone area as often as possible, avoiding or stopping building development in flood plains (land-use control) and developing appropriate building codes or zoning ordinances to reduce flood damage. The best way to reduce the damages is to prevent development on flood-prone lands with appropriate instruments of urban planning. Alternate use of flood-prone land should be

considered where possible. It is better to have the land zoned and used for purposes such as parks, nature areas or ecological reserves than to try and ensure that future development is flood proofed.

Adaptation strategies in case of flood events
▪ Installing early public warning systems ▪ Better information of the public, improvement of public awareness ▪ Developing and updating flood (risk) maps (see example in figure 2) ▪ Land use planning to avoid locating structures in risky areas (e.g. declaration of flood areas, change zoning to prevent development in flood-hazard areas) ▪ Preserving of ecological buffers (e.g. wetlands) ▪ Updating building codes to require more flood-resistant structures in floodplains ▪ Elevation of buildings in urban areas at risk ▪ Technical flood protection measures (e.g. construction or improvement of dikes, flood protection walls, retention ponds, river dams, barrages for low-lying developments) ▪ River restoration ▪ Increasing capacity of storm water collection systems

Table 2: Adaptation strategies for flood protection measures.

Precautionary and sustainable urban planning efforts must concentrate on attaining an equilibrium between economic urban development and urbanisation on the one hand and the needs to allocate more space to water for water retention on the other hand.

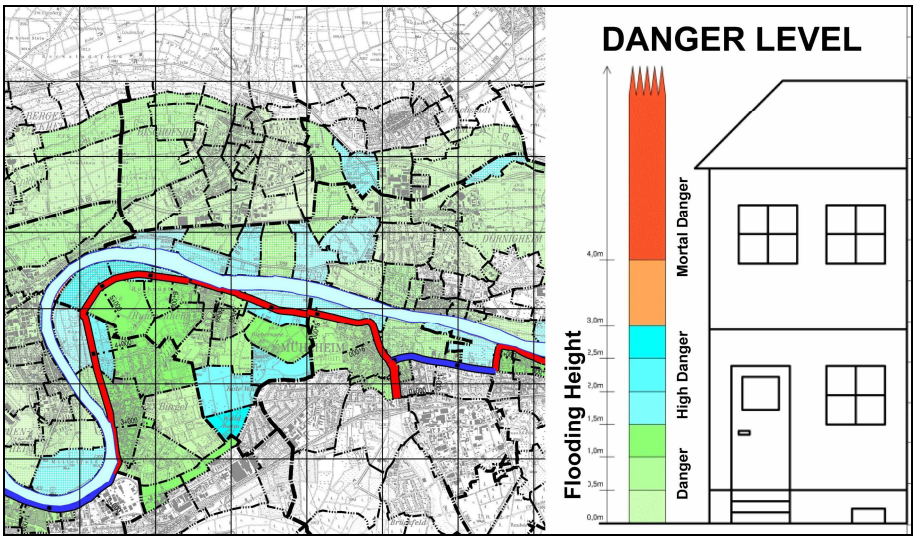

Figure 7: Flood hazard map for the river Main (Hesse/Germany) – excerpt form
Source: Regional Council Darmstadt (http://www.rp-darmstadt.hessen.de/).

3.4 Climate Change Governance

According to the World Bank (1991) governance can be defined as the exercise of political authority and the use of institutional resources to manage society's problems and affairs. In case of the challenges of climate change and the expected impacts, this understanding must be modified with view on the demands of effective adaptation and mitigation governance. Generally all governance systems must be taken into account and can occur in the following three different strategy types:

1. public private Partnership (PPP) or with the collaboration of community organisations;
2. market mechanisms whereby market principles of competition serve to allocate resources while operating under government regulation;
3. top-down methods that primarily involve governments and the state administration.

In the last years mainly city leaders have begun to incorporate climate change mitigation and adaptation priorities into city development agendas. They were mostly driven by the social, environmental and economic potential benefits. To be successful on a long term, climate change needs to be supported by the whole civil society and the citizens on the one hand and by the commercial sector on the other hand. Public attention and awareness have to be increased. Therefore awareness raising and communication are important measures of climate change governance.

In practice networks have been very efficient in climate policy governance as many stakeholders from the private, public and commercial sector can be involved. Network governance offers the opportunity for cities to better enable action from individuals and the private sector in climate policy design. The figure 8 (see page 13) shows the possible networks of governance.

Vulnerability to climate change has been affected by complex social and economic processes. Therefore climate change governance should consider these effects and comprise different sectoral policies as well as different levels (horizontal and vertical integration). Climate priorities need to be integrated in each stage of the urban policy-making process, especially in the spatial planning process (OECD 2010:180).

Climate change impacts in many cases spill over city borders and need inter-municipal network. The administrative structure of urban climate policy governance does not fit the cities' actual boundaries. Carbon-relevant functions, economic interchanges, flows of materials and energy, and transportation between commercial zones and residential areas normally overlap across multiple municipalities. Network between municipalities is necessary but often hindered by an absence of regulatory frameworks to guide inter-municipal initiatives. Successful climate policy needs co-ordination among municipalities, an inter-municipal collaborative framework or technical infrastructure that transcends city borders.

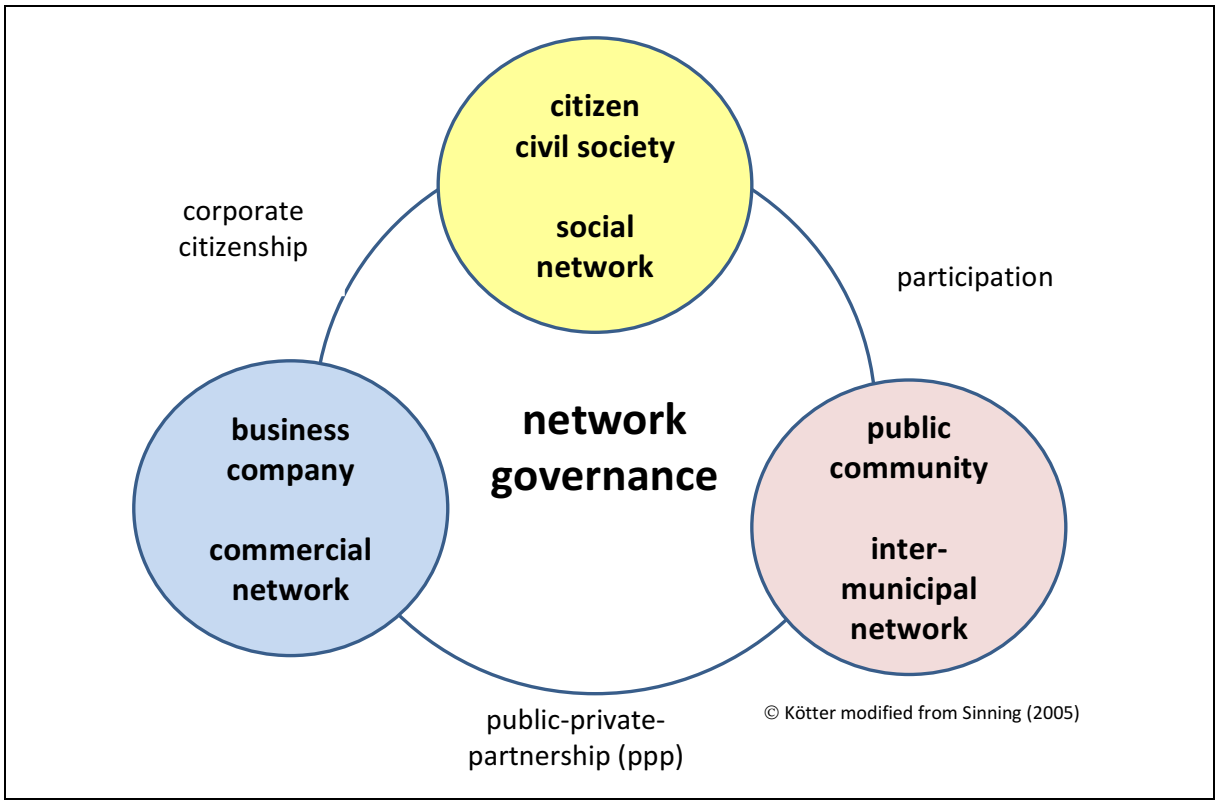

Figure 8: Network governance and stakeholder participation on climate change.

Regional approaches to climate change mitigation and adaptation are necessary to broaden the impact of local climate change governance, otherwise they operate in isolation. Another advantage of the regional level is the greater technical and financial capacity and environmental know-how than within individual cities or towns. Inter municipal network enable larger-scale responses and can link local policies.

Although increased research may reduce some risks, climate policy will always have to be formulated in a context predominated by uncertainty and ignorance. Climate change governance should be reflexive and able to learn from past experiences (Juhola, S.; Westerhoff, L. 2011:241).

Urban climate change measures are often developed outside of an integrated urban planning framework. Short-term responses and outcomes are wished, that hamper long-term systematic approaches. In many cases key challenges such as urban sprawl were not addressed.

As great barriers to successful climate governance on the local level the lack of appropriate institutions or necessary authority, insufficient expertise, and a lack of funding or central support by regional government can be identified. Systematical evaluations of urban climate policy have to be conducted to measure their progress, a huge challenge remaining for many cities.

4. CALL FOR CASE STUDIES CONCERNING URBAN PLANNING STRATEGIES FOR CLIMATE CHANGE

This position paper can be seen as the starting point of a series of contributions between 2012 and 2014 of FIG Working Group 8.1 on successful mitigation and adaptation strategies to deal with climate change based on urban planning. Urban planning and land management can play an important role to enhance the resilience of urban areas, especially as it is the urban poor who are most vulnerable to climate impacts (UN-HABITAT 2010:44, Williamson et al. 2010).

For this period, FIG and especially Commission 8 invites critical research papers and best practice projects that investigate and enlighten the relationship between urbanisation and climate change by addressing the question of how urban planning and land management can respond to the challenge of these two global phenomenons. Among others, possible topics can include:

- energy concepts and new governance structures,
- climate change and civic participation concepts,
- climate-proof land use planning,
- climate protection and transportation in cities,
- urban renewal and new means of climate protection,
- sustaining urban ecosystem services as contributions to climate protection in urban areas.

The collected concepts, methods and concrete examples for effective climate change policies will be elaborated in form of a final report for the FIG World Congress in Kuala Lumpur in 2014.

5. CONCLUSION AND FUTURE DIRECTIONS

As described in the paper, urban planning as a tool for mitigation and adaptation of climate change is becoming more and more important. Experts assume that especially the rise in global temperature and sea levels will intensify climate change-related risks, such as floods, droughts, landslides, and extreme weather events.

In order to be prepared for these disasters in the future, interdisciplinary and precautionary measures with regard to land management are needed. In particular urban planning with respect to the development of urban settlements play an important role in disaster risk management.

The variety of urban planning systems worldwide as well as the multitude of natural and socio-economic aspects of climate change response that differ from place to place make the formulation of general guidelines almost impossible.

In connection with climate change mitigation and adaptation long-term sustainable urban planning is needed, which mainly based on the following measures:

- Identification of climate-proof areas as well as alternative sites that are more suitable for urban development,
- Controlling the type of land use and development in urban areas by land use regulations and building codes,
- Retrofitting and building of settlements adapted to climate change disaster conditions (e.g. elevation of buildings),
- Relocation of urban population vulnerable to climate change risks,
- Renovation of urban energy and transportation systems,
- Engineering measures and construction of climate-proof infrastructure (e.g. construction and improvement of levees and dykes).

Because of the complexity of the effects of climate change and urbanisation, there is a strong need to cooperate between different administrative levels (international, national, regional, local) as well as various types of organisations (governmental, public, municipal, private) and disciplines (land management, water management, housing, energy supply, industry, transport). Against this background, FIG focuses on the surveyor's response to climate change, helping to build climate-proof infrastructure, increasing political relations both at national and international level, and facilitating economic, social and environmental sustainability.

REFERENCES

Barker T., I. Bashmakov, L. Bernstein, J. E. Bogner, P. R. Bosch, R. Dave, O. R. Davidson, B. S. Fisher, S. Gupta, K. Halsnæs, G.J. Heij, S. Kahn Ribeiro, S. Kobayashi, M. D. Levine, D. L. Martino, O. Masera, B. Metz, L. A. Meyer, G.-J. Nabuurs, A. Najam, N. Nakicenovic, H. -H. Rogner, J. Roy, J. Sathaye, R. Schock, P. Shukla, R. E. H. Sims, P. Smith, D. A. Tirpak, D. Urge-Vorsatz, D. Zhou, 2007: Technical Summary. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)].

Boateng, I. (eds) (2010): Spatial Planning in Coastal Regions: Facing the Impact of Climate Change. Publication of FIG Commission 8 Working Group 8.4, FIG Publication NO. 55, Download: http://www.fig.net/pub/figpub/pub55/figpub55.htm.

Breheny, M.J. (1992): Sustainable Development and Urban Form: An Introduction. In: Breheny, M.J. (Ed.): Sustainable Development and Urban Form. London: Pion Limited, p.. 1–24.

Couch, C. & Karech, J. (2006): Controlling urban sprawl: Some experiences from Liverpool. In: Cities, Vol. 23, No. 5, p. 353–363.

German Institute of Urban Affairs (Deutsches Institut für Urbanistik, (Difu)) (eds) 2011: Klimaschutz in Kommunen. Praxisleitfaden. Berlin. Download: http://www.leitfaden.kommunaler-klimaschutz.de/download.html (last access 12/03/2012).

IPCC (2007): Summary for Policymakers. In: Climate Change 2007: Mitigation. Contribution

of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Juhola, S. and L. Westerhoff (2011): Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. In: Environmental Science and Policy 14 (2011), 239-247.

Kamel-Chaoui, L. and A. Robert (eds) (2009): Competitive Cities and Climate Change, OECD Regional Development Working papers No. 2, 2009.

Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino, 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Magel, H. (2005): About Surveyors' Commitment, Role and Education for Society and Sustainable Development, Keynote Address at the Opening Ceremony of the 8th SEASC 2005 on November 22, 2005 in Bandar Seri Begawan, Brunei Darussalam.

Ministerium für Bauen und Verkehr des Landes Nordrhein-Westfalen (eds.) (2009): Klimaschutz in der integrierten Stadtentwicklung Handlungsleitfaden für Planerinnen und Planer. Download: http://www.mbv.nrw.de/Staedtebau/container/ KlimaschutzinderStadtentwicklung_10-2009.pdf.

OECD (2010): Cities in Climate Change, OECD Publishing; http://www.oecd-ilibrary.org/governance/cities-and-climate-change_9789264091375-en.

Parry, M.L.; Canziani, O.F.; Palutikof, J.P.; van der Linden, P.J. and C.E. Hanson (eds) (2007): Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Satterthwaite, D.; Huq, S., Pelling, M., Reid, H. and P. R. Lankao (2007): Adapting to Climate Change in Urban Areas. The possibilities and constraints in low- and middle-income nations. Download. http://pubs.iied.org/pdfs/10549IIED.pdf.

Siedentop, S. (2005): Urban sprawl - verstehen, messen, steuern. In: DISP, Vol. 41, issue 160: 23–35.

Sustainability Center Bremen (eds) 2009: Klimaschutz in der Region Leitfaden Klimaschutz in der städtebaulichen Planung. Download: http://www.klimazwei.de/LinkClick.aspx? fileticket=eVBdvyGZ3EU%3D&tabid=144&language=de-DE.

Tyrväinen, L.; Mäkinen, K. and J. Schipperijn (2007): Tools for mapping social values of urban woodlands and other green areas. In: Landscape and Urban Planning, Vol. 79, issue 1: 5–19.

United Nations Department of Economic and Social Affairs/Population Division: World Urbanization Prospects: The 2011 Revision, Highlights: http://esa.un.org/unpd/wup/pdf/WUP2011_Highlights.pdf.

United Nations Human Settlements Programme (UN-HABITAT) (2009): Planning sustainable cities. Global Report on Human Settlements 2009. http://www.unhabitat.org/downloads/docs/GRHS2009/GRHS.2009.pdf.

UN-HABITAT (2011): Cities and Climate Change. Global Report on Human Settlements 2011. http://www.unhabitat.org/downloads/docs/GRHS2011_Full.pdf.

Williamson, I; Enemark, S; Wallace, J. and A. Rajabilfard (2010): Land Administration for Sustainable Development. First edition.

World Bank (1991): Managing Development - The Governance Dimension, Washington D.C.

Internet sources:
www.umweltbundesamt.de/rup/flaechen/index.htm (last access 16/03/2012).
www.mbv.nrw.de (last access 16/03/2012).

BIOGRAPHICAL NOTES

Dr.-Ing. Frank Friesecke is project manager at the STEG Stadtentwicklung GmbH (Stuttgart, Germany). As partner to public and private concerns, STEG acts as consultant and service provider, as well as sponsoring and investing in all urban planning tasks. Frank's recent works and papers have explored public participation, land use planning and urban regeneration. He is chair of the FIG Working Group 8.1 'Planning Strategy for Urban Development and Regeneration', which analyses urban planning and renewal processes and their economic, ecological and social impacts.

Dr.-Ing. Sophie Schetke is post-doctoral researcher at the Department of Urban Planning and Real Estate Management at the University of Bonn. Sophie´s research areas are Multi criteria assessment (MCA), Decision Support Systems (DSS), and sustainable settlement development focusing on the assessment of Ecosystem Services and Quality of Life in urban areas. She teaches courses in urban planning and urban renewal. She is graduate of the University of Leipzig and holds a diploma in Geography. She received her Phd in urban planning from the University of Bonn in 2010.

Prof. Dr.-Ing Theo Kötter is Chair of the Department for Urban Planning and Real Estate Management at the University of Bonn. His papers and research interests are focused on sustainable development of towns and villages, land management and land valuation. He is co-editor of the magazine "Land management and Land policy" and member of the Academy for Spatial Research and Planning. From 2003-2006 he was chair of the FIG Working Group „Disaster Risk Management".

CONTACTS

Dr.-Ing. Frank Friesecke
die STEG Stadtentwicklung GmbH
Olgastr. 54
D-70182 Stuttgart, GERMANY
Tel. + 49 711 21068-118
Fax + 49 711 21068-112
Email: frank.friesecke@steg.de
Web site: www.steg.de

Prof. Dr.-Ing. Theo Kötter
Dr.-Ing. Sophie Schetke
Institut für Geodäsie und Geoinformation
Professur für Städtebau und Bodenordnung
Nußallee 1
53115 Bonn
Tel. + 49 228 73-2610
Fax + 49 228 73-3708
Email: t.koetter@uni-bonn.de, Schetke@uni-bonn.de
Web site: http://www.igg.uni-bonn.de/psb/