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Liveable City TP. Ho Chi Minh - Adaptation as response to impacts of climate change

Ronald Eckert, Ulrike Schinkel

(Dipl.-Ing. Ronald Eckert, Brandenburg University of Technology Cottbus, Department of Urban Planning and Spatial Design, Konrad-Wachsmann-Allee 4, D-03046 Cottbus, Germany, ronald.eckert@tu-cottbus.de)
(Dipl.-Ing. Ulrike Schinkel, Brandenburg University of Technology Cottbus, Department of Urban Planning and Spatial Design, Konrad-Wachsmann-Allee 4, D-03046 Cottbus, Germany, ulrike.schinkel@tu-cottbus.de)

1 ABSTRACT

The metropolis and economic centre Ho Chi Minh City (HCMC) north of the Mekong Delta is undergoing a rapid urbanization since the opening of Vietnam in the mid-eighties accompanied with a high population growth and an ongoing influx of migrants. As an emerging coastal region the city will be extremely vulnerable to climate change impacts in the future because of its topography. Even today, HCMC has to struggle with already perceptible climate-related problems like flooding, heavy rain events and increased temperatures. Those impacts are brought about or intensified by failures in managing the ongoing urbanization process. In particular the predicted sea level rise (SLR) can lead to a new dynamic in the urban development, which the current planning system is not prepared for. The city's high vulnerability necessitates a profound evaluation of all consequences for the built environment of HCMC and the execution of substantial countermeasures on all levels of urban development planning. One of the most outstanding challenges will be the implementation of an effective and successful adaptation policy and the mainstreaming of adaptation into the current urban planning. Thus, the paper tries to respond on questions like: How can HCMC become a liveable city against the background of climate change? How can urban planning respond to its impacts? And which role does the local population play in future development? In the further course, the paper presents a range of tailor-made solutions to improve the resilience of HCMC's urban areas. These significant results from research on adaptation strategies for megacities in Southeast Asia are compiled in a "Toolkit of adaptation measures to climate change".

2 HO CHI MINH CITY – AN EMERGING MEGACITY

The opening of Vietnam in the course of Doi Moi policy since the mid-eighties and the country's transition from a centrally planned economy to a free market economy initiated a transformation process, which the metropolis HCMC benefits most of. The region in the south of Vietnam is the most important target area of foreign direct investments and possesses double-digit growth rates far in excess of the country's average. Today, HCMC generates 20% and the overall region almost one third of the national GDP (GSO HCMC 2006). Therefore the city and the surrounding provinces are the most important driving forces for the economic growth and the modernization of Vietnam. However, better living and working conditions as well as the country's highest living standard result in an enormous rural-urban migration into the region of HCMC. The economic upswing was therefore attended with a population growth of more than 60% within 15 years, an increase from 3.9 million inhabitants in 1989 (NIURP 1994) to more than 6.2 million in 2005 (table 1; GSO HCMC 2006). The population projections by HCMC's Real Estate Association (HoREA) forecast around 12 million inhabitants in 2025 based on a scenario with an annual growth rate of 3.4% (Do Thi Loan 2008). However, these data do not include unregistered migrants and temporary workers. The actual population will exceed far from the 6 million inhabitants and even the estimations for 2025 have to adjust upwards taking the migrants in HCMC into account.

The land use and the population density differ considerably within HCMC's 2,095 sq.km of administrative area. The rural districts are dominated by agricultural land as well as swamp, marsh and mangroves. While about 600 inhabitants per sq.km live there on average, the population density in the inner districts reaches peak levels of 50,000 inhabitants per sq.km.

3 CLIMATE CHANGE RISK AND VULNERABILITY OF URBANIZED AREAS IN VIETNAM

The fourth IPCC assessment report accentuates the vulnerability of developing countries worldwide to the consequences of climate change. The high significance of climate-dependent economic sectors as agriculture and forestry, the particular endangering of poor people and the lack of financial, technical and personnel capacities make a profound adaptation response crucial for these countries (IPCC 2007; Germanwatch 2008). However, the highest vulnerability is located in the megacities and dense populated coastal regions. In these

"Hot Spots" natural catastrophes can cause heavy impacts on the population and the concentrated investments and infrastructure (Worldbank 2008).

As an "emerging coastal economy" (Carew-Reid 2008: 6) Vietnam will be extremely vulnerable to climate change impacts in the future because of its topography. Most of the Vietnamese population and economic activities are concentrated in the low elevation coastal zone (LECZ) along the more than 3,200 km coastline. This area, defined as continuous coastal area being situated below 10 m above sea level, covers the large part of Vietnam's agricultural und urbanized land and is home to more than 74% (over 60 million) of the Vietnamese population (Carew-Reid 2008). With a predicted SLR of 1 m around 5% of the overall land surface and around 11% of urbanized areas will be inundated, affecting almost 6 million inhabitants and over 10% of the nation-wide industrial production (Carew-Reid 2008; Worldbank 2007). A SLR of 5 m as a worst-case-scenario would affect over 16% of land and over 38% of the Vietnamese population (Dasgupta et al. 2007).

year	population	year	population	year	population
1900	183,900	1954	1,723,400	1989	2,796,200
1907	228,400	1958	1,383,000	1995	3,555,000
1911	249,500	1962	1,431,000	2000	3,992,000
1926	346,700	1967	1,736,900	2004	5,479,000
1939	495,800	1975	2,377,000	2006	6,240,000
1945	976,000	1979	2,701,000	**2025**	**est. 12,000,000**

Tab. 1: Population development of HCMC (Source: GSO HCMC 2006; Do Thi Loan 2008)

3.1 Consequences of climate change for the HCMC region

3.1.1 Flood risk

The metropolis and economic centre HCMC will be particularly affected. Located on the north-eastern edge of the Mekong delta and approximately 50 km inbound from the South China Sea, the city is built mostly on low-lying and marshy land. Over 60% of the administrative urban land and large parts of the surrounding provinces in the west and south-west are situated below 1.5 m above sea level (Ho Long Phi 2007). The estuary of Dong Nai River, Sai Gon River and Nha Be River forms a wide-spread network of rivers and canals with almost 8,000 km length, covering 16% of HCMC's area (Nguyen Minh Hoa and Son Thanh Tung 2007). The infiltration of tides up the Nha Be and Sai Gon River into the urban water system results in a periodic raised water level. Even today, when the tide reaches high peaks up to 1.54 m (Thanh Nien News 15.11.2008) large parts of the low land will be flooded.

Taking the predicted SLR of approximately 1 m until the end of this century into account, this would lead to an inundation of almost the half of HCMC's administrative area or to quantify, of around 860 sq.km of the overall 2,095 sq.km (figure 1; Carew-Reid 2008). However, not only the low elevated areas suffer from flooding. The urban hydrogeology regime is also affected by increasing heavy rain events and flooding from upstream areas (Do Thi Chinh 2008). A high groundwater level and an insufficient and mostly polluted sewer system cause backwater and retard the water run-off. This results in a frequently flooding of wide quarters of HCMC, even in the high elevated areas.

3.1.2 Increased temperature

The urban areas of HCMC will also experience other consequences caused by climate change. In general, the climate in the south of Vietnam is steadily warm to hot and humid all year round. The annual average temperature in HCMC is 26.9°C with peaks in spring of more than 40°C. Within the densely built urban districts the lack of vegetation, standing surface water and evaporation areas, changes in thermal properties of surface materials and human heat generation by air conditioning, transportation or industry led to an overheating of the urban areas (PC HCMC et al. 2007), the so called "Urban Heat Island Effect" (UHI). The uncontrolled expansion of urban land and the increase of building density intensified this effect.

Even today, the UHI effect is clearly noticeable in the inner city districts with up to 10 degrees higher than the average temperature of the surrounding areas. This trend will increase by further raising temperatures. According to the most likely projections the average temperature in the south of Vietnam will further rise by 1 - 2°C until 2050 due to global warming (Booth et al. 1999).

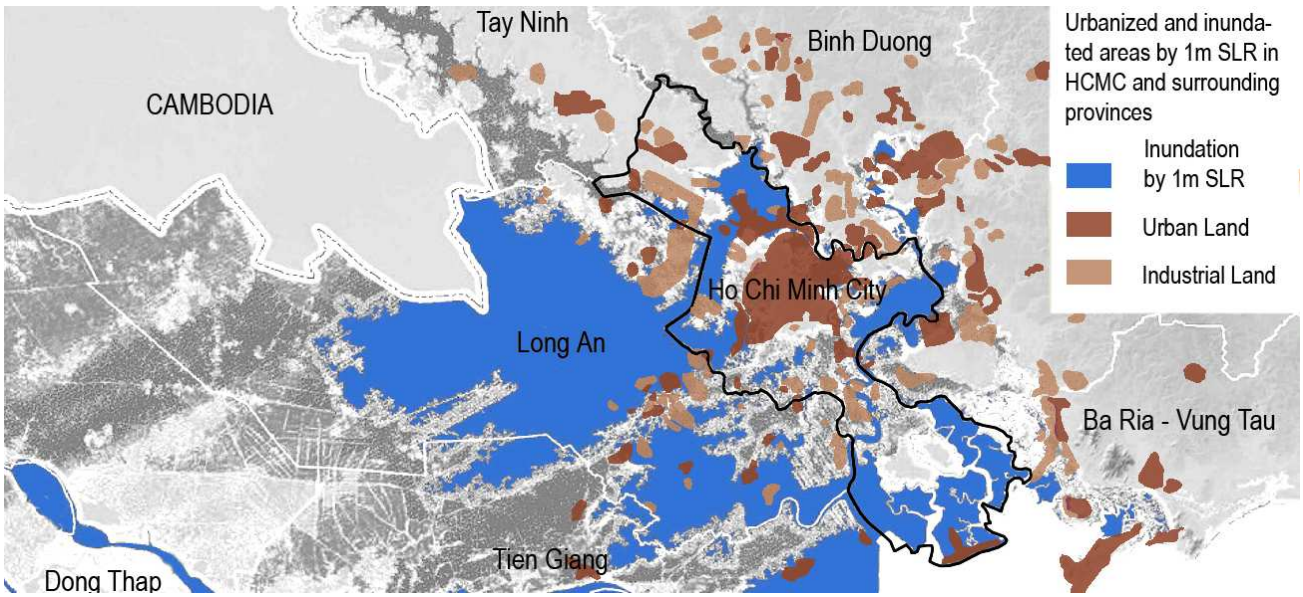

Fig. 1: Urbanized and inundated areas by 1 m SLR in HCMC and surrounding provinces (Own figure; Base map source: Carew-Reid 2008; SIUP South 2007)

3.2 Impacts on the HCMC region

3.2.1 Impacts on the built environment

The rising temperatures will affect the densely built districts of HCMC most. Here, the UHI effect is fostered due to the high ratio of sealed surfaces, the lack of evaporation areas and the reduced air convection. Hence, the increased cooling demand will be coped by an excessive use of air conditioning systems, in particular with an increased living standard in Vietnam. This will lead to a further overheating of the urban space and disproportionately increased energy consumption.

Urban flooding in HCMC has very serious impacts on the built environment. The housing production and the ground sealing by infrastructure on former retention and infiltration areas lead to a reduced drainage and storage capacity for flood and rain water. Even most parts of higher situated urban areas will therefore be inundated by flooding and heavy rain events with impacts on transportation (figure 2; table 2). Traffic jams happen quite often in the rainy season due to flooding. Flooding disperses the wastewater from sewerage all over the city, which causes water pollution, epidemic diseases, damage to houses and infrastructures. Flooding due to tide also causes salinity intrusion, which damages the crops and plants (PC HCMC et al. 2007).

Fig. 2: Flooded urban areas in HCMC (Photos by Vietnam News and Thanh Nien News 2008)

3.2.2 Impacts on population

The predicted SLR of 1 m will endanger more than 660,000 inhabitants or close to 12% of HCMC's population living in areas to be inundated, making HCMC the most affected province in Vietnam (table 2; Carew-Reid 2008). These figures are likely to be significantly higher if the forecasted inundation zones are

adjusted with the phenomena of backwater from the sewer system and reduced run-off capacities. However, the endangering of the Mekong Delta will probably have the most remarkable influence on population flows. With 15,000 – 20,000 sq.km area at risk, including more than 1,000 sq.km of agricultural land, the region will be the worst affected in Vietnam (IPCC 2007). This implies the loss of livelihoods for more than four million people (Carew-Reid 2008) and could lead to a new dynamic of migration influx into the HCMC region. The inundation of wide parts of the Mekong Delta will result in Vietnam's first climate change refugees.

Urban heat waves will be intensified within the dense built areas of HCMC and will influence the health and comfort of urban residents in a negative way. In particular the elderly, invalids, and the urban poor are most vulnerable to high temperatures.

Sector	Total	Predicted impact	% affected
Impact on land	2,095 sq.km administrative area	862 sq.km inundated area	43.0%
Impact on urban area	380 sq.km urban area	40 sq.km inundated urban area	10.5%
Impact on population	6,240,000 inhabitants	664,000 affected inhabitants These figures are likely to be significantly higher if the forecasted inundation zones are adjusted with the phenomena of backwater from the sewer system and reduced run off capacities.	10.6%
Impact on infrastructure	1,456 km transport infrastructure	226 km affected infrastructure	15.6%
Impact on industry	5,496 enterprises	491 affected enterprises	8.9%

Tab. 2: Impacts on the built environment and the population of HCMC by a 1 m SLR (Source: Carew-Reid 2008; GSO HCMC 2006)

4 CLIMATE CHANGE AND URBAN DEVELOPMENT IN HCMC

4.1 Failures of the current urban development

Even today, HCMC has to struggle with already perceptible climate-related problems, whose impacts are brought about or intensified by failures in managing the ongoing rapid urbanization since the mid-eighties. Since then, large parts, particularly in the northern and western territories of the city, had become built-up areas (PC HCMC et al. 2007). This uncontrolled urban expansion and land use change brought about by urbanization go along with an excessive change of natural land cover to sealed surfaces, the removal of natural retention and infiltration areas for precipitation, increased traffic volumes, and increased emissions related to transportation and industrial production. In addition to the population growth, the settlement area of HCMC has more than doubled in the past 20 years (figure 3; Tran Thi Van and Ha Duong Xuan Bao 2007). As a result of the mostly spontaneous land occupation, the adequate provision of technical and social services often lag behind in the marginal settlements on the outskirts as well as in inner city slums, causing considerable negative effects on the environment and urban society of HCMC (Wüst et al. 2002).

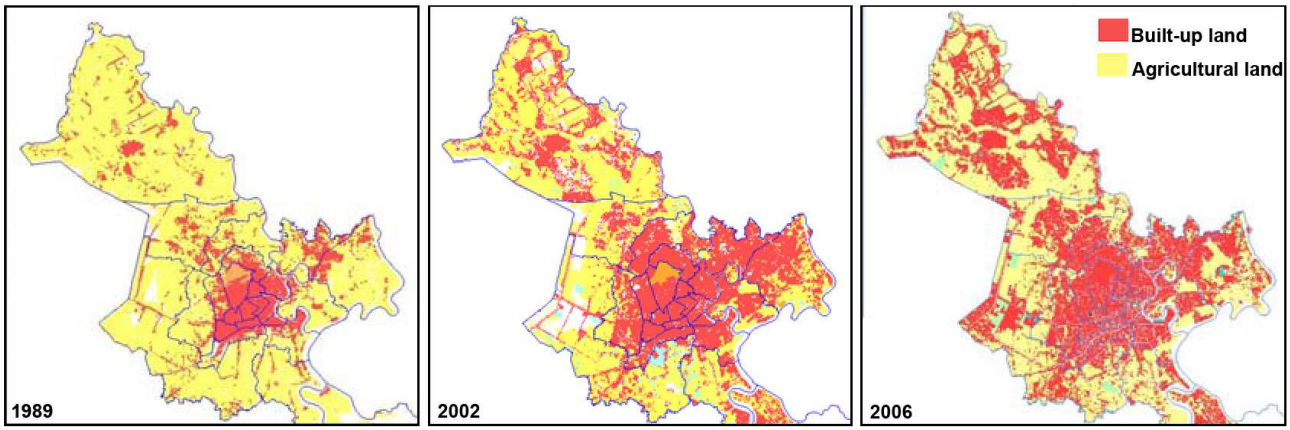

Fig. 3: Urban land cover change in the central and northern part of HCMC (Source: Tran Thi Van and Ha Duong Xuan Bao 2007)

However, even the formally planned urban growth neglected climate change issues considerably. The majority of current housing construction activities in HCMC are concentrated in large-scale urban expansion projects at the city's periphery in the south (Saigon South) and the east (Thu Thiem). Here, completely new urban districts were or will be created on low elevated, predominantly marshy land, which previously served as buffer area in times of flooding (Eckert 2009). These new neighbourhoods are basically influenced by

imported international urban design concepts and neglect traditional life styles and behaviour patterns of the Vietnamese population. The lack of working facilities, social and commercial infrastructure nearby induces enormous traffic flows, even today, when only a part of the projected population life there.

Less than 10 years after construction, damages of the area's main development axis, the Saigon South Parkway, were observed due to land subsidence. The Parkway already had to be elevated by 1-2 m. Also, the planning for another major project, the Thu Thiem New City Center opposite central District 1, had to be redesigned after significant delays during the implementation period. The endangering of wide parts of the proposed construction land by flooding will cause the necessity of cost-intensive landfilling before constructions can start (Eckert and Waibel 2009). These examples show first adaptation measures recently implemented in HCMC.

4.2 Challenges for the future urban development

Against the background of climate change, it is necessary to carry out a profound evaluation of all consequences for the built environment of HCMC and to develop substantial countermeasures on all levels of urban development planning. In particular, the predicted SLR can lead to a new dynamic in the medium up to long term urban development, which the current urban planning system is not prepared for. One of the most outstanding challenges will be the adjustment of the current land use management within the HCMC region to cope with the limited land availability. Due to the continuing population growth and the ongoing influx of migrants, the demand for housing space, particularly for the lower income groups, remains very high. Taken the projected SLR into account, potential areas for future housing developments will be reduced dramatically. While a majority of the already built-up inner-city districts are located on areas with good land conditions (defined as areas 2 m above sea level and good soil conditions), nearly 50% of the suburban districts are indicated as flood-prone areas or at least as areas unsuitable for long-lasting constructions (PC HCMC et al. 2007). However, these areas in the rapid growing suburban periphery pose the main potential for future building sites.

Both, the compact urban structures in the inner-city districts and the large-scale urban expansion projects as well as the sprawl on the outskirts of HCMC show shortcomings in their resilience to the impacts of climate change. Though, all urban typologies will have an individual capability to cope with problems related to flooding, high precipitation, and increased temperature and therefore, they need a slightly different approach for adaptation. The IPCC points out a broad spectrum of potential adaptation measures, ranging from purely technological measures like flood defences, the optimization of urban form and land use, or the dislocation of settlements. Further the IPCC mentiones behavioural measures like influencing the human life styles (e.g. with regard to mobility behaviour or energy consumption), managerial measures like altered farm practices, and policy measures like changing legal planning regulations (IPCC 2007). Ultimately, an effective and successful adaptation policy will consist of relevant options for all sectors. Focussing on the built environment the following approach generally deals with technological and implementation measures.

5 ADAPTATION AS RESPONSE

5.1 Need for action

Since HCMC has to struggle with increasing flooding events in large parts of the urbanized area, "low-tech" adaptation measures on the micro-scale can be already observed. In particular, structural modifications on private houses, like the elevation of doorsteps at the ground floor to prevent the influx of water, umbrellas for food stalls, or the construction of houses on piles were spontaneously developed by HCMC's inhabitants (figure 4). However, to effectively respond to the mentioned problems, current and future impacts of climate change have to be taken into account and therefore, the mainstreaming of adaptation responses in urban, socio-economic, and other sectoral strategies has to be emphasized in development planning.

As a first step, the impacts of climate change on HCMC and related vulnerabilities have to be assessed. Based on the results, adequate adaptation measures have to be identified. To achieve a sustainable urban development, the capacity of the local authorities has to be strengthened, and equally, a special focus has to be put on awareness rising among the local population and on the advancement of human resources. In the further course, concrete adaptation measures of various sectors are to be summarized in a toolkit with a main

focus on the neighbourhood level. Adaptation measures on the conurbation level and on the building scale will be developed accordingly.

Fig. 4: Small-scale adaptation measures observed in HCMC (Photos by Christian Voigt and the authors)

5.2 "Toolkit of adaptation measures to climate change"

The objective of the "Toolkit of adaptation measures to climate change" is to provide a range of tailor-made solutions against the consequences of climate change in HCMC. The toolkit illustrates responses to problems related to the two thematic fields of "Urban Flooding" (heavy rain events, sea level rise and ground water level rise) and "Urban Climate" (rising temperatures, heat islands). Higher-ranking sectoral responses lead to concrete adaptation measures on the conurbation level, the neighbourhood level and the level of buildings.

In the thematic field of "Urban Climate" for example, one sectoral approach to tackle the problem of rising temperatures and occurring heat islands would be the increase of the proportion of green space, the planning of green infrastructure and the reduction of sealed surfaces. In order to achieve these results, various adaptation measures may be implemented at different spatial levels. The construction of green roofs and facades on individual buildings can be integrated into a network of smaller green spaces or pocket parks on the neighbourhood level, which in turn may be part of a larger green grid on the conurbation level. This specific example illustrates the possibility to break adaptation strategies on the macro-level down to the meso-level and further down to the micro-level. According to the special problem background of the city, an evaluation of all adaptation measures will help to filter out actually relevant measures for HCMC. The adaptation measures of the toolkit in its whole shall be transferable to other cities in similar climatic circumstances. The following table presents a "work-in-progress" status of the adaptation toolkit and does not claim to be complete.

Urban Flooding (Sea Level Rise, Heavy Rain Events, Ground Water Level Rise)

Sectoral Response	Adaptation Measures
Source Control/ Land Use	▪ Moving of vulnerable settlements → resettlement or relocation → sustainable strategies for the Vietnam Urban Upgrading Project (VUUP) ▪ Upland management (Upland and lowland reservoirs) ▪ Shift of future key settlement areas to flood-save zones → north-east, north-west of HCMC
Drainage Systems	▪ Sustainable Urban Drainage System (SUDS) ▪ Managing flood pathways
Storages	▪ Flood attenuation / provision of temporary water storage (Greenwood Village 2005) (up- and off-stream storage, underground and channel storage, retention storage, detention storage)
	▪ One way valves fitted in drains and sewage pipes to prevent backflow
Vegetation	▪ Networks of green corridors → connection between existing parks and green spaces in District 1 and extension to other areas of HCMC
	▪ Green infrastructure (pocket parks, street trees, networks of green roofs)
	▪ Green infrastructure (green roofs (run-off reduction))
Water Resources and Quality	▪ Separate drainage systems for surface water and foul water ▪ SUDS (management of quantity and quality of run-off)

	▪ Rainwater harvesting, collecting and storage, SUDS ▪ Xeriscaping and permaculture landscaping techniques/ Storm overflow management ▪ Canal cleaning and removal of dilapidated structures → to ensure unhindered water flow in flood-prone low-income area of HCMC
	▪ Water efficient fixtures and fittings ▪ Rainwater harvesting and storage (building-scale SUDS)
Community-Based Adaptation	▪ Temporary migration → provision of emergency shelter ▪ Need-based service mechanism to support vulnerable households ▪ Community mobilization and awareness rising → structured training programmes ▪ Community driven adaptation strategies and actions ▪ Capacity building in technical and scientific knowledge about climate change ▪ Strengthening health-coping strategies (related to water-borne diseases) ▪ Disaster risk management → provision of early warning equipment and rescue equipments
Institutional Framework	▪ Committed policy action from governments, civil society and international community, multi-stakeholder dialogues
	▪ Engaging social movements at the local level, undertaking civil society action
Flood Defences	▪ Riverbanks, walls along rivers, outfalls and storage reservoirs, sluices (NAO 2001)
	▪ Dry / wet proofing, floating homes, amphibian homes (Nehlsen et al. 2007) ▪ Small scale low-tech adaptation in HCMC → raise and flexible use of ground floor level, umbrellas for food stalls, houses along canals on piles

Urban Climate (Rising Temperatures)

Sectoral Response	Adaptation Measures
Increase Proportion of Green Space + Infrastructure, Reduction of Sealed Surfaces	▪ Linked network of well-irrigated open spaces, green corridors ▪ Green infrastructure (greenways, rain gardens, wetlands restoration, trees, green roofs, swales, native landscaping)
	▪ Smaller open spaces, street trees, pocket parks ▪ Networks of green or living roofs
	▪ Green roofs, walls, facades
Increase Proportion of Water Bodies	▪ Blue pace, water, river, lakes, urban canals
	▪ Ponds, roadside swales, flood-balancing lakes, swimming pools, fountains
	▪ Use of (rain-) water for cooling
Solar Control	▪ Shading and orientation to reduce excessive solar gain
	▪ Cool pavement materials to increase of surface reflectivity ▪ Orientation of buildings and streets according to wind direction and solar irradiation ▪ Compact construction method: mutual shadowing of adjoining structures, shaded public spaces
	▪ Compact housing typologies, reduced solar irradiation, passive shadow elements → promotion of traditional Vietnamese housing typologies
Increase Ventilation	▪ Joint fresh-air corridors
	▪ Orientation of buildings and streets according to wind directions
	▪ Increase of natural ventilation → promotion of traditional Vietnamese housing typologies
Cooling	▪ Increase of rainfall permeability to benefit from the cooling effect of evaporation ▪ Network of cool roofs ▪ Light-coloured materials to prevent solar heat gain
	▪ Shading and advanced glazing systems, cool building materials, mechanical cooling, use of thermal storage (to absorb heat)

Legend	Conurbation Level	Neighbourhood Level	Housing Typology

Tab. 3: Toolkit of adaptation measures to climate change (excerpt)

5.3 Strategies for implementing adaptation measures

After filtering the composed adaptation measures according to their relevance for the context of HCMC, proposals for their implementation in potential pilot projects can been made. Though, a two-fold approach have to be taken, adaptation of the built environment, urban renewal and regeneration on the one hand and adaptation of urban growth and expansion on the other.

5.3.1 Adaptation in the field of urban renewal and regeneration

As the population of HCMC has been significantly increasing for more than 15 years (table 1), the provision of infrastructure and social amenities could not keep pace. Especially in the north and west of the city, this rapid growth led to the manifestation of large low-income areas with serious infrastructure shortcomings and a strong demand for urban renewal (INFRA-TL and EPC 2005). The institution in charge for urban upgrading and renewal in Vietnam is the Vietnam Urban Upgrading Project (VUUP). It is funded by the World Bank and carried out in Hai Phong, Nam Dinh, Can Tho and Ho Chi Minh City. The project's main objectives are poverty alleviation in urban areas, infrastructure upgrading and improvements of environmental sanitation. Additionally, the project aims at the increase of living standards of low-income areas and at the provision of micro finance to poor households (HUUP 2007).

The "Toolkit of adaptation measures to climate change" proposes concrete adaptation measures, such as the renovation of unstable structures to prevent dilapidation during heavy rain events, integration of green infrastructure to reduce surface run-off, such as pocket parks, reblocking measures to increase natural ventilation, the use of rainwater, cool pavement materials and shadow elements for cooling. In comparison to urban expansion, urban renewal and regeneration measures in existing neighbourhoods severely affect local residents, especially in low–income areas. Therefore the local community's involvement in planning, implementation and monitoring processes is essential. According to Shorbagi and Samol (2005) community participation will lead to improved efficiency in project implementation as well as enhanced effectiveness, as measures are adapted to the needs of the target group. Moreover, the sustainability, impact and replicability of the project are enhanced. Apart from participation in renewal projects, community involvement is necessary to react on arising problems related to climate change like flooding or rising temperatures occurring within the neighbourhood. Local communities have different levels of resources they can rely on (Pierson 2008) which consequently lead to various levels of participation, starting with the concepts of manipulation, information and consultation and continuing with consensus building, partnership, self-responsibility and self-determination. Taking these different levels into account, the 'Toolkit of adaptation measures to climate change' also comprehends community-based adaptation measures with different levels of participatory involvement, which range from community mobilization and awareness rising, strengthening health coping strategies related to water-borne diseases, capacity building in technical and scientific knowledge about climate change up to community driven adaptation strategies and actions, such as community-based flood warning systems or a self-organized waste management service.

The implementation of participatory projects depends on a well-organized and motivated civil society. Vietnam's urban administration is highly centralised on the one hand and decentralised on the other: While the government in Hanoi is responsible for laws and decrees concerning urban and housing policy, the People's Councils of cities and towns have certain autonomy regarding urban planning and development as well as administration. In HCMC, the 19 urban and five rural districts are directly guided by People's Committees and act with a certain independence from city authorities in planning and implementing of programmes. The sub-district People's Committees do not have own funds but work closely with the local police and organize social services. The Communist Party acts beyond this administrative structure and has a unifying influence on policy (Coit 1998). The emerging civil society sector of Vietnam comprises of mass organizations of the Communist Party, which occupy a position between the state and citizens having members and cells in every neighbourhood, local associations, professional and commercial associations, minority and religious groups, traditional village associations, and local city organizations (Perry 2004). However, Vietnam "does not, as yet, have a significant NGO or CBO sector" (Perry 2004, IX: 5).

In 2001, Vietnam has initiated a Public Administrative Reform (PAR) process, covering four reform areas (institutional, organisational, human resource and financial). To build the capacity of the HCMC local authority in planning and management and to develop and pilot a new urban governance model, the "Support to PAR in HCMC 2007-2011" (SPAR) Project was launched. One of the project's priorities is to encourage participation of people and society in management and public administration reform activities (Government of the Socialist Republic of Viet Nam and UNDP 2007). Provided that SPAR can establish a new governance model, projects on the neighbourhood level can be successfully implemented and may meet the challenge to enhance participation and adaptive capacity of concerned local communities to climate change and climate variability in HCMC.

5.3.2 Adaptation in the field of urban expansion

Against the background of an ongoing population growth and an increasing demand for housing space even the future urban fabric has to be adapted to the risks related to flooding, increased precipitation and high temperatures. Evidence of the above mentioned examples Saigon South and Thu Thiem show the necessity to figure out all relevant adaptation measures from the outset of the design process. This decision-making process starts with the adequate choice of building sites on flood-safe areas and ends on the scale of specific structural building details. Thus, a comprehensive planning framework with regulations and recommendations has to be developed and implemented into the national or local building code.

A great number of measures, mentioned above in the toolkit, aim at the adaptation and optimization of the urban infrastructure (water and waste water distribution, drainage systems, sewers, flood defences, provision of green infrastructure, etc.). Generally the public administration of HCMC is in charge of provision of adequate urban infrastructure and in particular, of it's adaptation to the challenges of climate change impacts. However, due to limited financial capacities, investments in public infrastructure were mainly funded by international donors from the development assistance in the past. These cash flows are likely to decrease in the future (Massmann 2008). Therefore, the private sector has to be more involved in infrastructure investments via public-private-partnership (PPP) models. Nevertheless, the awareness rising of the property market's driving forces will be crucial. Here the current "frozen market" due to the drawback of foreign capital and the resulting capital shortage of the most developers seems to be a good opportunity. A lot of housing projects in the planning or implementation stage were stopped and new investments were valued critically by almost all potential developers. According to Vietnam Real Estate (VietRees) most of the developers have to reorientate their investment strategies off from short-term profits to long-term and stable investments (Viet-Rees 2009).

Adaptation measures certainly rank at the top of the agenda due to the high vulnerability of HCMC. However, the ongoing rapid urbanization made the city the country's main emitter of human induced green house gases (GHG). The existing urban structures as well as future developments carry a significant potential to reduce the consumption of resources and to lower emissions. As Peter Droege with the label "mitaptation" proclaims, common aims of a sustainable urban development have to be combined with adaptation and mitigation strategies (Droege 2006: 70).

6 CONCLUSION AND OUTLOOK

To safeguard the future of Ho Chi Minh City and to steer its development towards a sustainable megacity, urban planning has to take into account the current and future impacts of climate change. To achieve this overall objective, emphasis has to be placed on the mainstreaming of adaptation responses in urban, socio-economic and other sectoral strategies. The presented "Toolkit of adaptation measures to climate change" provides sectoral solutions against impacts of climate change, but demonstrates only a theoretical methodology to tackle the problem. To substantially change the current planning trend, adaptation has to be firmly integrated in new planning systems and governance models. As impacts of climate change severely affect the local population, the residents themselves will play an important role in future developments. Community-based adaptation for example will be a considerable measure on the neighbourhood level.

7 ACKNOWLEDGEMENT

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8 REFERENCES

BOOTH, T. H.; NGUYEN HOANG NGHIA; KIRSCHBAUM, M. U. F.; HACKETT, C. and JOVANOVIC, T. (1999): Assessing Possible Impacts of Climate Change on Species Important for Forestry in Vietnam. In: Climatic Change 41. pp. 109-126. Dordrecht.

CAREW-REID, J., Ed. (2008): Rapid Assessment of the Extent and Impact of Sea Level Rise in Viet Nam. International Centre for Environment Management (ICEM). Brisbane.

COIT, K. (1998): Housing Policy and Slum Upgrading in Ho-Chi-Minh City. In: Habitat Intl., Vol. 22, No. 3. pp. 273-280. Paris.

DASGUPTA, S.; LAPLANTE, B.; MEISNER, C.; WHEELER, D. and YAN, J. (2007): The Impact of Sea Level Rise on Developing Countries. A Comparative Analysis. World Bank Policy Research Working Paper 4136. Washington.

DO THI CHINH (2008): Urban Flooding in Ho Chi Minh City: The Causes and Effects. Paper presented at International GIS Summer School 2008. Geographical Information Science for Urban and Regional Development in Asia and Africa, September 21 - October 4, 2008. Vientiane (Laos).

DO THI LOAN (2008): Vietnam Property Market. Unpublished Presentation during the Starter Forum on October 22, 2008. Ho Chi Minh City.

DROEGE, P. (2006): The Renewable City. A Comprehensive Guide to an Urban Revolution. Chichester.

ECKERT, R. and WAIBEL, M. (2009): Climate Change and Challenges for the Urban Development of Ho Chi Minh City / Vietnam: In: Pacific News 31. pp. 18-20. Hamburg.

ECKERT, R. (2009): Klimagerechte und energieeffiziente Siedlungsstrukturen in urbanen Wachstumszentren Vietnams. Strategien für Stadtentwicklung und Wohnraumversorgung zur Anpassung an die Folgen des Klimawandels in Ho Chi Minh City. In: ISB Leipzig, Ed.: Proceedings of Anderes Klima. Andere Räume! Zum Umgang mit Erscheinungsformen des veränderten Klimas im Raum. November 3 – 4, 2008. Leipzig. (forthcoming)

GERMANWATCH, Ed. (2008): Globaler Klimawandel. Ursachen, Folgen, Handlungsmöglichkeiten. Bonn, Berlin.

GREENWOOD VILLAGE, Ed. (2005): Greenwood Village Drainage Criteria Manual. Available online: www.greenwoodvillage.com/documents/CommunityDevelopment/DrainageManual/ch13.pdf. Last accessed: 04.02.2009.

GOVERNMENT OF THE SOCIALIST REPUBLIC OF VIETNAM and UNDP (2007): Support to PAR in HCMC 2007 – 2011. Ho Chi Minh City.

GSO HCMC, GENERAL STATISTICAL OFFICE HO CHI MINH CITY, Ed. (2006): Statistical Yearbook of Ho Chi Minh City 2005. Ho Chi Minh City.

HO LONG PHI (2007): Climate Change and Urban Flooding in Ho Chi Minh City. In: Finish Environment Institute (SYKE), Ed.: Proceedings of Third International Conference on Climate and Water, September 3 - 6, 2007. pp. 194-199. Helsinki.

HUUP, HCMC URBAN UPGRADING PROJECT MANAGEMENT UNIT and PC HCMC, HO CHI MINH CITY PEOPLE'S COMMITTEE, Eds. (2007): For a Sustainable Community Development. Ho Chi Minh City.

INFRA-TL, THANG LONG INFRASTRUCTURE DEVELOPMENT COMPANY and EPC, INVESTMENT AND ENVIRONMENTAL PROTECTION CONSULTATION COMPANY, Eds. (2005): Independent Monitoring on the Resettlement Action Plan (RAP) Implementation. The Second Time Report. Ho Chi Minh City.

IPCC, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Ed. (2007): Climate Change 2007 - Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel of Climate Change. Cambridge.

MASSMANN, O. (2008): Assessing the PPP Enabling Environment in Viet Nam. Paper presented at the ADB Workshop: Strengthening Public-Private Partnership (PPP) for Infrastructure Investment in Viet Nam. November 3 – 7, 2008. Hanoi.

NAO, NATIONAL AUDIT OFFICE, Ed. (2001): Inland Flood Defence. Report by Comptroller and Auditor General, HC 299, Session 2000-2001. Available online: http://www.riksrevisjonen.no/NR/rdonlyres/372C7DB1-E239-45D3-9DBC-57A2BF578546/0/2001UKInlandFloodDefence.pdf. Last accessed: 04.02.2009.

NIURP, NATIONAL INSTITUTE FOR URBAN AND RURAL PLANNING, Ed. (1994): Data Book Ho Chi Minh City. Hanoi.

NEHLSEN, E.; WILKE, M.; GOLTERMANN, D. and PASCHE, E. (2007): Flood Mitigation Using Cascading Dike System. In: Heneka, P.; zum Kley, B.; Tetzlaff, G. and Wenzel, F., Eds.: Proceedings of 8. Forum DKKV/CEDIM: Disaster Reduction in a Changing Climate, October 15 - 16, 2007. Karlsruhe.

NGUYEN MINH HOA and SON THANH TUNG (2007): Governance Screening for Urban Climate Change Resilience-building and Adaptation Strategies in Asia: Assessment of Ho Chi Minh City, Vietnam. Institute of Development Studies (IDS). Brighton.

PC HCMC, HO CHI MINH CITY PEOPLE'S COMMITTEE; UPI, URBAN PLANNING INSTITUTE OF HCMC and NIKKEN SEKKEI, Eds. (2007): The Study on the Adjustment of HCMC Master Plan up to 2025. Unpublished Final Report. Ho Chi Minh City.

PERRY, K. (2004): CURA – Comprehensive Urban Renewal Areas Feasibility Study in the Tan Hoa – Lo Gom Basin, Ho Chi Minh City. Final Report. Ho Chi Minh City.

PIERSON, J. (2008): Going Local – Working in Communities and Neighbourhoods, in association with Community Care. Oxon.

SHORBAGI, M. el and SAMOL, F. (2005): Modul 2: Partizipation, Self-help and Public Relations. Improvement of Sanitation and Solid Waste Management in Urban Poor Settlements. GTZ, Deutsche Gesellschaft für Technische Zusammenarbeit GmbH. Eschborn.

SIUP SOUTH, SOUTHERN SUB-INSTITUTE OF URBAN AND RURAL PLANNING, Ed. (2007): Ho Chi Minh City Metropolitan Region Construction Planning. Unpublished Report. Ho Chi Minh City.

THANH NIEN NEWS (15.11.2008). Record flood tide swamps southern hub. Ho Chi Minh City.

TRAN THI VAN and HA DUONG XUAN BAO (2007): Urban Land Cover Change through Development of Imperviousness in Ho Chi Minh City, Vietnam. In: Asian Association on Remote Sensing (AARS), Ed.: Proceedings of 28th Asian Conference on Remote Sensing, Kuala Lumpur.

VIETNAM REAL ESTATE (VietRees), Ed. (2009): Low-End Housing Market Set to Recover this Year. Available online: http://www.vietrees.com/index.php?navi=news&article_id=7564. Last accessed: 30.01.2009.

WORLD BANK, Ed. (2007): Adapting to Climate Change. East Asia Environment Monitor 2007. Washington.

WORLD BANK, Ed. (2008): Climate Resilient Cities. A Primer on Reducing Vulnerabilities to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities. Sustainable Development - East Asia and Pacific Region. Washington.

WÜST, S.; BOLAY, J.-C. and DU, T. T. N. (2002): Metropolization and the Ecological Crisis: Precarious Settlements in Ho Chi Minh City, Vietnam. In: Environment & Urbanization 14. pp. 211-224.