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The Dynamics of Urban Change in Times of Climate Change – the Case of Ho Chi Minh City

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1 ABSTRACT

According to the redefined role of urban environmental planning in times of climate change, spatial planning concerns the impact assessment of space and place as a basis for action or intervention. Accepting this new task, spatial planning goes beyond traditional urban land use planning to bring together, draw upon and integrate policies for urban development and land use. The challenge of a changing climate influences both the nature of urban spaces and profoundly how they can function. Recently the Vietnamese political and administrative authorities have become conscious of their responsibilities relating to climate change effects and associated impacts. They have also become aware that if not addressed, the inadequate and unsustainable urban planning practices will exert an influence on many of the future climate change related challenges for many generations to come.In general, there is a methodological void between regional climate change models and urban development scenarios, which is limiting effective impact assessments. Knowing future temperature, precipitation and flooding trends without knowing the general urban development path, limits the assessment of vulnerabilities for future urban structures in relation to the future climate conditions in a regional context. To assess and illustrate the inter-linkages between dynamic urban development processes and the feedback on the urban climate itself, our research strategy is strongly focused on parameters describing the urban structure and their functional properties. Urban planning scenarios linking urban development and climate change are exploring the main driving forces of future risk.

2 LAND USE PLANNING IN HO CHI MINH CITY

The Department of Natural Resources and Environment (DoNRE) is responsible for the land use plan of Ho Chi Minh City (HCMC) for the next planning period 2025 and for the assessment of all spatial plans in HCMC by means of the environmental impact assessment (EIA) procedures. Recently the Vietnamese political and administrative authorities have become conscious of their responsibilities relating to climate change effects and associated impacts. They have also become aware that if not addressed, the inadequate and unsustainable urban planning practices will exert an influence on many of the future climate change related challenges for many generations to come.

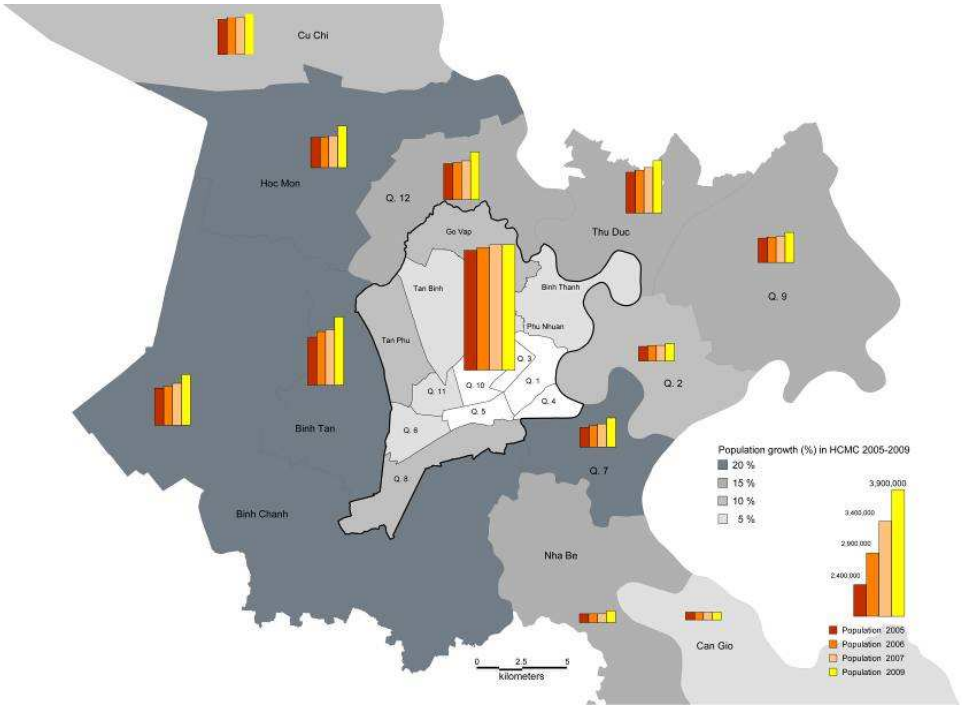

Figure 1: Population change in HCMC's districts 2005-2009.

The settlement area of HCMC has more than doubled during the urbanisation processes of the last 20 years, with an estimated population of 7.1 million official inhabitants in 2009 plus around 2 million additional migrants (SO-HCMC 2009). In 2009 the inner districts of HCMC experienced for the first time a significant stagnation or decrease in population, while at the same time the surrounding periphery districts show a sharp spike in population with often an increase of more than 20% (see figure 1).

By the year 2025, on the basis of the current HCMC urban development master plan, the available agricultural land (121,000 ha in 2008, ca. 58% of the total area) will reduce to 83,000 ha, with 38,000 ha rezoned as construction land and becoming available for new developments (VNNEWS 2010). Alongside this ongoing urbanisation (see figure 2), comes the loss or deterioration of the valuable surrounding multi-functional green and open spaces, which are not only important for agricultural production but also for the regulation of both the urban climate and urban water balance of HCMC (STORCH et al. 2011; RUJNER et al. 2010). If planned in an inappropriate manner such an expansion would increase the physical and social vulnerabilities of both the existing and planned urban system to climate change impacts as well as place a greater number of people at risk from thermal stress and inundation (KATZSCHNER 2010; THINH et al. 2009).

The DoNRE is one of the central actors for the official planning of the future structure of HCMC. This implicates an increasing importance within the administrative structure of the city, but also an increasing pressure and essential necessity to adapt its own planning to the unavoidable future impacts (STORCH & DOWNES 2010; STORCH et al. 2009). Integrating climate change considerations into land use planning in HCMC is a complex decision making problem, which requires a careful assessment of the decision situation, related to the concrete places and spaces. A wide array of adaptation options are available, but more extensive adaptation than that currently occurring is necessary to reduce the overall vulnerability to climate change significantly.

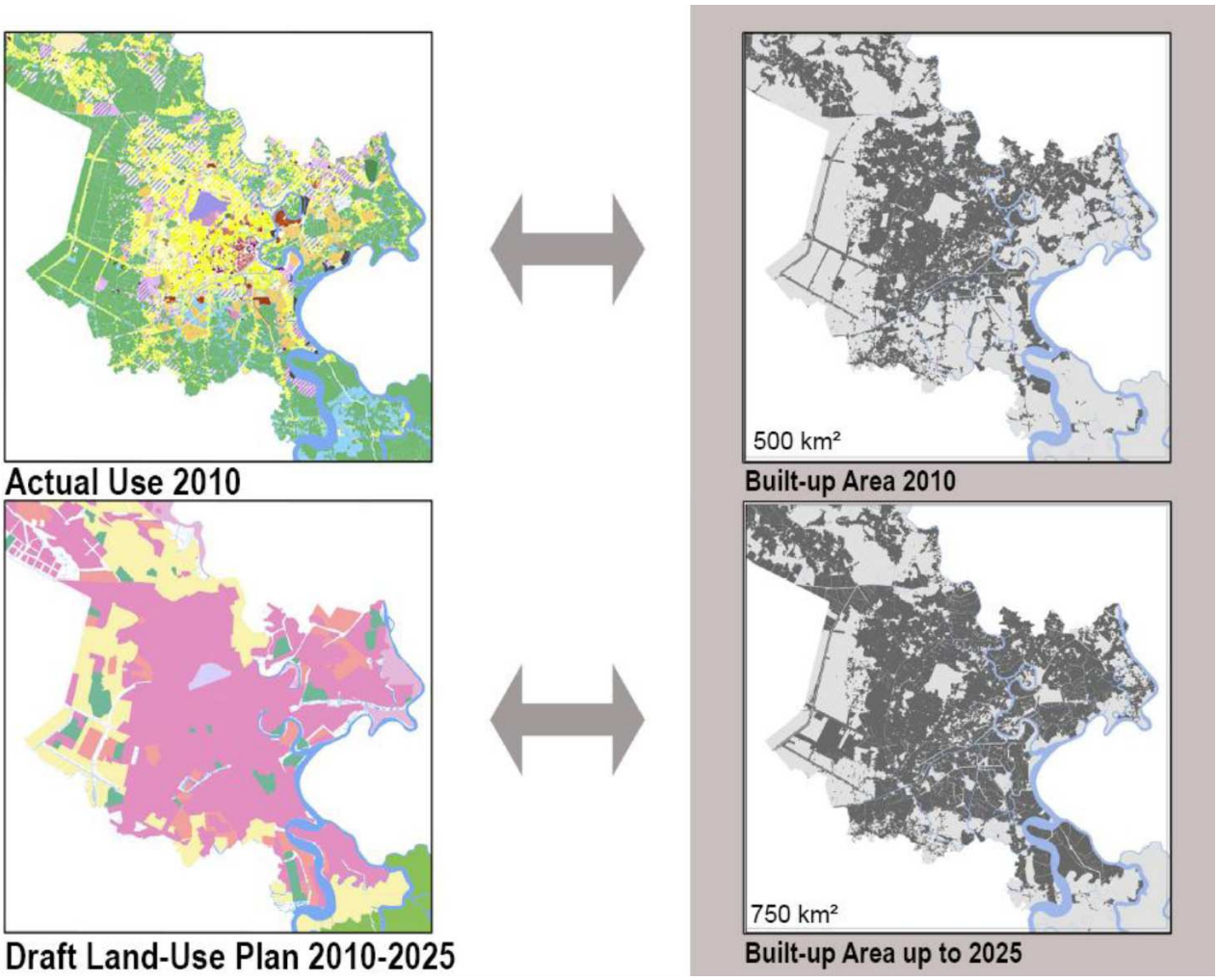

Figure 2: Land use Planning and resulting Changes of Built-up Areas in HCMC 2010 to 2025

Currently in Vietnam an important aspect of the difficulty in implementing the adaptation measures into spatial planning is the lack of tools and methodologies to instruct and consult the administrative decision makers and more sectoral experts on the local level Improving and developing the essential tools and methodologies for spatial analysis needed for spatial adaptation strategies are important activities that should be carried out immediately.

In HCMC autonomous environmental planning for the concretisation of regional requirements is presently not seen. Upon their request, the main focus is on the provision of support and assistance to DoNRE for the adaptation of HCMC's land use planning to the current and future climate-related impacts. Therefore the research results are needed to be capable of fulfilling the prerequisites of the new land use plan in terms of both transparency and professionalism. From our research work DoNRE expects:

- The provision of indicators and forecasts for climate change related impacts.
- The development of adaptation measure for integration into land use planning.
- The drafting of an implementation plan and guidance with the integration of methods throughout the implementation process.
- The establishment of monitoring and evaluation criteria for spatial planning.
- The establishment of criteria for climate proofing, strategic environmental assessment and environmental impact assessment.

It is envisaged that through the mutual development and discussion of adaptation planning for HCMC, the administrative planning bodies will be encouraged to treat other aspects of environmental protection and the protection of natural resources in a similar way. Their interest in the classification of protected areas and the determination of impact and priority areas or even "taboo areas" has an important role to play in the overall improvement of the planning process in general, because the designation of environmental functions of natural areas and their zoning status, are new for Vietnamese land use planning. The consistent generation of planning information beginning with the processing of spatial data from the database to the thematic planning recommendation map is a substantial part of the knowledge advancement and transfer within the context of the project.

3 DEVELOPING PLANNING RECOMMENDATION MAPS

A central element of our approach is the processing of reliable core indicators to compile transferable planning information to the different actors at the administrative level, responsible for the integration of environmental standards in spatial planning. In further steps, domain specific GIS applications, analytical models and thematic assessment methods will be used to develop customised packages which in turn will generate sector-specific risk and vulnerability analyses in a spatially explicit manner (STORCH et al. 2009). On the back of the obtained results from these procedures, so-called planning recommendation maps, an essential element for future urban planning and management will be generated. The overall aim here is the interlocking of the planning recommendation maps (multi-functionality of the landscape functions) or at the very least endeavour to consider the joint heighten significance of spatial areas, provided by the fact that many areas share a common requirement profile and should not only be individually represented in a plan. In this respect the same area may contain significant unsealed surfaces, or exhibit an infiltration, retention and or evaporation potential. In addition the same or adjacent area may also render itself suitable for preferential roof greening or for the development of retention water bodies or even for the protection of nature river banks. The official HCMC land use plan itself displays only the pure designation of land use utilisations. The inherent qualities i.e. environmental significance or the exposure or resilience of areas or structures, the urban structural densities or the real utilisation are not illustrated. For measures and planning recommendations maps, an initial differentiation between the restoration of the existing asset and the planning recommendations/guidelines for new designated areas will be undertaken.

4 ADAPTATION PLANNING FRAMEWORK

In HCMC, there is now widespread recognition that combating climate change requires a combination of mitigation and adaptation measures (STORCH et al. 2011). A well-balanced and integrated adaptation planning approach to support decision making in spatial planning is needed to highlight integrated solutions

and avoid negative cross-sectoral effects of inaction or inappropriate measures in other sectors. Successful adaptation to climate change on the urban-level will depend on the extent to which the issue is integrated into the individual decision making in all relevant administration bodies responsible for water and flood management, transport, infrastructure and energy supply. At the same time, there is a pressing need to coordinate these sectoral policies at the different levels of decision making more effectively. Land-use planning is a promising candidate for facing these challenges.

4.1 Methodology

The main tasks of the adaptation planning framework are fourfold: to compile existing vulnerability concepts from various thematic and scientific disciplines; to apply indicators for spatially explicit vulnerability assessment for climate change and natural hazards; to apply and improve GIS- based quantitative approaches for analysing and modelling vulnerabilities and risks and to undertake complex spatially explicit vulnerability and risk assessments for the mega-urban region of HCMC based on advanced GIS techniques and the integration of remote sensing data for data management, data analysis and up- and downscaling within the framework of mapping vulnerability and risks.

4.2 Planning information system: development of urban structure types

Climate change-related urban adaptation decisions require a rational characterisation of urban structural landscapes according to vulnerability relevant features. The urban structure type (UST) approach is the main supportive module for our planning information system. The UST approach ensures that data integration of different sources with their original specific spatial-temporal resolutions and thematic contents can be operationally integrated in the GIS environment of the research-project.

The digital version of the official land use map is a central instrument - on the one hand as a digital base map to run the planned applications, while on the other hand, as the main official and actual information system. However as expected the supplied data could not satisfy all demands relating to the differentiation of the land use structure and also to the segmentation of block units. Resultantly a classification of “urban structure types” was derived (MOON et al. 2009; STORCH et al 2009). An important precondition was that both classifications – land use types and urban structure types - correspond to the same basis (i.e. the same digital block unit). This results in every block unit retaining both information sets: the land use type (originally from DoNRE) and the urban structure type (from the project) (see Tab. 1).

	Grouping, Typologies	No. of blocks	Area in km²	% HCMC	% of Utilisation Type
URBAN STRUCTURE TYPES	4 classes, 27 groups, 82 types	16.280	2114,88		
Residential Use	5 groups, 25 Types	6717	445,9	21,10	
Shophouse based	(3 sub-groups) 12 types	6346	424,8	20,09	95,30
Villa based	4 types	107	8,4	0,40	1,88
Apartments	5 types	103	5,0	0,24	1,12
Central Business District	2 types	160	7,4	0,35	1,66
Public & Special Use	9 groups, 20 types	760	52,0	2,43	
Industrial & Commercial Use	2 groups, 4 types	828	56,6	2,67	
Green & Open Spaces	9 groups, 33 types	7995	1173	55,46	
Predominantly Agricultural	13 types	6154	703,3	33,25	59,96
Streets & Surface Water			388,1	18,34	

Table 1: Urban Structure Types Defining the Actual Land use Map

Only in certain cases, the existing block units have been divided based upon the examination of satellite imagery. However as a general rule, the structure of the DoNRE Land Use map at a scale of 1:25.000 was maintained.The first UST classification for the inner core area of HCMC was started in 2009 and was finalised by the start of 2010. The entire classification for an initial version was completed by the middle of 2010. The necessity for the designation of a detailed “Actual Map” on the basis of over 16,280 individual

block units becomes apparent in the comparison of the current land use plan (LUP 2010) which is valid until 2010 (see figure 3). It can be seen that not only single settlements but agglomerations of settlements located in the peri-urban fringe and the rural districts of HCMC have ignored the designations of the LUP 2010. In comparison, although the LUP 2010 will be revised in the course of next year in the development of a plan up to 2025, designated large industry and settlement areas are yet to be developed. Here it becomes clear that without the development of an Actual Use Map within the research project, a rigorours climate change impact assessment as well as a GIS-based vulnerability assessment would not be possible.

As the UST´s were determined on the basis of the visual interpretation of high resolution satellite imagery captured in the time period 2009-2010, many of the marked construction area located in the urban fringe may have been subsequently developed. The focal point and the dynamic building activities to the South and East of the city; which form the frontier of urban development can be verified. In addition it is visible that not all new construction sites are inline with the LUP 2010, instead some developments are located in areas that should only be first approved following the draft LUP 2025.

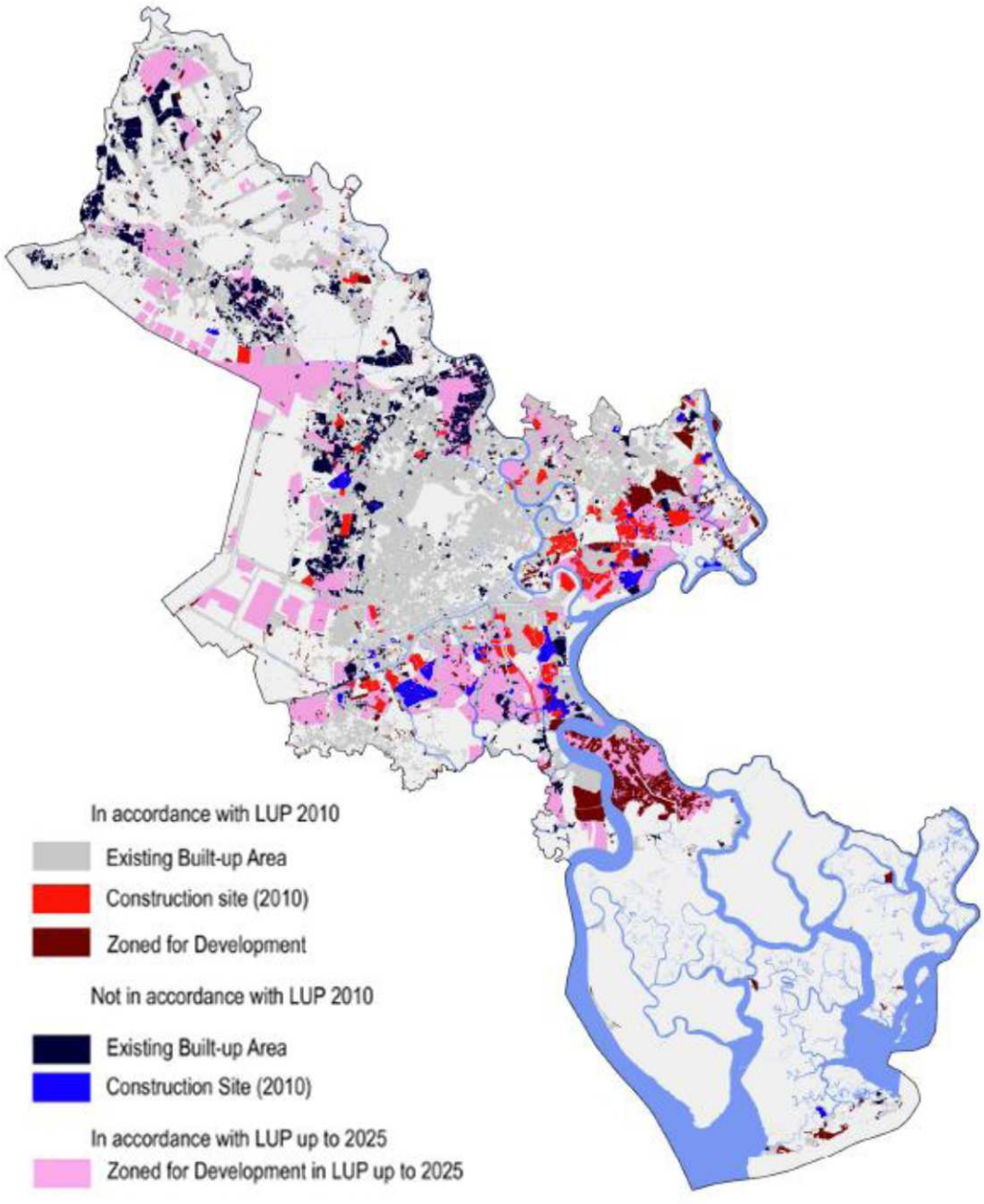

Figure 3: Comparison between the Actual Use and Planned Land Use in Accordance with the official LUP 2010 and the draft LUP 2025

With these few examples it becomes obvious that land use planning in HCMC is clearly both restricted in terms of its planning freedom and has evident implementation problems. These examples also highlight the potential of the UST approach, which promises to deliver an integrated view of climate change-specific problem areas to urban and environmental planners in a form that makes sense to them, because it provides a unit of analysis that is attractive to each of them. The main function of the UST approach is to link an indicator concept spatially to integrate the biophysical aspect of the 'Exposure' to climate change related effects with the aspect of assessing the 'Sensitivity' of people and places (STORCH et al 2009).

5 DOWNSCALING CLIMATE CHANGE ASSESSMENTS TO THE URBAN LEVEL

Knowing future temperature, precipitation and flooding trends without knowing the general urban development path limits the assessment of vulnerabilities of the future urban structures in relation to the future climate conditions in a regional context. The most common approach to projecting climate change on regional levels by downscaling regional climate change models under various global emission scenarios is a complex top-down process and the results are difficult to interpret and may be of limited use for spatial planning.

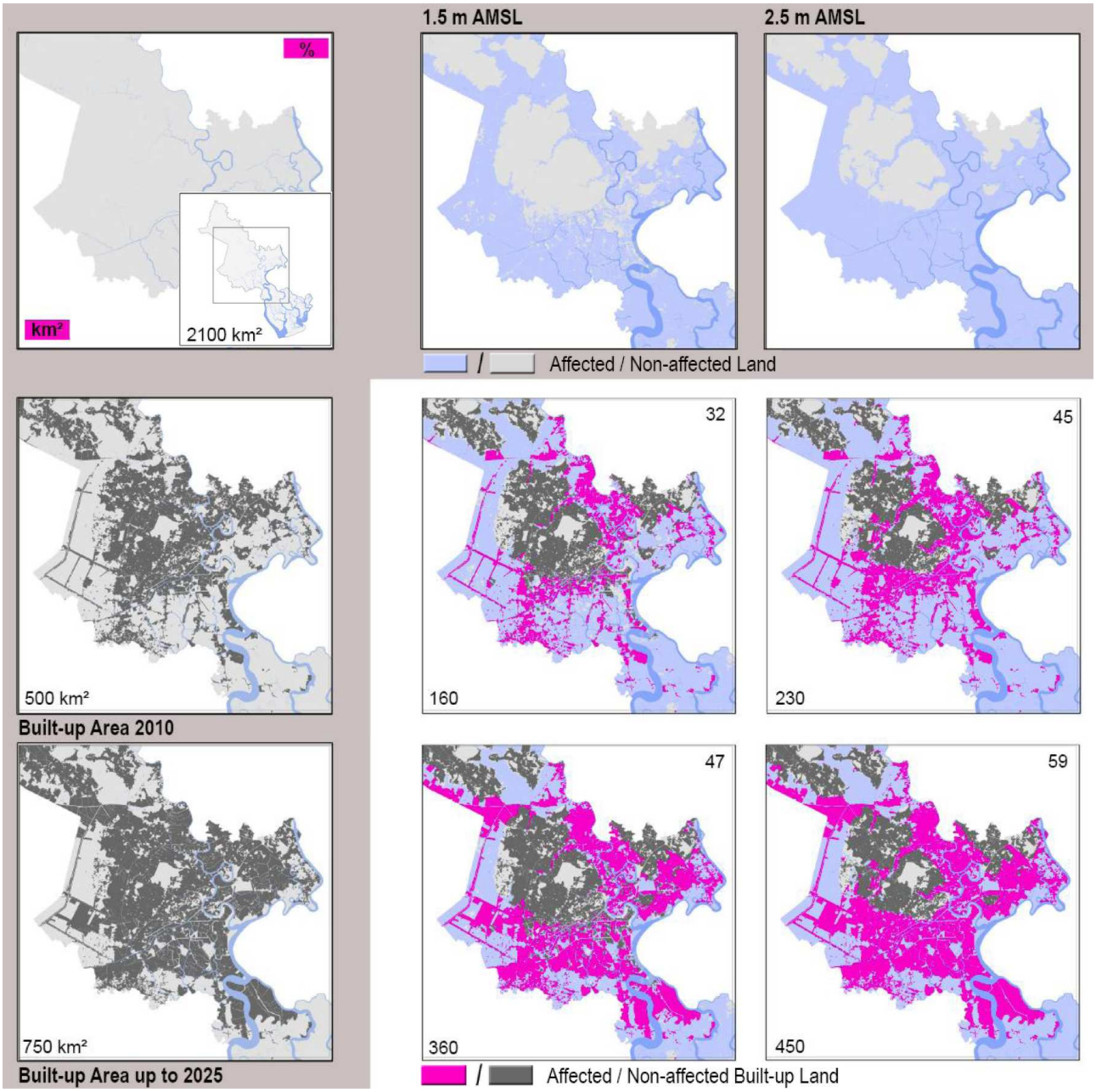

Figure 4: Interrelationship of Urban Development Scenarios and Potential Changes in Sea Level

Additional to the problems related to spatial resolution between climate sciences and land use planning in HCMC a major shortcoming is, that there is temporal mismatch in time horizons, while land use planning in HCMC has a realistic time-frame of about less than one decade, the results of climate-change models need to be interpreted over more than a few decades. Our approach is based on the vulnerabilities of urban development as opposed to climate change risk calculations, which requires that detailed structured and high-resolved actual urban land use information is available. For realistic urban development scenarios up to at least the next two decades, the availability and accessibility of the administrative land use plans in digital form is required.

Megacities have a specific urban climate, as their extensive and highly dense built up areas exhibit strong influence upon local weather parameters. Urban areas are sealed to different degrees according to the related urban structures present and normally a large proportion of precipitation is quickly converted to surface runoff. Often the existing sewer systems in the fast emerging megacities of Southeast Asia do not have the capacity to cope with large surface runoff volumes following strong tropical rainfall events. As a consequence in HCMC even its higher lying districts regularly experience localised flooding (PHI 2007) due to a combination of tides, heavy monsoon rains and storm surge floods (THINH et al. 2009). The flood dimensions of the urban areas affected are constantly changing to due the rapid urban development taking place.

Within the project the selected downscaling approach is based on a detailed mapping of the future urban development of HCMC. On the basis of the UST map, future planning situations can be portrayed on the block structure of the official land use plan. The potential of this approach is displayed in Fugure 3. On the basis of the actual use map (AUM), future urban development trends from the draft land use plan 2010 to 2025 are portrayed. Displayed are the built-up areas (residential and industry). As way of illustration, the current tidal max of 1.5 metres and the extreme of sea level rise of 1.0 meters up to a total of 2.5 metres AMSL are displayed. These increase corresponds to the IPPC high emission scenario (A1F1) for the year 2100 (see table 2).

IPPC Emission Scenarios			2020	2030	2040	2050	2060	2070	2080	2090	2100
High	A1FI	High	11.6	17.3	24.4	33.4	44.4	57.1	71.1	86.1	101.7

Table 2: Sea level rise scenario's for Vietnam (in centimetres)
(Source: Prof. Tran Thuc and Associates; Vietnam Institute of Meteorology, Hydrology and Environment, Hanoi, 2009)

This interrelationship matrix of urban development scenarios and potential changes in sea level (see figure 4) illustrates the significant role of urban development planning for the reduction of climate change risks. Alone the future urban development in current flood risk areas (below max tide) would lead to an increase of the affected built-up areas from 160 to 360 Km^2 with the implementation of the draft LUP 2025. For the maximum scenario of an additional 1 metre SLR, the built-up area affected leaps to 450 km^2 for the same plan. This highlights the central role land use planning in HCMC has to play for the adaptation to climate change associated impacts.

6 SUMMARY

The impacts of climate change will significantly alter land use practices in HCMC, whose regulation is a major concern of land-use planning. It is already based on integrative approaches, includes different actors, involves a wide range of spatial planning instruments and – most importantly - considers future scenarios of urban development. Our initial research results document that the spatiotemporal processes of urban development, alongside climate change, are the central driving forces for climate-related impacts within HCMCity's urban system. The influence of planned urban developments up to 2030 on future flooding risk is considerable greater than the effect of projected sea level rise up to 2100. In HCMC however, spatial planning actually faces a particular dilemma: while the need for coordination and integration across sectors, scales and levels is growing, the capacities to respond are very limited due the rigidity of administrative borders, resulting in a stability of individual departmental policies and strengthening of sectoral interests and preferences for small-scale solutions. Therefore the main focus of the adaptation planning framework is to

support the cross-sectoral and information-based integration of climate change adaptation into land-use planning.

7 ACKNOWLEDGEMENT

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