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Liveable and resilient Ho Chi Minh City: Tackling the challenges of climate change, energy security and sustainable urban development.

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1 ABSTRACT

Emerging Megacities in East Asia face common challenges in responding to rapid population growth and there is an urgency to develop these cities in a more liveable and sustainable manner. Future Asian Megacities can play a key role in improving energy efficiency and addressing the effects of climate change through practical and pragmatic urban environmental planning measures. This contribution illuminates the way adaptation to climate change is tackled in spatial planning strategies. The possible impacts of climate change on mega-urban regions in South-East Asia are highlighting that spatial design and urban environmental planning are a promising tool in adapting to climate change, because its integral responses are capable in dealing with uncertainties.

Dealing with adaptation to climate change in the context of emerging Asian megacities requires a shift in policy options towards more proactive response strategies. While urban development trends in HCMC are addressing both mitigation needs and the rationale of adaptation to the effects of climate change, the main focus of combating climate change impacts in the mega-urban region of HCMC has to be the practical implementation of adaptation measures. Planned adaptation implies spatial planning decisions and measures at the urban-scale that facilitates the reduction of the adverse impacts of climate change. Further however adaptation has the potential to realise new opportunities for defining livability and sustainability in an Asian context of urban development planning, scoping planning issues and opportunities at different spatial scales.

2 ADAPTATION TO CLIMATE CHANGE IN VIETNAM

Vietnam has a long history of coping with natural disasters and mitigating their effects in many ways. However, the country must recognize that some impacts of global climate change are unavoidable, and as such there is an urgent need at present to start adapting the mega-urban regions to the current impacts of extreme weather events and the predicted impacts of climate change with which they are likely to be confronted in the future. With more than half of Vietnam's population now living in low elevation zones, coastal urban settlements are becoming increasingly vulnerable.

Recently climate change and its future impacts on Asian megacities in high-risk zones, such as the continent's main river delta regions, have emerged at the top of the international research agenda. Since then, international policy agreements have been established to limit the emission of greenhouse gases. Nevertheless, even if a reduction in these emissions is achieved, the time lag in the climatic system will inevitably cause a substantial degree of climate change. The impacts of this change are, however, uneven with inter-tropical, densely populated delta regions exposed to rising sea levels among those expected to be hardest hit. Here unprecedented cooperation and research is needed to identify the planning options available for adapting these regions to changing climate, advancing and disseminating knowledge and understanding. Spatial planning strategies which focus on the adaptation strategies to climate change require information regarding future changes at a scale relevant to the area under investigation.

2.1 Adaptation needs in the context of mega-urban regions in South-East-Asia

The overall objective of adaptation measures to reduce the future impacts of climate change is to assist the relevant authorities, in particular developing countries, including many of the least developed countries, firstly to improve their understanding and assessment of impacts, vulnerability and adaptation; and secondly to improve their ability to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account, of course, current and future climate change and variability. Adaptation tools are however only practical at the local level, in concrete spatial localities. For our research project a mega-urban approach is the main guiding element. Only at the urban level is it possible to integrate the many layers of site specific information and to work closely with the many administrative actors. The presence of a megacity enables the site specific weighting of options, the integration of stake-holders and administrative institutions and the results and success of measures to be evaluated.

Table 1: Population Changes (2004-2009) in HCMC at district-level

Name of district	Area (km^2)	Population (Oct 1. 2004)	Population (Apr 1. 2009)	Population Difference 2004-2009	Population Density Difference 2004-2009 (Inh./km^2)
District 1	7,73	198.032	178.878	-19.154	-2478
District 2	49,74	125.136	145.981	20.845	419
District 3	4,92	201.122	189.764	-11.358	-2309
District 4	4,18	180.548	179.640	-908	-217
District 5	4,27	170.367	170.462	95	22
District 6	7,19	241.379	251.912	10.533	1465
District 7	35,69	159.490	242.284	82.794	2320
District 8	19,18	360.722	404.976	44.254	2306
District 9	114	202.948	255.036	52.088	457
District 10	5,72	235.231	227.226	-8.005	-1400
District 11	5,14	224.785	226.620	1.835	357
District 12	52,78	290.129	401.894	111.765	2118
Go Vap District	19,74	452.083	515.954	63.871	3236
Tan Binh District	22,38	397.569	412.796	15.227	680
Tan Phu District	16,06	366.399	397.635	31.236	1945
Binh Thanh Dist.	20,76	423.896	451.526	2.763	1331
Phu Nhuan Dist.	4,88	175.293	174.497	-796	-163
Thu Duc District	47,76	336.571	442.110	105.539	2209
Binh Tan District	51,89	398.712	572.796	174.084	3355
Total Inner Districts	**494,01**	**5.140.412**	**5.841.987**	**701.575**	**1420**
Cu Chi District	434,50	288.279	343.132	54.853	126
Hoc Mon District	109,18	245.381	348.840	103.459	948
Binh Chanh Dist.	252,69	304.168	421.996	117.828	467
Nha Be District	100,41	72.740	99.172	26.432	263
Can Gio District	704,22	66.272	68.213	1.941	2
Total Suburban Districts	**1.601**	**976.839**	**1.281.353**	**304.514**	**190.202**
Entire City	**2.095,01**	**6.117.251**	**7.123.340**	**1.006.089**	**481**

(Source: Statistical Office HCMC 2009)

3 URBAN DEVELOPMENT TRENDS IN HCMC

The spatial form of urban areas must be considered for adaptation planning. Asian cities, like HCMC, are getting more and more dispersed (see table 1), increasing their land areas without taking into account the natural conditions. This urban expansion processes are at the root of many urban hazards, especially urban floods. The later identification of risk areas and the resettlement of populations from these urban areas is a complex process which involves social, technical and financial questions not easily managed. As long as the current model of urbanization in Asian megacities continues to ignore the environmental constraints, no planned adaptation to climate change is possible. The current patterns of urban development, expansion and land use must be re-examined, because the generated dispersed urban forms (see figure 1) are reflections of processes which reproduce climate change related risks in new contexts, amplifying their intensity and increasing the numbers of vulnerable urban areas and population.

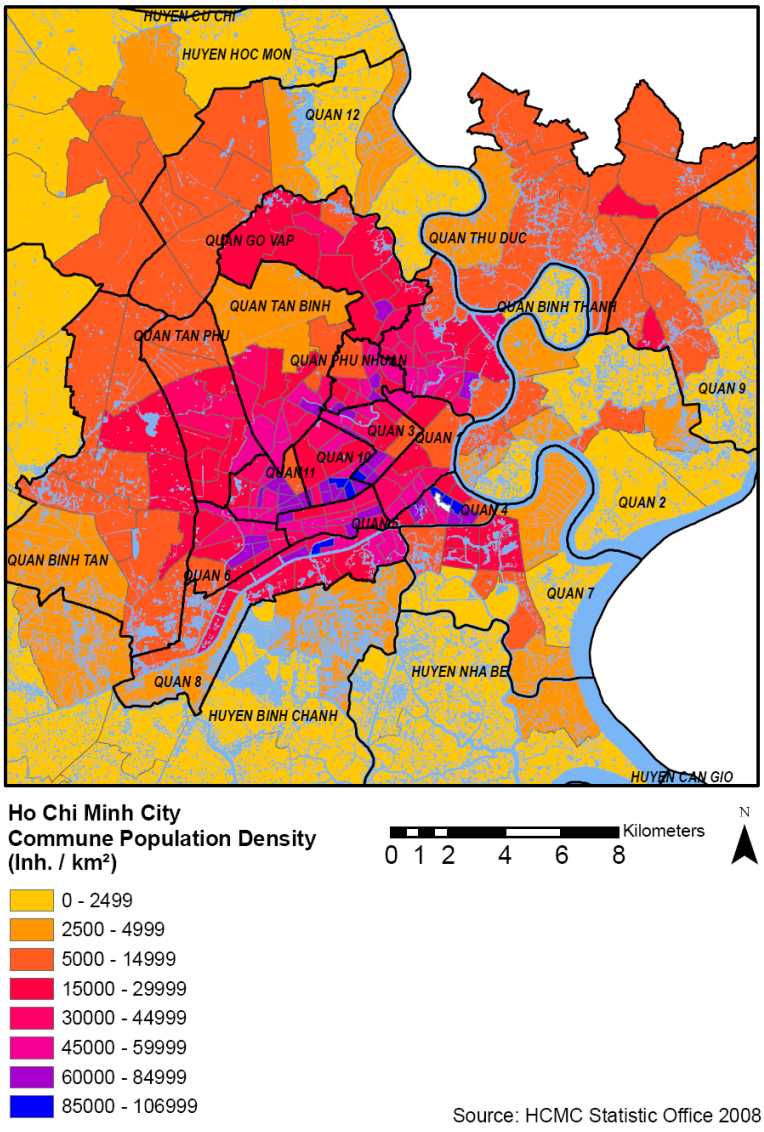

Figure 1: Ho Chi Minh City's Population Density in 2008 at Commune-level

Asian cities will play a specific role in adaptation research related to Climate Change. With population increasingly concentrated in urban spaces, and considering their dense nature and diverse urban forms and disrespect for the natural site conditions and climate phenomena, cities are among the spaces of greatest vulnerability to Climate Change. Ho Chi Minh City constitutes a hotspot where Climate Change related natural hazards are intensified, also congregating social and economic risks, whether or not they are produced at the urban scale. Emerging megacities, like HCMC, therefore, constitute a specific focus for adaptation measures guided by spatial planning science, since they are and will increasingly be the principal spaces of vulnerability.

4 SPATIAL PLANNING AND CLIMATE CHANGE

Climate change exhibits a strong influence on HCMC and its surrounding areas. Adaptation of the urban pattern and form, natural areas and the water system as well as housing and buildings is essential to protect HCMC from both the present and future impacts of climate change and extreme events to its complex system of physical, economic and social structures. Many of the components are interrelated, and therefore research needs to focus on the different scales evident in the mega-urban context (building, street block, neighbourhood, district, city, mega-urban conurbation) and their respective interaction. Due to the fact that investments in cities are long-term (sewage system, industrial areas, urban development projects, transport and water infrastructure etc.), finding the appropriate timing intervals in which action can be undertaken additionally plays an important role. These transitions in HCMC demand a careful organisation and allocation of space, which is difficult not only to plan but also to manage. Therefore future climate scenarios, with all their associated uncertainties, must now be taken into account in development plans, urban design and environmental urban management concepts.

4.1 Adaptation tools for indicator-based decision-making in spatial planning

To gain insight into the effects of climate change on the urban level, such as the risk of flooding, heat stress in built up areas, a higher level of land subsidence and inadequate sewer capacity and to deal with them, the planning authorities of HCMC have the need to use spatially explicit information of climate effects highlighting which problems are to be found where, as well as diagrams of promising adaptation measures and projects. The indicator-based assessment approach we are taking calls for knowledge – and the dissemination of knowledge – to comprehend the consequences of climate related impacts on the urban area of HCMC. To draw up a well-considered climate adaptation strategy or to enable an assessment of its effects, certain tools to enable decision-making are needed. These include vulnerability assessment tools – which play a role particularly in policy preparatory work of spatial planning, such as urban development scenarios, spatially explicit assessment frameworks, such as risk and vulnerability assessment tools based on Strategic Environmental Assessment (SEA) for land-use planning– and evaluation tools that can be utilized at the implementation stage of concrete projects (planning studies, pilot project), such as monitoring and evaluation methods.

5 THE INTEGRATING CONCEPT OF “SPACE”

An adaptation of the mega-urban region of HCMC to climate change can only be achieved through the broad integration of urban and environmental planning approaches. The scale of the megacity itself presents the opportunity for sector-specific adaptation and mitigation approaches to combine into an integrative planning approach. As a result the central integration concept is `spatially referenced`. The concept ´space` allows the impacts of climate change on the megacity to be positioned on different spatial scales. Here spatial planning as a central strategy within our project can meaningfully combine individual approaches through the integrating concept of “space” as well as the embedment of the goal orientation of local stakeholders from administration and science. The spatiotemporal process of urban development, next to climate change, is the central dynamic element which enables spatially explicit scenarios. The integrative process of developing an Adaptation Planning Framework forms a comprehensive basis for implementing urban development adapted to climate change. For this, the broad inclusion in the administrative and political decision-making structures is necessary. An important contribution to the future political agenda for urban development in HCMC can thereby be made.

5.1 Administrative spatial planning framework

The most important agencies which determine overall land use, spatial zoning and environmental quality in HCMC are the Department of Natural Resources and Environment (DoNRE), the Department of Architecture and Planning (DPA) and the Department of Construction (DoC). Urban planning (in Vietnam, also referred to as urban development planning) is an essential tool for steering urban development processes and the spatial arrangement of land uses in HCMC. Theoretically, in Vietnam land-use and urban planning are a practical expression of socio-economic development strategies. In HCMC there are three master plans: the Socio-economic Development Plan, the Urban Development Plan (Master Plan) and the Land Use Plan. The Socio-economic Development Plan is designed to provide a context for the Urban development Plan and the Land Use Plan. Although these three plans differ in both their legal origins and their responsible administrative agencies, in principle they should share common targets for a coordinated and sustainable urban development. One important condition for the effective use of these urban environmental planning

tools and guidelines is that they take into account the specific characteristics of climate change and adaptation policy. These include not only the inherent political character of planning processes in general, but also the long-term perspective, the uncertainties that arise and the dependence on other societal interests and developments. The planning administrations in HCMC require clear and unambiguous, spatially explicit and location-specific information that must be available and usable in the short-term. At the same time they are confronted with the need to draw up long-term spatial land-use and urban development plans with regard to climate change and are faced with major uncertainties of climate projections on the local level.

6 INDICATOR SYSTEM TO SUPPORT INTEGRATIVE URBAN LAND-USE PLANNING

The main objective of the proposed indicator system is to support the research project and the relevant administrative bodies in HCMC with indicator selection and the application of vulnerability and risk assessments in the context of impacts resulting from climate change and associated natural hazard impacts. The indicator system combines the challenge of theoretical conceptual improvement with the required integration of remote sensing and GIS techniques for both the monitoring and mapping of vulnerabilities and risk. The main tasks of the integrated indicator concept hereby are to: (1) assimilate existing vulnerability concepts from various scientific disciplines (e.g. flood management, urban climate assessment, urban energy security and transport planning); (2) apply indicators for spatially explicit vulnerability assessments for climate change and natural hazards; (3) apply and improve GIS-based quantitative approaches for analysing and modelling vulnerabilities and risks; (4) 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 in the framework of mapping vulnerability and risks.

6.1 Spatially explicit indicator system

According to the redefined role of urban environmental planning in times of climate change, spatial planning concerns the vulnerability 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. Therefore, the integration of climate change adaptation planning into the spatial planning framework at the urban level is necessary. Here the main task of an indicator system is to capture the degree of integrated adaptation measures of spatial planning in a quantifiable manner. The development of the proposed indicator system has been guided by the following principles: (1) Indicators for adaptation planning in a spatial planning context need to be based on adaptation and mitigation objectives that can be derived from spatially explicit land-use and urban development plans, (2) These indicators must reflect spatial planning's contribution to the achievement of integrating specified key sector-specific adaptation and mitigation policies in the urban areas of HCMC.
Indicator sets can then be incorporated into a monitoring system that can assess spatial planning outcomes in terms of cross-sectoral adaptation and mitigation policy integration. A major consequence therefore is that the analysis of spatial adaptation plans will no longer solely focus on single indicator values, but increasingly on the combination of single base-indicators to yield meaningful policy measures, guiding adaptation and mitigation measures. Naturally, this type of analysis has to include the spatial dimension of the indicator system, by emphasising the importance of functional areas, spatial linkages and connections. Urban planners and key stakeholders can then utilise these plan-led indicators to revise their assumptions and core strategies that initially led to the policy actions. They will then be able to modify climate-related adaptation and energy-related mitigation policy in light of new issues identified. As a result the adaptation planning framework will help provide a communicative and iterative learning approach to monitoring, which will embed monitoring right in the centre of the policy-making process.
In our indicator system, single indicators are not intended for use in an isolated manner, but rather within an integrative framework which views them as parts of the resulting zoning guidelines in spatially explicit planning recommendation maps. Similarly, by using an Urban Structure Type approach the indicator system views individual locations as parts in a much wider spatial context rather than as isolated entities. This approach provides adequate flexibility to stretch the potential of obtained data to yield the necessary spatial information base, allowing effective monitoring of planning policy deliverables in combating adverse climate change impacts at the urban level.

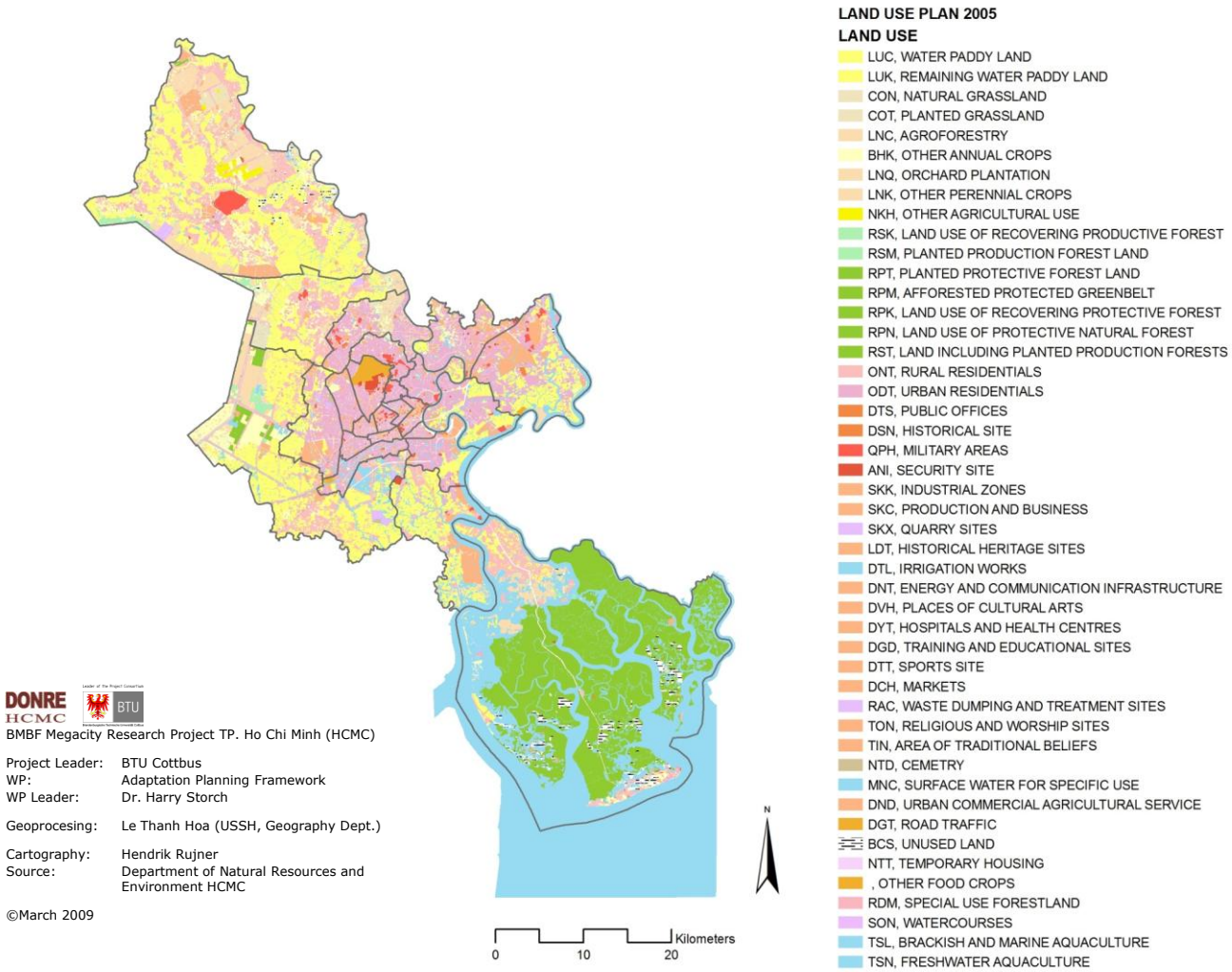

Figure 2: Land use map of HCMC as central component of the spatial information system

6.2 Spatial Urban Information System

Given the complexity of spatial policy implementation for adaptation and mitigation measures, the analytical and model-driven integration of base indicators is an essential tool for providing a more rounded view of different aspects of climate change policy. The emphasis is on developing a group of indicators within each thematic sector (Flooding, Climate, Energy and Transport) and collectively analysing them to understand the broader thematic spatial planning outcomes. This approach facilitates cross-cutting analysis by combining indicators across different thematic sectors, as well as including other more contextual sets of indicators.

If spatial planning activities involving indicator-driven spatial databases are not coordinated with the local administrative planning bodies, the indicator-specific data generated at various levels for urban planning and management purposes remains uncoordinated and limits their use to support decision making. In order to address these issues in a holistic manner, the central Spatial Urban Information System, developed from our specific GIS databases, will assist spatial planning decisions at the most relevant scales for the HCMC mega-urban region. The Urban Information System will also be useful for assisting the modification and preparation of the upcoming versions of the Land Use Plan and the Urban Development Plan. Furthermore it can support more detailed urban planning schemes and serve as a decision-making support and strategic environmental assessment platform.

The Urban Spatial Information System has the key objective to meet the requirements of land-use, urban and environmental planning in the existing organisational and institutional environments of the administrative spatial planning departments of HCMC. The basic spatial data such as the base map, land use map and thematic maps generated can be utilised by various planning departments as well as for the further generation of derivative themes and sector-specific information.

7 TOOL FOR INTEGRATION INTO THE INSTITUTIONAL ENVIRONMENT FOR CLIMATE CHANGE RESPONSES

For the process of adaptation to climate change, land use planning is a key criterion for effective strategies to deal with the coming challenges. Adaptation is unattainable without improvements in the usability of scientific results for decision making and their integration into the existing planning process. Within the HCMC administration there is profound awareness in regards to the necessity of integrating environmental aspects, in particular the requirements from global climate change into the existing planning system. Nevertheless, the challenges of climatic change require a new level of cooperation to emerge between politics and administration, between the different sectors of administration and between academics, planners and decision makers in general. In order to identify possible starting points for the integration of climate change relevant planning requirements into the existing planning process, on the one hand, the organisation of the administration and governance structures within HCMC and the paths for decision making and on the other hand the problems concerning the integration of environmental requirements in the planning process, all these have to be analysed. To identify and estimate the local risks and adverse impacts arising from climate change, the project supports the HCMC administration to establish a well-founded data base with reliable information. The organisation of data access and the process of data exchange and dissemination between different sectors of the administration are important challenges in this context, not only in a technical sense but even more in the administrative respect. On the basis of such, data sets and maps with planning advice in reference to measures (restrictions, bans, conditions and development objectives) can be developed.

Some of the main spatial data for indicator base maps and land use maps will be obtained from remotely sensed sources, which will then be used for integration with the official land-use map using our Urban Structure Type approach. The focus of the indicator-driven Urban Spatial Information System is primarily to address the urban land-use planning and management functions. The data currently used has been collated from the respective urban administrative bodies and relevant departments, integrated into the GIS environment, and spatially geo-referenced. This data is then processed to derive spatial explicit 'base indicator maps'.

7.1 Developing Planning Recommendation Maps: Goals and Problems

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. 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 has to be undertaken. Using the example from the Urban Climate and Urban Flooding viewpoint the focus here lies on recommendations and measures for the protection of Green- and Open Spaces and the establishment of more urban green in existing structures. Additionally the fundamental guidelines for new development sites i.e. regulations regarding building height, building density, and soil sealing degree will be suggested. For the thematic fields of Urban Climate and Urban Flooding, the formation of planning recommendation maps for the HCMC urban area arranges itself along the following considerations:

7.1.1 Reducing the surface runoff following extreme rainfall events.

Through the utilisation of the water household model ABIMO, in the framework of the research project, the mean surface water runoff can be investigated on the one hand due to the effects of climate change and on the other by the processes of urbanization. Hereby the additional problems associated with rainwater drainage will be seen. Planning recommendation maps are not specially localised, but inherently general

suggesting increasing evaporation and where possible also infiltration by appropriate measures, i.e. rain water utilisation.

7.1.2 Protection of the Existing Forest and Green and Open Spaces

The protection is valid for all green and open spaces which are able to counteract or reduce the adverse effects of climate change for the urban area, i.e. are able to act as retention surfaces, urban-climatic functionally important areas etc. It is to be assumed that the Urban Climate investigations will validate their significance as local evaporation areas and temperature compensating areas/zones. Hereby, highlighting more precisely their interactions and specific importance and function to the surrounding settlements.

7.1.3 Planning of New Residential Developments with low flooding risk

The classification of development sites in areas which are at risk of flooding. In this context, in next working step of the project, the scientific justification and identification of such risk areas will be strengthened.

7.1.4 Enlargement of the Urban Green on the basis of urban climate considerations

This is the central goal of the work package Urban Climate. The main strategy is to improve the local urban ventilation patterns/ cold and fresh air generation zones and decrease the overall heat Island potential of the urban area. The designation of protection worthy zones in potential new development areas and within existing developments and the determination of small proportions of green areas for the entire greater regions should be implemented. Naturally a significant enlargement of the Urban Green will not be possible, since widespread demolition is not an option, but in light of the present situation in HCMC, the protection of these current areas is an asset. As widespread demolition is not an option, options include the potential "networking of green areas and "eco-belts" along the existing traffic arteries or the possible roof greening of existing structures. These measures could also lead to a reduction in the Urban Heat Island effect (and associated health impacts).

7.1.5 Classification/Designation of Retention Surfaces

On the one hand, the reservation of retention area (protected areas) for flood waters associated with Sea Level Rise or fluvial flooding events. While on the other hand, additional surfaces for the intermediate storage of rain waters must be identified and safeguarded for heavy rainfall events (rainwater retention functions).

7.1.6 Focus areas for measure to reduce surface runoff in existing area

Measures include unsealing, roof greening, rain water storage and –reuse. Whether it is however both possible and meaningful to locate these areas must be discussed (i.e. areas with high soil sealing rates, areas which are often flooded, areas where the existing canalization is inadequate). In the field of Urban Climate, a similar strategy is required, i.e. existing development on the basis of the "Thermal Load Map" are required to be defined and which are primary envisaged to be suitable for unsealing and greening.

8 OUTLOOK AND SUMMARY

In HCMC autonomous environmental planning for concretisation of the regional requirements is presently not recognizable. Therefore, the working results should be capable of fulfilling the needs for the new Master Plan in terms of transparency and professionalism. The process of joint development and discussion of planning bases will enable the administrative planning bodies to treat other aspects of environmental protection and the protection of natural resources in a similar way. Their interest in the approach of classification of protected areas and the determination of impact and priority areas or even "taboo areas" have an important role for the improvement of the the planning process. The consistent processing of spatial data from the database to the planning map is a substantial part of the knowledge transfer in the context of the project. Thereby an important role for cooperation arises in work-sharing groups of equitable scientists and planners with a common obligatory objective. Via the cooperation of German and Vietnamese scientists from various universities on the one hand and different administrative bodies of HCMC on the other, the research project strengthens the willingness to cooperate for mutual benefit.

In regard to the administrative deficits, which exist in the administration of HCMC, large improvements are foreseen to result from this research project and by the incorporation of the Vietnamese partners. In the centre stands the consistent processing of reliable core indicators as planning information as well as their exchange between the different actors and the administrative bodies of development and environmental

standards in spatial planning. Altogether a high demand for consulting exists, in regard to the development of environmentally referenced spatial data and their implementation into planning.

9 ACKNOWLEDGEMENT

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