

City Resilience in the Mekong Delta
SOC TRANG Resilience Assessment

Technical Study
June 30, 2018

ACKNOWLEDGEMENTS

This study was prepared as a background report under the “Enhancing Resilience of Mekong Delta Secondary Cities” activity. It is one of seven city level assessments carried out as part of this activity which had the objective of integrating resilience and informing the design of the Scaling Up Urban Upgradation project in Vietnam. We sincerely thank all the officials and stakeholders in the seven selected cities for their kind cooperation in the preparation of these studies.

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Executive Summary

Introduction

Soc Trang is the capital city of Soc Trang province, located at river mouth, South Hau river. The city administrative boundary covers an area of 76,16km² (108,23km² planned for city extension) with a population of about 137,642 in 2014. The city urbanization ratio achieved 100% in 2014 with an average urbanization growth rate of about 0,4%/year in the recent 5 years.

Urbanization embedded in the river mouth + sand dune, agro-geo-ecology landscape and the canal + road hybrid.

Soc Trang city has been formed at the hybrid intersection of canals and roads and is incorporated with the coastal sand dune morphology surrounded by a constantly transformed productive landscape. The canal network geometry of the South Hau river presents a great number of lines, intersections and convergences, with even five- and seven- junctures at some points.

Roads were built parallel to the canals and rivers, beginning during the French colonial era. The main regional connecting roads to Soc Trang (National road No1A to Can Tho and No1 + No60 along the eastern coast) took advantage of the already higher, safe ground land, built along the canal or through the dune settlements along the coast, accelerated the modernization and urbanization along. At the particular location of hybrid waterway and road concurrent geometries, the city has formed with particular shape with the combination of colonial setting and the dune's settlements.

Rich layers of urban form

The city has been shaped as an intersection of canals and roads, the combination of canal network geometry, colonial setting, coastal sand dune and road settlement morphology as well as the new logic of urban extension. The city form has been created through time by overlapping and interacting amongst multi-layers of social features, culture life styles, historical transformation, modernization and industrialization. Its combined characteristics can be found in different social layers, soft-hard water layers, road-street layers, traditional settlements and grid pattern layers, urbanization densification and extension layers.

Urban Planning

The current master plan envisages an important transformation of the city form with a multi-polar spatial structure, largely driven by the road and transport sector¹. The plan hinges upon orientations for aligning different types of economic activities along the main arterials, accompanied by ambitious proposed road alignments. These are however, not backed by real demand or traffic projections. For example, data related to future potential for employment, economic activity, current and projected contribution of the city to the provincial and national GDP, in and out migration are all inter-related with traffic demand. These will influence proposals for land use zoning and development rights. However, evidence based planning does not back the current master plan.

Main findings

- ***Soc Trang City is a third-tier city aiming to become a second-tier city by 2020.*** The Soc Trang master plan to 2020 envisages substantial future growth in terms of urbanization and industrial areas. Urban development is concentrically organized and largely extended to the surrounding landscape, taking a large amount of land out of production through proposed

¹ North, East, South, East and South-West are developed on the basis of different advantages with the axis of development being the influences of National Road No.60, National Road 61, provincial roads towards to the Hau River such as provincial road 933, provincial road 934 and some routes planned to open under this revising plan.

urbanization. The entire development was proposed to become an equalized mesh that is primarily road-based, especially the ring road system and curve boulevard, having little to do with the city's existing geography and identity. The closed urban landscape and water bodies are strictly zoned in the new ordering of the territory. Furthermore, the multi-centric city proposed with the ring road system could be an ideally theoretical form applied without understanding the locality of human settlements and urban structure.

- The Master Plan 2030 is presently under implementation. However, the master plan incorporates several road sector proposals which have been challenging to implement. Further, ***Soc Trang has received directives for revising their master plans to suit growth requirements for achieving a Grade II City status.*** Preparations for revision of the master plan are underway. The CPC is engaged with the DoC in the preparation of the revised master plan.
- ***Soc Trang's aspiration to become a Class 2 city may become a barrier to alternative, more efficient and resilient urban development strategies.*** Achieving the Class 2 population standard would require a 45% population growth in Soc Trang, when the annual growth rate is merely 1%. This unrealistic growth projection is distorting the master and sectorial plans, prioritizing expansive urban development and expensive (and unnecessary) road infrastructure.

Key recommendations

- ***The revised master plan needs to be based on higher levels of capacity to realise implementation.*** There are solutions for eco and compact growth using smarter planning and development management based on international experience, but changes should be made on developing management capacity, methods and drivers for growth. If some concepts of eco city and urban clusters are adopted to drive towards new city forms, then smarter and more prudent planning and development management can help to make sure new urban form will still be eco, compact, and efficient with low use of land and efficient infrastructure development.
- ***Resources and evidence-based approaches should be promoted in revising current master plan.*** Shorter term projections, using more locally based and reliable statistics, market sensitivity, economic and social structure accountability can provide better grounds for making more realistic and resilient general plans.
- ***Planning codes, methods, and development management regulations should be revised to reflect local needs*** and affordability based on evidence. More integrated planning with proper data (GIS compatible) is necessary for short and long term plan making and implementation.

Land use

Main findings

- ***Evidence of demand for more non-agricultural jobs to promote faster urbanisation was not convincing.*** Whether economic conditions can generate higher growth when endogenous drivers (agricultural) are slow and external drivers (industrial and service sectors) limited is highly doubtful.
- ***Resource constraints challenge proposed expansion and upgrading of the new plan.*** Long-term proposals based on inflated demand assumptions make the plan unsustainable and incompatible with improved resilience objectives.
- ***High demand for housing for the poor compares unfavourably with low revenues and mobilisation capacity.***
- ***Land management is functioning in a slow growth pattern***

Key recommendations

- ***The city is encouraged to organise a competition to recruit the best consultants to prepare the revised plan based on terms of reference as outlined above.*** If it is too late, it is strongly

recommended that the city/provincial authorities appoint a capable team of experts to assess the proposals using a professional review method.

- **The over-riding importance of national government in determining planning standards, norms, regulations and administrative procedures for land use planning and management** suggests that discussions be sought with MOC, MONRE, and possibly MOT/MPI with a view to reviewing and, where appropriate, revising the regulatory framework to ensure consistency with policy objectives for improving urban resilience to climate change.

Transport planning

Soc Trang can be easily accessed from the other provinces and cities in the region, and it has a relatively good 129-kilometer long urban road network. In 2013, Soc Trang province adjusted its Master Plan for Transport Development, consisting of plans for highways, public transport, waterways and airways. The adjusted plan was to complete highway and waterway systems to ensure the stable, balanced and sustainable transportation to 2020, and also supporting the city class upgrading. The ambitious plans seem to bring not only opportunities for growth and better quality of life of the citizens, but also challenges for sustainable development. Obvious challenges may include high investment requirement (more than 2.5 billion USD needed) and significant land acquisition (nearly 8,600 ha).

Main findings

- **Soc Trang's land use and transport plans are not well coordinated** missing an opportunity to improve accessibility and reduce the need for motorized trips. There appears to be good potential for robust water freight transport system in Soc Trang, especially as the new Soc Trang port becomes operational. Existence of the port does not eliminate the need for the city centre river dock. They serve different markets, and can coexist.
- The **master planning process lacks data essential for transportation planning**, such as mode share, road safety, vehicle ownership, household spending on transport. The data is either unavailable or aggregated in disadvantageous ways.
- People in Soc Trang need **more diverse options for moving around the city**. The transport plan prioritizes motorcycles, and to some extent taxis, over local bus service and bicycles which would provide critical mobility options for lower and middle income residents. Soc Trang has developed high quality public spaces which enhance accessibility and inclusiveness.
- There are good examples in Soc Trang of ways to **incorporate green infrastructure (bioswales) into street design** to increase storm water discharge and improve drainage. Mobility disruptions from flooding and other events would be further minimized if roadway designs were informed by travel demand, and not overbuilt.

Key recommendations

- Collect reliable city-level transport data on mode share, traffic counts, freight tonnage, vehicle ownership and road accidents to have a clearer picture of current travel demand and behaviours. Use **travel demand modelling** and forecasting with conservative population growth forecasts to predict future demand, paying particular attention to the proposed ring roads. Increase DOT staff's capacity to manage consultants' forecasting and interpret the results.
- Modify master planning process so **land use and transportation** plans are developed in a more integrated way. Look for opportunities where new development can take advantage of the increased accessibility of existing transport networks. This will reduce the need to travel, and lower congestion and emissions. GIS can be a useful tool for integrated planning.
- Instead of designing the widest roads possible, Soc Trang should adopt street designs that reflect actual demand, and **continue creating spaces for people**. Streets should incorporate more green infrastructure (like the bioswales) to reduce cost, lower emissions and mitigate

flooding risk. Infrastructure construction and maintenance standards need to address risks from salt intrusion and subsidence.

- Successful negotiation of the **Soc Trang Port operations contract** will be critical, but challenging since there is only one bidder and DOT is inexperienced in contract negotiations. Revive and maintain the city centre dock to preserve the water transport link to the central marketplace.
- Create a **public transport development plan** that prioritizes local bus service and bicycling in order to improve mobility and access, especially for vulnerable groups like children, elderly, people with disabilities, women. This will help reduce emissions, and provide redundant mobility during flooding when motorcycles may be unusable.

Disaster Risk Management, Climate Change and institutional capacity

Soc Trang City is affected by floods, drought and SWI, although these are not so prevalent; SWI was most severe in 2016. High tides occur in early September and mid-December. Inundation is caused by a combination of heavy rainfall, rapid urban infrastructure development an outdated and incomplete drainage infrastructure (with a lack of connectivity to natural drainage), and high tides. Sea level rise will impact on the province. Land subsidence, because of groundwater extraction is likely to be a problem. The City's water supply is based on ground water, levels of which have declined, become salinized and polluted.

Main findings

- **Updating the City Master Plan (2011)** is needed to integrate CCA and DRR, based on the MoNRE 2017 CC and SLR scenarios.
- **Digitised maps, delineating natural hazards, do not exist.** These are essential for risk-informed sector spatial planning and zoning. As with other MDR cities, no hydraulic or hydrological modelling has taken place. It is essential for the city and province to have such modelling and risk maps to inform the City Master Plan and sector plans and adjust accordingly. Building codes and standards have not yet been adjusted to respond to climate change.
- **Knowledge of green infrastructure and bioengineering solutions needs improving,** to incorporate into the urban design. This includes sustainable urban drainage, for example, permeable surfaces, filter strips and drains, swales, water retention areas, and preserving wetlands.
- **The city's water supply is dependent on groundwater (GW),** which has reduced and might be contaminated by saltwater and pollutants. Groundwater is reducing, while there are few surface water (SW) sources of freshwater. The Prime Minister's Decision 2140/QD-TTg aims to reduce GW use in MRD cities.
- **There is an incomplete drainage to cope with inundation.** The City needs to develop a wastewater management plan, considering centralised and decentralised systems and the effective use of natural drainage areas to regulate storm water and to reduce localised flood.
- **Training capacity needs strengthening in DRM, CCA** – specifically on integrating CCA and the DRR into the SEDP and sector plans – and in community-based DRM. The latter will enable community-based disaster risk assessment to be carried out in the City, and in communes and wards in the province.

Key recommendations

Technical assistance, training and capacity building for DoNRE, DPI, DARD, DoC, other key departments, and the CPC is needed to:

- Commission a **comprehensive review of IWRM** including surface water, groundwater, and rainwater capture to develop a **strategic plan to transition from GW to SW**, with DoNRE, the CPC, and other key departments.
- Develop a **wastewater management plan for Soc Trang City**, with the centralised and non-centralised treatment of wastewater before discharge to the environment, and the effective use of natural drainage areas. Incorporate **capacity building for HR** of URENCO, the Water Supply Company, and DoNRE.
- Commission **research to map, develop and protect ecosystems** within and around Soc Trang City.
- Facilitate **training and capacity building** on: (1) **Green infrastructure and bioengineering solutions, including SUDS**; (2) **Disaster risk management, CCA, CBDRM, and on integrating CCA and DRR** into the SEDP, the City Master Plan and sector plans.
- **Speed and scale-up fulfilling the CBDRM program** to cover the province and Soc Trang City, including **community-led risk-assessment (CBDRA) of urban wards**.
- **Automate monitoring of SWI** at four critical points along the Hau River, including developing necessary HR capacity of DoNRE, HMS, DARD, other relevant stakeholders.
- **Update City Master Plan to integrate CCA and DRR**, based on the MoNRE 2017 CC and SLR scenarios.
- Carry out **public awareness raising and provide basic equipment for piloting the '3Rs'**, in selected urban wards, then the whole city.
- Carry out **hydrological and hydraulic modelling of the whole province** ensuring this includes capacity building for key staff.

Water Management

In Soc Trang, salination is a serious threat² to surface water quality and there is over-reliance on groundwater sources with 80% of supply from groundwater. Flooding occurs in five city areas and upgrading of the urban drainage system is needed. While sanitation in the city has improved through good progress made on wastewater collection and treatment, household wastewater connections require facilitation. A review of the hydrology of land development plans and improved planning for sustainable urban drainage is required. There is a need to formulate development plans that incorporate an integrated approach to the management of the urban water cycle. In relation to storm water management, implementation of sustainable drainage initiatives is needed which involves a proactive process recognizing the opportunities for urban design, landscape architecture, and storm water management infrastructure to be intrinsically linked.

Main findings

- Encroaching salinity lasted 5 months in 2016 and required the surface water WTP to reduce production and to blend production with groundwater sources.
- A water transfer scheme for salination prone cities is planned by government and Soc Trang may take transfer water from the Aquaone Transfer WTP.
- An Integrated Water Resource Management Plan is required for Soc Trang to include surface, ground and rainwater sources.

² According to data of Soc Trang provincial Water Resources Department, saltwater has intruded deeply into the mainland in Soc Trang with an intrusion level of 65km in 2016. According to data from Soc Trang provincial Department of Rural and Agricultural Department on 23 February 2016, there have been 6 out of 11 districts of Soc Trang city under salt water with the highest salinity of 10%. 10.000ha rice in Soc Trang province are seriously affected by salt intrusion and drought, in which 902ha completely lost, costing 38,9 billion dong.

- Hydraulic modeling and preparation of a Drainage Master Plan is required followed by upgrading of the urban drainage system.
- An IEC program is required to support the household wastewater connection program.

Key recommendations

- Need for an integrated water resources plan, capacity building of the water supply and urban works companies, and further assessment of implications of hydrological transformation of land for housing development.

The priority actions required are:

- Integrated Water Resources Management study of surface, ground and rainwater sources;
- Capacity building at Soc Trang WSC for water supply network management, improved groundwater treatment process, HR strengthening and AMP preparation;
- Capacity building at STDC for Drainage Master Plan preparation, IEC program for household wastewater connections, faecal sludge management improvements;
- Hydro-meteorological and hydrological modelling of urban land development proposals.

GIS and Information Management

Strong institutions demonstrate inter-sectoral coordination. Integrated planning, enabled by geospatial platforms, indicates a systemic understanding of problems, and of contradictions between various stakeholders involved in the process of development.

Main findings

- ***Institutional capacity facilitates measurement of spatial and non-spatial data related to social, economic, physical, environmental, infrastructure and transportation sectors.*** Soc Trang demonstrated varying institutional capacities across the various departments in charge of managing land and infrastructure services³.
- ***Cross-sectoral approach:*** While sectoral plans have been juxtaposed on the master plans, they do not address cross cutting issues. For example, phasing of urban expansion needs to be linked to municipal finance and available investments – public or private. Similarly, measures for prevention of flooding need to address urban design of public spaces, canal front as well as the road and transportation and drainage sectors.
- ***Data availability: Spatial data concerning natural hazard risk,*** such as digital terrain data, mapping of watersheds, areas prone to flooding, drought and saltwater intrusion and other natural hazards, required for urban planning and implementation, are unavailable. Further, non-availability of disaggregated data makes planning for the worst-case scenario difficult.
- ***Disaggregated data for socio-economic indicators*** are available on a yearly basis, as non-spatial data, at the ward and commune levels⁴.

³ For example, URENCO supplied water efficiently to almost 100% of the city, while urban land management entails challenges of reconciling supply and demand. Despite varying capacities, visits to areas occupied by traditional settlements indicated a fairly good level of maintenance. Capacity building programmes proposed for Soc Trang shall have to consider this aspect. At the same time, technical capacities in using geo-spatial databases would be essential in all the departments at all levels of disaggregation.

⁴ While decadal census captures household level data, the PSO conducts limited sample surveys, on an annual basis. The number of indicators documented follows a national decree. For annual data updates, at the ward and commune levels, the PSO officials derive statistical estimates for the indicators from a hierarchical system of data extrapolation. The sample frequency is variable based on the project requirements – it is not a fixed parameter. Further, the GSO at the central government level determines the sample area. The local PSO or DSO does not have a say in this process. However, the DSO or the PSO conduct surveys for specific areas, if required. This data is not linked to any spatial data currently available with the CPC, at household, ward or commune levels.

- **Water sector data:** URENCO has digital data available, however, in Autocad format. While this data platform is adequate for sectoral service delivery, it does not permit cross sectoral analysis.
- **Parallel projects:** The central government has commissioned research institutes at the centre to process LiDAR data, which will in turn help generate digital terrain models and disaster risk simulation models. However, the DoC and the CPC were not aware of availability of Lidar data for parts of the city of Soc Trang. Data sharing and information sharing platforms need to be enhanced between the centre, province and city levels.
- **Data compatibility and formats:** Cadastral data is available in Microstation, a format compatible with the GIS platform. However, the CPC has not mapped cadastral data, population and employment and socio-economic indicators for Low Infrastructure Areas (LIAs). Preparation of a data base for LIAs require institutional coordination between DoC, DoNRE, DSO/ PSO and local people. The macro level spatial data for the Master Plan is only available in Auto Cad format (master plan data and data with URENCO). Master plan data is not linked with non-spatial-socio-economic data (age, gender and areas of inhabitation of physically challenged persons). In other words, the available master plan is not organized in form of geo-spatial database.
- **Institutional coordination for data sharing** between sectors in Soc Trang is fairly good.
- **Capacity building needs:** Presently, within the DoC and CPC, none of the staff members is trained in the domain of GIS. The officials in charge shared the need for receiving training in GIS enabled urban planning.

Key recommendations

- **Commence GIS enabled Master Planning in 2017, along with Capacity Building Programme:** Soc Trang City has committed to undertake the revision of its Master Plan in 2017. The Master Plan 2030 is being revised by the CPC, for a planning period of 2030 and a vision up to 2050. It is therefore key that Soc Trang city undertakes this revision through a GIS enabled planning approach⁵.
- **The creation of a GIS data base first requires design of a data model and data structure.** Populating this data model and data structure, with real time data, will span more than a term of five years, at the minimum. It is therefore recommended here that a data structure first be established for Soc Trang. Considering the nascent stage at which the data base currently exists, care may be taken at the very beginning, in forming a data base with no data discrepancies: (1) The data structure of the current master plan and other current/ allied plans need to support spatial database creation; this implies that they need to be unified to meet MoNRE's regulation of following the VN 2000 projection system; (2) The coordinate system of spatial data in master plans must be forced to follow VN2000 that is required in MoNRE's regulation of geographic maps.
- **Data for integrated planning:** Need for a framework for integration of province level CCAP into Statutory Master Plans of Soc Trang city and accordingly, corresponding data integration into primary data base; further, framework for integration of province level CCAP into Sectorial Master Plans for Long Xuyen city and integration of corresponding data with primary database.
- **Primary data collection and creation** of a robust geo-spatial data infrastructure for scaling up of economic development imperatives on the one hand through Master Plans and Sectorial Plans and disaster risk proofing on the other.

⁵ The revision of the master plan must also be accompanied by a capacity building programme, with the DoC, DoNRE, DSO, Company of Water Supply and Electricity, DARD officials and staff as officials. Using a GIS platform for master planning and plan implementation, now, will help the city plan using multi-criteria analysis and further, it can be used for evaluating policy outcomes through a monitoring and evaluation framework.

- **Data integration:** Integration of multiple spatial and non-spatial data sources from multiple governmental, non-governmental organizations, and World Bank funded projects, is essential and feasible in avoiding duplication of efforts. These include: (1) *Data management:* In the long term, real time updating of spatial and non-spatial data essential in order to develop a reflective and flexible approach to addressing disaster risks; (2) *Data Monitoring and Evaluation:* In the long term, a Monitoring and Evaluation (M&E) Framework may be evolved based on local growth conditions and requirements, for evolving a demand driven planning approach that measures extent of master plan and project implementation; also, a M&E framework to evaluate policy outcomes emerging from Climate Change Action Plan's mandates for risk proofing of Soc Trang; (3) *Training and Capacity Building Programme:* for augmenting capacities in use of GIS data base, conducting multi-criteria analysis and formulating planning tools that will incorporate detailed data sets. Capacity building should also include use of GIS for conducting trend analysis using time series data, to the extent available. This capacity building will aim to enable a demand driven urban planning approach and data management at the province and city levels.

Priority Actions

- MoC to lead and initiate discussions with other ministry level offices and corresponding province level departments, for kicking off an 'integrated urban planning and development' project in the MDR; Establish required protocols with MoNRE, MoC, GSO, MoT and other ministry level offices to explore the possibility of setting up a GIS Data lab at Soc Trang, in the medium term.
- Formulate action plan for initiating integrated master planning, including setting up of an elementary GIS Data centre, evolving cost effective methodologies for collecting a minimum data set, conducting situation analysis through multi-criteria assessments; formulate vision for the city's development with long term, mid-term and short term objectives, proposals and conducting simultaneously, a Capacity Building Programme.
- Alternatively, propose pilot projects delineating specific planning areas within the core area of the city or urban peripheries; use GIS platform at a smaller scale, for planning, enforcement and monitoring of plan implementation and evaluation of planning outcomes.
- Estimate financial value of the project preparation and establish a funding agency for supporting the project to be commenced in 2017.

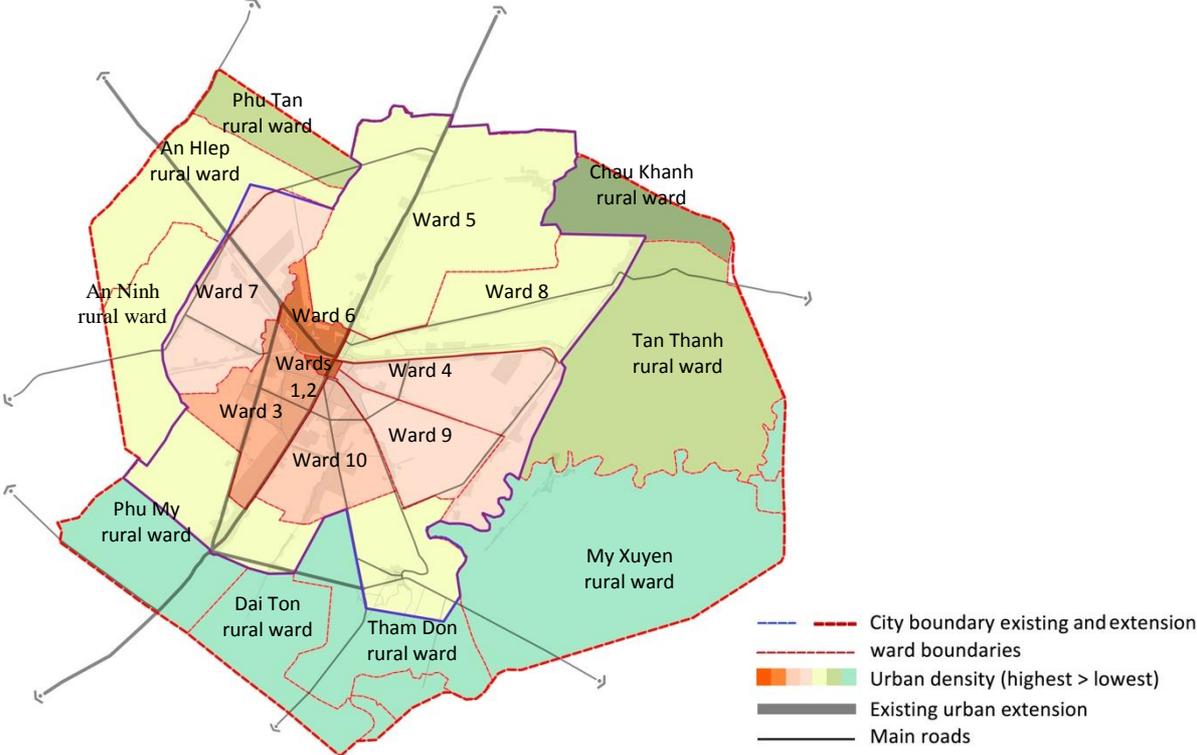
Conclusion

The infrastructure on the surrounding productive landscape with the 1st and 2nd ring roads has been built based on the master plan 2020 and largely shows fragmented development, rather than creating effective connectivity or conditions for economic achievement. In fact, different from the logic of the master plan, the linear development has extended to different directions, either urbanizing or connecting to existing settlements and new vast planned industrial and residential areas. The major potential for extensions of the city are the directions to connect with My Xuyen, An Nghiep, and the old airbase. The logic of development in Soc Trang rather shows an open system than the closed framework as the proposed ring roads of the existing master plan. The existing development and extension have still allowed productive landscape and water urbanism and rural - urban linkages, which should be taken as consideration in the revised master plan. Therefore, the urbanization with soft - hard infrastructure provisions for urban - rural linkages should be incorporated to support for the movement of the fresh economy into brackish economy of Soc Trang city and the province in the new context of climate change and SLR.

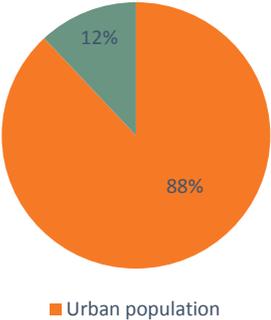
INTRODUCTION: URBAN AND LANDSCAPE TRANSFORMATION

General context

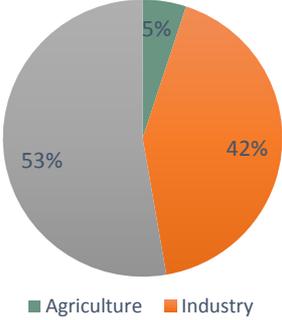
Soc Trang is the capital city of Soc Trang province, located at river mouth, South Hau river. The city administrative boundary covers an area of 76,16km² (108,23km² planned for city extension) with the population of about 137,642 in 2014. The city urbanization ratio achieved 100% in 2014 with the average urbanization growth rate is about 0,4%/year in the recent 5 years. The Income per capital is 3.267USD (2016). There are 2711 poor households (9%) and 3494 close to poor households (11,73%). In which, Khmer's poor households is 1676 (19%). (source: Soc Trang city statistic books and others).



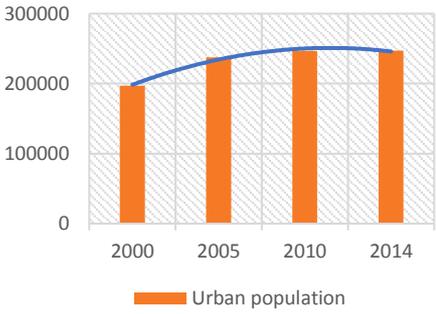
Soc Trang city administrative (with extension) and density map



Urban, rural population ratio 2014



GDP share in economic sectors (2015)



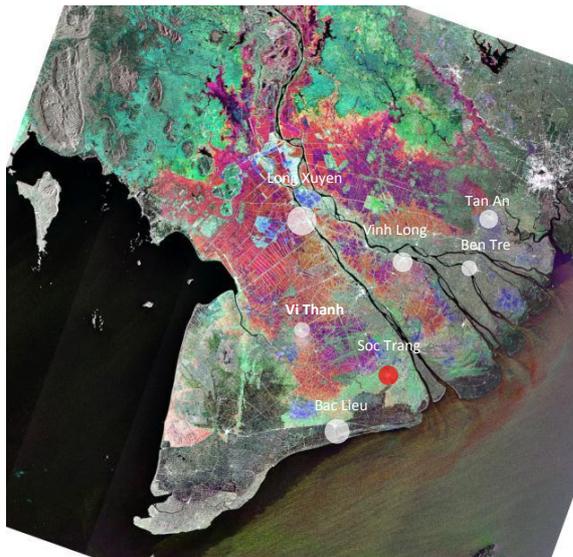
Urban population in 15 years

Cities in the river delta

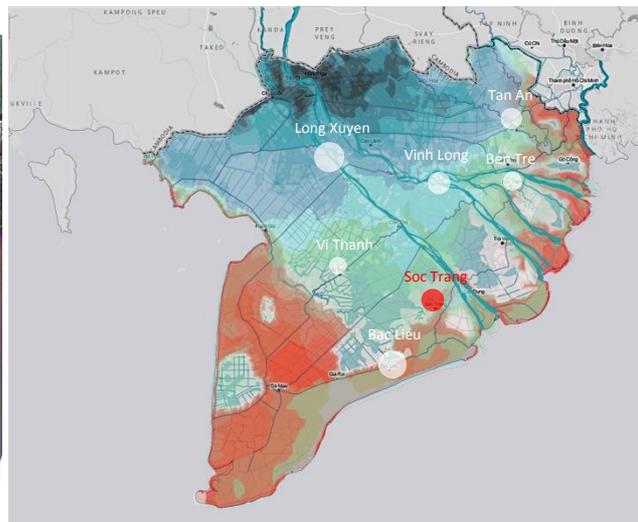
The cities in the Mekong delta region (MDR) were firstly formed as service hubs for intensive agriculture and more recently became the foundation for becoming urbanized economic drivers. Their

initial morphology and relation to water were based on rice intensive culture. This has created a unique form with urban rural interlinked characteristics, with exceptionally differentiated and specified features embedded in unique geological and ecological water landscapes.

Soc Trang is a coastal province located west of the Hau River at the East coast where the geology is diversified with channel bars, back swamps, coastal plains, sand spits, sand dunes and mangrove marsh; therefore, the ecological landscape is also diverse, especially also near the river mouth where the fresh water meets the salt water. The particular topography of the area is particular for the irregular wave-form with higher sand dune strips and lower salinized and sulfas areas. The population concentrated with higher density here in Soc Trang compared to further South due to the additional fertility of the river alluvia. Hence, for hundreds of years, rural settlements were formed densely on the curved sand dunes along the coastal line with different scales and shape depended on the natural shape of the sand dunes.



Soc Trang and other 6 cities in MDR intensive agriculture map 2015. Adaptive map: <http://spaceref.com/asia/developing-agriculture-from-the-sky.htm>



Soc Trang and other 6 cities in MDR flooding and salinity map 2050. Adaptive map: <http://icem.com.au/DELTA/>

The particular context of river mouths and sand dune geo-ecology landscape of Soc Trang is the gradual change from the fresh alluvial eco-agro sub-region to the coastal brackish eco-agro sub-region of the MDR. The area was affected extensively by saline intrusion and the fresh water was limited before the completion of the canals network in 1990s to transport water from the Hau River to coastal area. In the mid - 1990s a series of sluice gates were installed in Soc Trang province to control saline intrusion, and as the result, the paddy production has expanded. Within the recent 10 years, however, Soc Trang as other coastal areas has experienced a large conversion from fresh water of rice cultivation to brackish water for intensive shrimp farming, due to higher profits as well as higher domestic and global market demands.

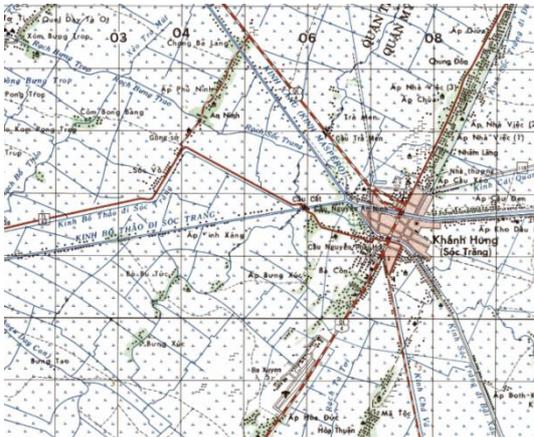
The climate scenario map shows severe impacts on the MDR, with sea level rise estimated at 17 cm and 30 cm in respectively 2030 and 2050 (the medium emission scenario). With the high emission scenario, the sea level rise is even estimated at 1 meter, which will cause 90 per cent of the Delta to be inundated annually. The saline and drought impacts in coastal areas will be more substantial in Soc Trang, causing a major threat on fresh water supply for the city in the future.

Specific context

Urbanization embedded in the river mouth + sand dune, agro-geo-ecology landscape and the canal + road hybrid

The city has been formed at the hybrid intersection of canals and roads and is incorporated with the coastal sand dune morphology surrounded by a constantly transformed productive landscape. The canal network geometry of the South Hau river is recognized by a great number of lines, intersections and convergences, with even five- and seven- junctures, entangled with boats. The water traffic and trading activities become the significant culture landscape of this land. The major hybrid water accesses to Soc Trang city are Maspero and Bo Thao canals to transmit freshwater from Hau river to the East coast, linking to the regional Quan Lo - Phung Hiep canal and Ba Xuyen river, providing also convenient water transportation of passengers and freight. The barrage at Soc Trang is representative of many of such constructions built throughout the delta, all which required skilled engineering and man-power to construct, needing continual maintenance and possible transformation in the new context of the climate change.

Roads were soon built parallel to the canals and rivers, similarly beginning during the French colonial era. The main regional connecting roads to Soc Trang (National road No1A to Can Tho and No1 + No60 along the eastern coast) took advantage of the already higher, safe ground land, built along the canal or through the dune settlements along the coast, accelerated the modernization and urbanization along. At the particular location of hybrid waterway and road concurrent geometry, the city has formed with particular shape with the combination of colonial setting and the dune's settlements.



Original hydrological geometry and road hybrid creating urban form of Soc Trang



The barrage at Soc Trang (Archives nationales d'outre mer, Aix-en-Provence)

Rich layers of the urban form

The city has been found as a concurrency of canals and roads, the combination of canal network geometry, colonial setting, coastal sand dune and road settlement morphology as well as the new logic of urban extension. The city form has been created through time by overlapping and interacting amongst multi-layers of social features, culture life styles, historical transformation, modernization and industrialization. Its combined characteristics can be found in different social layers, soft-hard water layers, road-street layers, traditional settlement and grid pattern layers, urbanization densification and extension layers.

Soc Trang's known as the land of long history of Chenla (ancient Khmer) dynasty since 5th to 8th century, also the land where Khmers have been living together with Chinese, original Chams, later Viet people. The original Khmer settlements with orchards have been formed in long sand dunes (higher land form of 0,4 - 1,5m above the sea level) parallel to the coastal line with rice fields on the surrounding lower land. This has formed a culture and life style called "dune culture" distinguished for the East coastal sub-region of the MDR. The landscape domestication together with the immigration of Viet population, has been altering the cultivation tradition and creating the richer mix of culture.

The Chinese people have also contributed to the cultural diversity in Soc Trang, which can be observed in the typical shop-house urban setting and the past water trading culture. The ancient Chinese harbour was found in

My Xuyen, at Ba Xuyen river bank, about 5km from Soc Trang, where in the 17-18th centuries, the trading along the waterways to Sai Gon - Cho Lon used to be very active. However, urban formation and transformation based on the hybrid canals and roads, have helped Soc Trang becoming a more convenient location for urbanization than My Xuyen.

French colony marked the city with typical boulevards and grids toward the waters (the canals and the Fresh Reservoir), with colonial governmental buildings and main public facilities, forming the shape of the urban core which has been playing an important role in the city until now. Through America time and later after the war, urban space has been densified within the grid patterns. Urban fragment around the city has been taking advantages of either urbanizing existing rural settlements or regional connecting roads and the city ring roads developed upon the masterplan 2020.

Further extension mainly along the main roads and canal, linking the city center along the national road No1-No60 to the north with new residential area (5A) and to the south connecting to the old air-base, to the west along National road No1 to An Nghiep industrial zone, and to My Xuyen the old Chinese port. Not only urban and industrial area should be re-qualified, the old port should be revitalized, the old air-base also has high potentials for urban renewals and re-used for city economic activities such as tourism. Extending from the French urban core, the provincial administrative and public center have been built and renovated with a typical morphology of large formal square grids, formal modern-style colonial governmental buildings, large paved squares for festival and public gatherings and boulevards with trees and large sidewalks.

Water urbanism is also the key urban identity in which urban morphology has strong relation with canals, rivers, water reservoir, underground and surface water, natural wetlands and water-productive landscape. These can be seen as advantages but also challenges due to the climate change and SLR. In relation with water, another city's cultural characteristic with the combination between hybrid canal culture of South Hau river and Khmer's "sand dune culture" can be observed. As an example, the Oóc-om-boc Ngo boat race festival organized annually has been contributed to create particular rich and colorful images of the urban life.



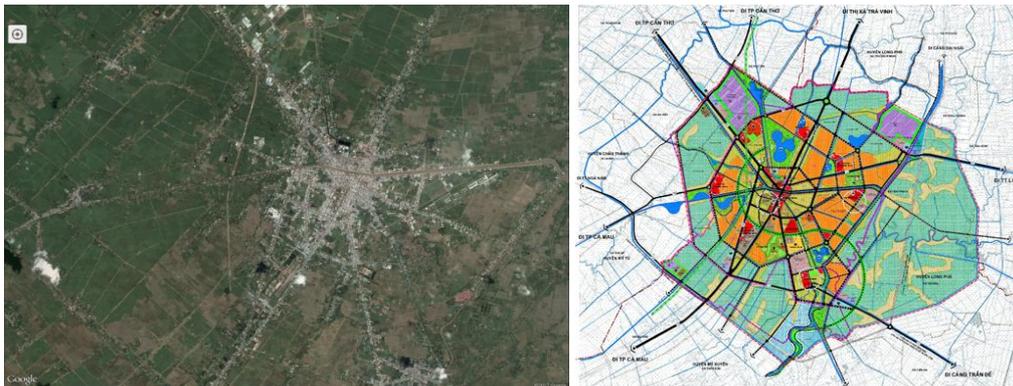
Soc Trang's urban dense and new urban residential project area (Adaptive map: Google 2016)

Road extension, industrialization and planning ambition

Soc Trang master plan to 2020 has substantial growth slated for the future, in terms of urbanization and industrial areas. Urban development is concentrically organized and largely extended to the surrounding landscape, taking a large amount of land out of production through proposed urbanization. The entire development was proposed to become an equalized mesh that is primarily road-based, especially the ring road system and curve boulevard, having little to do with the city's existing geography and identity. The closed urban landscape and water body are strictly zoned in the new ordering of the territory. Furthermore, the multi-centric city proposed with the ring road system

could be an ideally theoretical form applied without understanding the locality of human settlements and urban structure.

The 5A residential area is typical with generic road-based development, so far, still struggling for investment. An Nghiep industrial zone has been established with the expectation of attracting general industries, and has achieved about 50% infrastructure provision and 35% built-up, mainly for agro-aqua processing. Another larger industrial zone, proposed with similar expectations, so far failed in its development. In fact, agro-aqua based industry does not necessary need to be concentrated in such a large industrial zone, but should be decentralized to different resource areas to be flexible for developing and amending especially in the new context of climate change and SLR.



Urban extension existing and expectation: Google map 2016 & Master plan to 2025 with the same scale.

The infrastructure on the surrounding productive landscape with the 1st and 2nd ring roads has been built based on the master plan 2020 and largely shows fragmented development, rather than creating effective connectivity or conditions for economic achievement. In fact, different from the logic of the master plan, the linear development has extended in different directions, either urbanizing or connecting to existing settlements and new vast planned industrial and residential areas. The major potential for extensions of the city are the directions to connect with My Xuyen, An Nghiep, and the old airbase. The logic of development in Soc Trang rather shows an open system than the closed framework as the proposed ring roads of the existing master plan. The existing development and extension have still allowed productive landscape and water urbanism and rural - urban linkages, which should be taken into consideration in the revised master plan. Therefore, the urbanization with soft - hard infrastructure provisions for urban - rural linkages should be incorporated to support for the movement of the fresh economy into brackish economy of Soc Trang city and the province in the new context of climate change and SLR.

PART 1. URBAN PLANNING

Background

Soc Trang city is a provincial capital of an agricultural based province in the Mekong delta region, located 220 kilometres from HCMC, 60 kilometres from Can Tho city and 40km from the coast. The population in 2016 was 138,080 (10% of the province's) and is increasing at a net rate of 1% a year, just below the natural increase. GDP per capita in 2016 is estimated about VND 70million, while the GDP growth rate is reported as extremely high at more than 16%⁶ annually during the last 5 years, probably the highest among seven cities visited. The city and province include a considerable proportion of ethnic Khmer and Chinese in the population.

The current master plan adopted in 2011 is under revision. It reflects an ambition to become a green, class II eco-city in the near future. This plan (to 2020, vision to 2025) will soon be replaced by a general (master) plan to 2030, with a vision to 2050, presumably within 2018. This revised plan aims to update the development situation and address planning problems. However, it seems that the ambition to become a class II city is driving the revision, of which reaching 200,000 population from existing volume can only be realised through the annexation of nearby settlements⁷. The new plan expands the city radically in all directions, some even 10km away from existing centre. New commercial housing areas towards the East, industrial zone to the North West and small scale development to South West. There will be some impressive links from 60m to 75m from old to new areas surrounded by large scale public facilities.

City form and structure

Overall, the existing city structure is effective in meeting the social and economic needs of the population. The city has developed in a radiant compact form with a combined commercial and administrative centre spreading outwards towards the surrounding areas along canals and main roads. This layout reflects a highly adapted economic structure to the city's agricultural eco system with a small city scale, a large number of small businesses, and endogenous drivers of growth combined with a slow provincial urbanisation rate. Low industrial input implies low emissions and investment needed to combat pollution. The city has maintained its green infrastructure in both the city centre and along the main development axis. The link between urbanity to rural setting and canals is strong and is achieved by the development of houses facing to the main road or green fields. The concentration of public facilities and services in the city centre helps sustain this compact development pattern. Distances to the centre are reasonable from all parts of the city and can be reached in a ten-minute ride.

However, the current master plan envisages a multi-polar spatial structure for Soc Trang, largely driven by the road and transport sector⁸. The plan hinges upon conceptual orientations for aligning different types of economic activities along the main arterials, accompanied by ambitious proposed road alignments. These are however, not backed by real demand or traffic projections. For example,

⁶ This figure needs to be confirmed as it is significantly higher than the figure for provincial growth which is under 10%, and is itself also debatable.

⁷Annexation is chosen as the current means of increasing population growth. At the current annual 1% growth, this would require 36 years to reach 200,000.

⁸ North, East, South, East and South-West are developed on the basis of different advantages with the axis of development being the influences of National Road No.60, National Road 61, provincial roads towards to the Hau River such as provincial road 933, provincial road 934 and some routes planned to open under this revising plan.

data related to future potential for employment, economic activity, current and projected contribution of the city to the provincial and national GDP, in and out migration are all inter-related with traffic demand. These will influence proposals for land use zoning and development rights. However, evidence based planning does not back the current master plan.

Resilience qualities

Amongst the cities of the Mekong Delta Region, Soc Trang aspires to be a Grade II city. Augmentation of port-based trade is one of the main strategies the city has envisaged, to become part of a key economic triangle comprising Soc Trang City - Tran De Port (Tran De District) - Dai Ngai Port (Long Phu District). On 18 April 2011, the Province People's Committee (PPC) of Soc Trang approved the proposal for revising the general master plan of Soc Trang City for a planning period of 2030 with a vision up to 2050. Given the absence of disaggregated data, proposals in the master plans that attempt to meet Grade II aspirations do not rely on actual assessments of challenges and potential. With a population growth rate of less than 1%⁹, like several other cities of the MDR, Soc Trang faces the challenge of meeting the pre-requisites for achieving Grade II City status. The current urbanized area of the city is about 76,062 ha. The proposed urbanizable area in the current master plan is about 18,440 ha, with proposed conversion of about 10,823 ha of agricultural land into urbanized land, within a period of twenty years. Further, the planning area of the master plan is 18,440 ha, providing further possibilities for urban expansion. With the new decree that allocates grants to cities that meet Grade II status, Soc Trang is presently striving to evolve innovative strategies to achieve the pre-requisites. Annexing adjoining communes¹⁰ into the planning area of Soc Trang is one such strategy, in order to achieve the needed targets. A current population of 137,899 people, occupies a current urbanized area of about 7.606,2 ha, positing the present urban area density at about 70 persons per hectare. However, the total average density of the city is about 18 person/ ha¹¹ and in order to achieve Grade II status this needs to be increased to 80 persons per ha by 2020.

Pressure to gain promotion to class II city status and apply explosive growth patterns threaten city resilience. Although the city may have better land conditions for building, easy land conversion that reflects official urgency for an accelerated growth rate would harm the city's financial and environmental balance in the future. A move from agricultural to industry is an understandable reason, but it seems the local authority has weak evidence on which to restructure the local economy. A more pragmatic, market sensitive approach to decision making would provide a better tool for improving local level resilience. Due to the rather small scale of new development (600 -700 ha so far), the adverse impact of urban land expansion into agricultural areas is limited; however, it will increase significantly if all approved projects are to be implemented. It is too early to reflect the costs of infrastructure in peripheral urban areas as distances to work and to public facilities are acceptable for most of local citizens.

A revised approach is needed to increase housing affordability to lower middle income groups. Although the extent of lower middle income support is low; however, as all support provided to commercial residential development, resettlement people are uninterested in dwelling and in moving into new residential zones with restricted opportunities for in-house economic activity and accessibility to potential customers. This explains why the majority of new plots built for resettlement households are still vacant.

DOC, DONRE, AND PMU staff fully acknowledge the challenges they face; however, this has not translated so far into increasing resiliency in terms of land use and social development. It rather reflects the limited capacity to implement targets embodied in the master plan and there is no

⁹ The natural population growth rate in Soc Trang is about 0,63% in 2015. However, the urban population growth rate varies during 2010- 2015, average rate reaches 8.48%/year.

¹⁰ 13 neighbouring communes and townships of My Xuyen, Long Phu, My Tu and Chau Thanh districts.

¹¹ According to the Statistical Yearbook of Soc Trang province in 2015.

evidence as yet for formulating a more appropriate plan and the management capacity for improved resilience.

According to report of the department of Labour, Invalids and Social Affairs, the working work force participation rate of the city in 2015 was about 40% of the total population of the city. While this seems advantageous for the city in terms of future economic development potential for urban growth, discussions with officials of the CPC and DoC revealed that skillsets and training needed for an urban transition was unavailable. New forms of industry and services sector economic activities demand training and skilling the working age group.

Cross-cutting issues

It seems that ethnic and social issues do not pose a major concern. However, if the city proposes to upgrade its water environment, it would impose on canal areas, where most of the poor live. However, as existing resettlement projects are developed only inside residential zones, some concern will arise on the impact on the livelihood of the poor after relocation. A detailed review on site arrangements for the poor would help.

Existing levels of motorcycle use as the main transport means and low density development with non-industrial economic dominance does not pose an immediate threat to traffic congestion. However, a major increase in private car use may threaten the city centre due to its radial road layout and road widths. The city centre may need to restrict car access via an improved parking policy in future together with proper zoning regulations to reduce travel distances.

Future concern exists on current development pattern. Existing public utilities and public space are comparatively well maintained in the city centre. Current compact style helps reducing distance to local residents' accessibility; however, when city expands tremendously as projected, some concern is how city could retain this convenience given the level of public investment often lag behind spatial growth pace.

Climate Change Action Plans. Soc Trang faces several threats of natural disasters including storm, salt-water intrusion, drought, flood etc. Through discussions we learned that two storms hit the city directly (storm no 5- Linda, in 1997 and storm no 9- Durian, in 2006) that caused severe damage to human life, livelihoods and assets¹².

Soc Trang also suffers drought, generally in the dry season which ranges between October and May. Droughts have increasingly become more complex¹³ and directly affects vulnerable sectors as agriculture and food security, surface water and underground water and waterways as well, in the Maspero river. The city also is quite strongly affected by salt-water intrusion¹⁴. In alignment with mandates of the Climate Change Department of MoNRE, MoNRE published the Climate Change Action Plan in 2016, for Soc Trang province. Dovetailing Climate Change Action with implementation of the master plans and sectoral plans requires an integrated approach to planning.

¹² The storms left 5 people dead; 363 houses collapsed and were severely damaged and 2,416 houses were partially damaged; about 1,282 ha of agricultural land and about 800 ha of aquaculture land was inundated; more than 2 km of river embankments were affected.

¹³ In 2006, first drought lasted from 18/8 to 24/8, and second one was in early September; In 2007, there were three droughts (the first one was from June 5 to June 9, the second from July 17 to July 27, the third from 5/9 to 10/9); In 2008, there were 3 droughts (1st round from June 2 to 8, 2nd from 10/7 to 21/7, 3rd round from 22/8 to 31/8).

¹⁴ According to data from Soc Trang provincial Water Resources Department, saltwater has intruded deeply into the mainland in Soc Trang with the intrusion level of 65km in 2016. As the data from Soc Trang provincial Department of Rural and Agricultural Department on 23 February 2016, there have been 6/11 districts, Soc Trang city under salt water with the highest salinity of 10%. 10,000ha rice cultivation in Soc Trang province are seriously affected by salt intrusion and drought, due to which 902 ha of land have been completely lost for any productive use, costing 38,9 billion VND of losses last year.

Integrated Urban and Regional Development. Internationally, cities and regions bearing similar characteristics as the Mekong Delta have addressed complex and inter-related demands through an integrated approach to planning. This means that priorities, investments and development initiatives of various departments are largely aligned with one another, while maintaining climate change mitigation and adaptation as central focus area. Cities such as Singapore and Rotterdam offer desirable examples of planning processes that harness upon the need to address both climate change and social and economic development. As one of the priorities, they have created robust geo-spatial data infrastructure platforms. Superimposing spatial and non-spatial data sets help these cities to simulate and anticipate worst case scenarios. By treating planning as a framework within which multiple adaptations can be accommodated these cities plan in advance for adverse environmental, social, economic impacts, helping them maintain resilience.

At the macro level, Master Planning process presently follows a normative structure, mandated by the Central Government's Planning Law. This prescribes plans to be undertaken at four distinct scales, viz., Regional plans at 1:25,000, City Master plans at 1:10,000, zoning plans at 1: 2000 and detail plans at 1: 1000 and design plans at 1:500 scales.

Within this structure, in order to address integrated planning and development and risk proofing of Mekong Delta Cities, a dual strategic approach is proposed here: cross sectorial planning that cuts across multiple scales is recommended here. This requires integration of spatial and non-spatial database, to be constructed in a structured and phased manner.

Varying Institutional Capacity. Soc Trang presented a unique case in the Mekong Delta Cities. The team of experts from The World Bank met with officials of several departments, including DoC, DoNRE, DoT, DARD, URENCO, CPC etc. These institutions displayed varying levels of strengths and challenges. While URENCO has fared well in provision of water supply and addressing sanitation conditions, the DoT, the DoC and the CPC have faced several challenges in implementation of the transportation plan and master plan respectively. While the reasons may span from inadequate investments, weak inter-institutional coordination, issues related to compensation for acquisition of land, lack of demand and so on, these factors are inter-related and impact one another.

Gaps, challenges, constraints

The mobilisation of further resources for urban development have not yet materialised. Slow, but smart growth needs to be cultivated, rather than switching into new risky development patterns. It seems that policy towards expanding the contribution of the tourist sector to the local economy, through eco and green city proposals, will require a higher quality of place to be filled and needs proper research on market demand and the capacity to respond.

Pushing for a higher city ranking challenges efforts to remain resilient and sustainable. This suggests that the priority to keep using cheap land as a main resource will eventually decrease resilience. Using long-term and improper methods of calculating needs and demand will not help allocate scarce resources and responding to future needs of climate change within an increasingly uncertain international economic environment.

The need for capacity building is compelling. City authorities relied on external agencies to prepare the master plan while limited local capacity to monitor and assess development impedes the result. On behalf of the city authorities, the DOC Director explicitly requested WB support in meeting their objectives of improving resilience and managing growth towards class II status. This will be important in ensuring that the revised plan can successfully mobilise resources from the province and city authorities.



	(km ²)
City boundary	76,16 + 108,23 extension
Built-up areas	10,00 (2012)
Planned urban areas	



Existing and urban extension	
New roads 2030	
Waterways and surface	

Urban extension and new infrastructure in master plan 2030 (adaptive maps: masterplan 2030 and google map 2016)



City plan and the loss of productive landscape (adaptive maps: masterplan 2030 and google map 2016)

Recommendations

The revised master plan needs to be based on higher levels of capacity to realise implementation.

There are solutions for eco and compact growth using smarter planning and development management based on international experience, but changes should be made on developing management capacity, methods and drivers for growth. If some concepts of eco city and urban clusters are adopted to drive towards new city forms, then smarter and more prudent planning and development management can help to make sure new decentralised urban forms will still be eco, compact, and efficient with low use of land and efficient infrastructure development.

Reviews and revisions should be aligned with technical and institutional support. Revisions to planning and inappropriate priorities to grow the city to another class justify the need for central authorities to review the approaches and methods used to prepare and adopt master plans. Resources and evidence-based approaches should be promoted in revising current master plan. Shorter term projections, using more locally based and reliable statistics, market sensitivity, economic and social structure accountability can provide better grounds for making more realistic and resilient general plans. Planning codes, methods, and development management regulations should be revised to reflect local needs and affordability based on hard evidence. More integrated planning with proper data (GIS compatible) is necessary for short and long term plan making and implementation.

PART 2. LAND-USE

Main findings

The current master plan over-estimates the future population and land use consumption requirements and therefore seriously threatens the objective of improved resilience. The population growth rate from 1.75% to 3% per year projected in the plan is based on an assumption of regional development for which no convincing evidence was presented. The official requirement that a population increase of 1% requires an annual increase of 1.3 hectares¹⁵ explains why three developers (PCVL, 586, and Minh Chau) who are putting 400ha of land on sale are suffering with less than 30% absorption over the past decade. If the existing plan could not successfully expand from the current built-up area of 2,000 hectares within the city boundary of 7,000 hectares, it is difficult to see what justification exists for enlarging the city boundary and urbanised area to 18,000 hectares. No calculations have been made on: 1) the economics of land development; 2) present or projected market-demand; 3) the appropriateness of proposals to the social income structure, or; 4) a comparative analysis between the old and new scales of investment and affordability. To meet the standardised public/infrastructural MOC space requirement stipulated in the national planning code applicable for promotion from class III to class II city, it will be necessary to convert an immense land stock, yet none of these factors have been examined in the plan using standard cost benefit analysis approaches.

Evidence of demand for more non-agricultural jobs to promote faster urbanisation was not convincing. For example, although tourists' visits to the city increased more than 10% per year, reaching 1.4 million in 2016, most were passing through without staying, so low spending travellers could hardly generate high incomes and jobs. The An Nghiep industrial park that has been in existence for 10 years reported that 90% of available plots had been registered. This contrasted with observation during a site visit that revealed that up to 70% of leased land is being used for cultivating lotus, rice, vegetables, and dragon fruits. Given the small white and blue collar labour force, it is understandable that commercial housing projects are also suffering when only 20% of 5,000 land plots were sold in five new urban development projects that have been available for occupation for 7 years. A payment of \$10millions paid in advance for land and high standard utility infrastructure will drain capital from the developer when they could hardly find buyers at a premium site just 2 kilometres from the city centre. Whether economic conditions can generate higher growth when endogenous drivers (agricultural) are slow and external drivers (industrial and service sectors) limited is highly doubtful.

Resource constraints challenge proposed expansion and upgrading of the new plan. As a poor province, reliant on subsidies, Soc Trang has been suffering from budgetary tightening since 2011. Most public development projects are either on hold or slowing down, including critical or urgent ones such as a coach station, road improvements and vocational schools proposed in 2015 and 2016. The medium-term budget for infrastructure (2016-2020) with VND 85bn in 2017 (out of VND 450bn committed) implies a shortage of public investment needs¹⁶ and explains why an impractical project for road widening up to 75m right of way was cancelled. Public investment for city upgrading schemes vary according to unstable/unpredictable land use fees revenue¹⁷. These constraints challenge the ambition for synchronised infrastructure development and business attraction. In short, long-term proposals based on inflated demand assumptions make the plan unsustainable and incompatible with improved resilience objectives.

¹⁵ Based on the official standard of 100m²/person.

¹⁶ Priority ones are identified within the provincial Party's Standing Committee and are legalised in the People's Council – a top down process under democratic form.

¹⁷ City budget in 2017 was supplemented around VND 40bn from the provincial budget surplus (land related revenue) from 2016 (equal 40% of previous year budget for infrastructure development).

High demand for housing for the poor compares unfavourably with low revenues and mobilisation capacity. Soc Trang has a higher proportion of poor household compared with other provinces in the region. Of the two schemes: favourable groups (poor veterans and merited groups) and the poor, 'favourable' groups are financed by donations from local enterprises and philanthropic organisations. These attracted enough funds to rebuild 453 units with VND 32millions support each year since 2012. Meanwhile, housing for the poor (a scheme combining donations from society and State support) provided only 48 units so far (VND 50 million since 2012). 54 units are under construction, but in total these only satisfy 3%¹⁸ of the poor household number.

Land management is functioning in a slow growth pattern. With slow growth and cheap land, it seems the city can handle land acquisition needs. Actual land conversion is well below planned levels (19% as planned from individuals and 12% public projects in 2016). There is no major concern on disputes over resettlement and enforcement resulting from development control. Land registration has reached 98% of urban land, implying that only a small number of land plots along canals and past encroachment are unregistered. The actual number of unregistered households is not yet calculated; however, they will be revealed when upgrading projects are to be implemented.

Key recommendations

The city is encouraged to organise a competition to recruit the best consultants to prepare the revised plan based on terms of reference as outlined above. If it is too late, it is strongly recommended that the city/provincial authorities appoint a capable team of experts to assess the proposals using a professional review method.

Priorities for action by focussing on the over-riding importance of national government in determining planning standards, norms, regulations and administrative procedures for land use planning and management suggests that discussions be sought with MOC, MONRE, and possibly MOT/MPI with a view to reviewing and, where appropriate, revising the regulatory framework to ensure consistency with policy objectives for improving urban resilience to climate change.

¹⁸ 1,800 households (6%) are under poverty line, 3,400 (10%) are closed to this line may require housing supports. Over the past 5 years, only 2 projects provided 48 units and 54 other units are ongoing with both public and private support.

PART 3. URBAN TRANSPORTATION

Background

Soc Trang can be easily accessed from the other provinces and cities in the region, and it has a relatively good 129-kilometer long urban road network. In 2013, Soc Trang province adjusted its Master Plan for Transport Development, consisting of plans for highways, public transport, waterways and airways. The adjusted plan was to complete highway and waterway systems to ensure the stable, balanced and sustainable transportation to 2020, and also supporting the city class upgrading. The ambitious plans seem to bring not only opportunities for growth and better quality of life of the citizens, but also challenges for sustainable development. Obvious challenges may include high investment requirement (more than 2.5 billion USD needed) and significant land acquisition (nearly 8,600 ha).

Main findings

Climate Change Mitigation.

Transportation emissions, which comprised 13% of Viet Nam's total greenhouse gas (GHG) emissions in 2010, are forecast to nearly triple in volume by 2030¹⁹. ***The national government has set a target to reduce GHG emissions by 8% of the 2010 baseline by 2020***²⁰. Reducing emissions from the transport sector will be critical to achieving that national goal and minimizing climate change impacts. Yet, Soc Trang has not prioritized more energy efficient modes such as public transit, waterway passenger transport, bicycling and walking.

In Soc Trang Province, there are 420 registered ***motorcycles*** per 1,000 people, and the rate is surely higher in Soc Trang city. As in other Mekong Delta cities, the motorcycle is ubiquitous. While convenient and relatively affordable, motorcycles impose high societal costs in terms of noise pollution, local air pollution²¹, GHG emissions²² and road safety²³.

DOT has supported the creation of a ***taxi service*** in Soc Trang, granting three taxi companies the rights to operate in the city. This adds diversity to the city's transportation services, although primarily for the upper income residents only.

¹⁹ In 2010, emissions from the transport sector (31.8 million tons of CO₂eq) comprised 13% of Viet Nam's total GHG emissions with LULUCF (Land Use, Land Use-Change, and Forestry). Transport sector emissions are projected to increase by 176% to 87.9 million tons CO₂eq by 2030. (MONRE 2014).

²⁰ Socialist Republic of Vietnam 2012.

²¹ Motorcycles are a leading cause of urban local air pollution for two reasons: (1) the inefficient design of their 2- and 4-stroke engines; and (2) many countries lack strong emissions standards and/or enforcement. Vietnam's emissions standard for motorcycles is only EURO 2, and EURO 3 is planned for this year. How effectively the standards are enforced is unknown. Air pollution causes an estimated 6.5 million deaths each year, and in Vietnam's cities, motorcycles are a primary contributor of local air pollution. 98% of Vietnam's population is exposed to levels of fine particulate matter (PM_{2.5}) exceeding the safe thresholds established by WHO, and traffic is the main source. Motorcycles also emit smog-producing pollutants and GHG emissions. (IEA 2016; UNEP & Kjaer Group 2013).

²² Although 4-stroke motorcycles emit half of the GHG emissions of a car, they are still less efficient than a diesel bus. CO₂eq per passenger-kilometer: car (gasoline) 130-170; motorcycle (2-stroke) 60-90; motorcycle (4-stroke) 40-60; bus (diesel) 40-60; bus (natural gas) 25-35. (Tulyasuwan 2013)

²³ DOT reported motorcycles represented 59% of the reported road fatalities in Soc Trang province in 2016. World Health Organization (WHO) estimates a total of 22,419 road fatality deaths in Vietnam in 2013. Road fatalities are the third leading cause of death of 5-14 year olds in Vietnam, and the 2nd most common cause for 15-29 year olds. While national data is not available for road fatalities and injuries by mode in Vietnam, across Southeast Asia motorized 2- and 3-wheelers comprise 34% of all road fatalities. (WHO 2015; Passmore 2012).

The existing public bus service in Soc Trang includes 9 intra-provincial and 5 inter-provincial bus routes operating infrequently²⁴. There are plans to add two additional routes between Soc Trang and other parts of the province. While two of the provincial routes pass through and make stops in the city, **there is no local bus service**²⁵.

Reportedly, school children, housewives, the elderly and poorer residents are the primary **bicyclists** in Soc Trang. And while bicycle mode share and ridership rates are unknown, it is clear that **bicyclists are disproportionately killed in road crashes**. Together, bicyclists and pedestrians accounted for nearly 15% and 25%, respectively, of the provinces reported road fatalities in 2016. Unfortunately, the city has no intentions to provide protected bicycling facilities nor promote cycling in Soc Trang. The city is relatively small in size and has a flat terrain, so it could be a very bicycle friendly place, if safe bikeways were provided.²⁶

The city has succeeded in developing some well-designed public spaces for a diversity of users. Two public squares/plazas along Tran Hung Dao Road are an appropriate scale for **pedestrians** (not too expansive), and included exercise equipment, children’s play area, and an open plaza area where children were riding bicycles and adults were sitting and chatting²⁷.

Soc Trang’s **inland waterway transport almost exclusively carries freight**. The Saintard River provides a great regional waterway connection to HCMC and Ca Mau, while the Maspero River offers a link to Can Tho. These connections could provide Soc Trang valuable economic links to the major cities in the region, and an important way to reduce freight transport emissions, compared to road transport²⁸. Furthermore, maintaining an efficient connection between the water and road transport will be critical for the port’s success. Before construction of the Soc Trang Port, the river dock in the city centre handled water passenger and freight transport. DOT has closed the river dock now since its freight transport function is considered redundant with the new facility. However, this small river dock is ideally situated across from the 24-hour Central Market providing farmers direct water access to the market. DOT officials indicated the demand is low and that many farmers transport their goods by truck to market. Closing the river dock is a missed opportunity to provide transport choice and redundancy, which increases the city’s resilience.

There is no waterway passenger transport service in Soc Trang, and no plans to introduce any. In the past, people used to be able to take a river taxi to the central city port, but not any longer. DOT officials indicated passenger water transport demand has declined because of the efficiencies of the highway network.

Climate Change Adaptation

According to the latest climate change scenarios, **Soc Trang is most at risk for flooding, saltwater intrusion, and subsidence**. There was good awareness and information about the flooding risk and impacts but not necessarily about the other impacts. It seems infrastructure design, construction and maintenance standards have not yet been updated to reflect these risks. Flooding tends to occur

²⁴ Service frequencies are typically 45-60 minutes.

²⁵ DOT officials believe since trip distances are typically short, and “everyone has a motorcycle”, there is no real need for local bus service. There are some vague ideas of introducing local bus service in the long-term but no immediate plans.

²⁶ An advantage a bicycle has over a motorcycle is that one can bring their bicycle into a market and not pay for parking.

²⁷ One of the park areas included a small concession stand selling refreshments, and paid bicycle and motorcycle parking was available. The walkways on either side of Maspero River are also nicely designed, with an appropriate scale, lighting and benches. These are nice public amenities, which encourage walking.

²⁸ On the Saintard River in Ward 8, the Soc Trang Port was just constructed with support from the World Bank and Australia Aid. Once operational, it will be able to receive 1,000-ton barges, mostly carrying agricultural products and construction materials. The operating contract is currently out for bid and with only one operator having expressed interest, the DOT may not have a strong negotiating position.

during the heaviest rains, typically between August and October, and for short durations of one to two hours. The common cause of flooded roads is poor drainage systems. Five roads – Phu Loi, Tran Binh Trong, Le Hong Phong, Le Duan, and Nguyen Thi Minh Khai – flood most severely to depths of 0.3 or 0.4 meters. DOT and DOC acknowledged Soc Trang is starting to integrate drainage design into roadway engineering.

Salt intrusion²⁹ has become a serious concern in the province in recent years, although Soc Trang suffers less compared to other districts. Groundwater has been affected which can pose a risk for transportation infrastructure since when saline water is used to mix concrete, salt can corrode infrastructure from the inside out. While aware of the increased salination, DOT and DOC have no information about the specific impacts it is having on infrastructure. MOT is assessing the impacts of salt intrusion on transportation infrastructure, in part to determine the need for salt resistant concrete and other mitigation measures.

Finally, **subsidence is a known problem in the MRD region³⁰** which is not well understood in Soc Trang. DOT was not aware of local subsidence nor of any impacts it might have on transportation infrastructure like roads, bridges and docks. The infrastructure maintenance teams are not monitoring for salt corrosion or subsidence and have not modified their construction practices to adapt to the increased risk. This is an opportunity for improving the city's climate change resilience.

Travel Demand and Integration

Soc Trang's master planning process lacks three critical things: (1) basic transportation data, (2) travel demand forecasts, and (3) integration with land use planning. **Transportation data** essential for transportation planning, such as mode share, freight tonnage, fleet size, and household spending on transport, are missing or aggregated in disadvantageous ways. The data may never be collected, may not be disaggregated properly, or may be collected and retained by the consultants. For instance, most data – such as mode share, vehicle registrations and road accidents³¹ – collected for transport planning is aggregated at the provincial, not district, level. Firms report total tons of product shipped but not tons by transport mode. Likewise, the private bus operating company reports total trips for the province, but not at the city or route level. It is difficult for DOT staff to make sound transportation planning decisions without the right data. The transport master planning process requires a **travel demand forecast³²**, and Soc Trang, like many other cities in the region, relies exclusively on consultants for this modelling. Crude origin- destination matrices are constructed for the entire district, not within the city. The current data does not give DOT any insights into travel behaviours within the city. Over-reliance on consultants weakens the city and provincial staff's capacity to understand the forecasts, manage the consultants and evaluate their results. The city's land use plan is aspirational, not based on sound population and jobs growth forecasts, and the transportation staff do not appear to have a strong grasp of how **land use and transportation** interact³³. The current master plan prioritizes urban

²⁹ The salinity of groundwater and floodwaters is increasing. Transportation infrastructure can be corroded from the outside, when it is submerged in saline floodwaters. When saline water is used to mix concrete, salt can corrode infrastructure from the inside out. See Water Management Sector for more discussion about risks of increased salination.

³⁰ It is estimated that the annual average subsidence rate across the Mekong Delta between 2006-2010 was 1-4 centimetres (Erban, L. et. al. 2014) although no specific data is available for Soc Trang itself.

³¹ Police Department is responsible for tracking vehicle registrations and accidents. They typically aggregate it at the provincial level, and may be willing to disaggregate it at the district/city level if asked. But that is an extra step for the city, which they have not taken.

³² Travel demand forecasts use a mathematical model, population and employment estimates, and land use data, to predict the number of trips that will occur on each mode, route and time of day. The model results include traffic volumes on roads and transit ridership. Travel demand models can also be used to estimate transport emissions. (FTA 2012)

³³ Very simply, developing housing or industrial zones, for instance, generates trips as people travel to and from the new sites. Likewise, new roads and bus service increase access and mobility, and make new development viable. Every land use decision affects travel; and every transportation network decision changes the accessibility of the land, influencing how much and what kind of development the area can support.

expansion, rather than alternatives that may be more energy and financially efficient. It seems there is little discussion about the travel proposed land uses will generate, nor locating new development in the areas of highest accessibility to reduce the need for motorized transport.

Infrastructure Design and Finance

In the absence of robust, defensible travel demand forecasts, DOT and CPC cannot have confidence in what carrying capacity is needed on new roads. Instead of sufficiently sized roads, designed to meet the demand, Soc Trang often plans for the widest possible streets. At times the justification for **extra-wide roads** seems to be purely aesthetic or ceremonial. The oversized infrastructure strains the already limited transportation infrastructure maintenance budgets³⁴.

There appears to be limited understanding or acknowledgement of the **impacts of wide roads**. In addition to higher construction and maintenance costs, the extra width requires more construction materials, especially concrete, which increase GHG emissions³⁵. In many international contexts, constructing new roads to reduce congestion has the opposite effect – new roadway capacity induces travel, eventually leading to re-congested roads. Furthermore, the wide roadways reduce accessibility and safety since they are more difficult for pedestrians – especially elderly, children and people with disabilities – to cross.

Soc Trang has insufficient budget to complete their master plan, and so have shown good resourcefulness by exploring creative ways to **leverage private sector investment** in transportation infrastructure. The DOT has already implemented a land value capture scheme on a segment of Ring Road 2 and would like to replicate this mode elsewhere to pay for road investment costs, but their understanding of its limitations and implementation seems limited.

People's Mobility

The SUUP investment proposal includes upgrades to several alleyways in **low-income** areas. Poorer residents' mobility will likely be improved if these upgrades prevent or reduce the frequency and severity of flooding. Statistics indicate at least 7.5% of the Vietnamese population – roughly 10,125 residents in Soc Trang – are living with disabilities³⁶. During the site visits, several **people with disabilities** were seen using hand tricycles along the side of the road. The sidewalks and high-floor buses are not fully accessible. The statutory planning process requires public communication and consultation, but the current implementation is ineffective. It is unclear what voice the nearly 36% of the population that are ethnic minorities as well as marginalized groups most affected by transportation planning and investments, such as women, elderly, people with disabilities, the poor, have in the process.

Cross-cutting Issues

In some cases, **transportation priorities and investments impact the resilience of other sectors**. The transport master planning process needs to understand and assess these interdependencies. Better coordination and alignment between transportation planning and land use, drainage, sanitation,

³⁴ Soc Trang Province DOT's transportation infrastructure maintenance budget only covered maintenance of 20 out of 106 roads, or 19% of need. Only 35% of roads have been maintained well.

³⁵ Climate change mitigation actions tend to focus on reducing tailpipe emission, without considering the total life-cycle energy consumption and emissions. The production of vehicles, infrastructure and fuel also produces significant environmental impacts. For on-road transportation, life-cycle energy inputs and GHG emissions add an additional 63% to road transportation operations. A key way to reduce road transportation total lifecycle emissions and energy is to reduce the volume of concrete used (Chester and Horvath 2009). This could be achieved by building narrower roads.

³⁶ Palmer et. al. 2015.

disaster risk management will allow Soc Trang to make urban development decisions that are more data-driven and responsive to various climate risks.

Over-sized roads increase costs and emissions, induce travel, and reduce walkability and accessibility. They also increase the cost of acquiring and developing land (See Master Planning and Land Use Section). **Wide, paved roads and sidewalks are impervious to rain and negatively impact hydrological systems by increasing rainfall run-off, and worsening flooding** (See Water Management Section). Travel demand forecasts can help correctly size roads, and green infrastructure designs can improve environmental and climate change adaptation benefits.

As in the other MRD cities, **canals play a vital role in Soc Trang’s hydrological system**, providing natural drainage, collecting rainwater, mitigating flooding, and supplying agriculture irrigation water. In some areas, canals have been covered or even filled in for transportation access. In theory, only canals that serve neither a drainage nor navigational purpose, are allowed to be filled in. Yet, it is unclear clear how well those regulations are adhered to and reinforced.

Resilience Qualities

There are seven characteristics of resilience that cities should aim to achieve in their transportation infrastructure, operations and maintenance. The transport systems should be reflective, robust, redundant, flexible, resourceful, integrated and inclusive³⁷. A description of how Soc Trang’s transportation sector demonstrates these qualities follows, along with some examples of transportation resilience from other cities.

Resilience Quality	Soc Trang	Examples
A reflective system accepts uncertainty. It learns from past experiences, which informs future decisions. Standards and norms reflect emerging evidence.	Soc Trang responded to the heavy flooding in 2011, by upgrading several roads and parts of the drainage system. They have also installed bioswales on several streets that help absorb storm water and reduce emissions.	In response to devastating flooding from Hurricane Katrina in 2005, New Orleans adapted its urban plan to embrace its identity as a water city. Its plans include widened canals surrounded by absorptive green spaces, and pervious pavements.
A robust system does not rely on a single asset. It is well-designed, constructed and maintained so it can withstand hazards without catastrophic damage or loss of function.	There is no evidence that transport infrastructure designs nor maintenance procedures in Soc Trang have been modified in response to salt intrusion.	Tan An’s transportation infrastructure maintenance division of DOT has taken impressive steps to incorporate salt corrosion inspections into their operations with a team of infrastructure monitors. They have modified their infrastructure design in order to adapt. For instance, they are minimizing the use of steel structure, increasing the strength of concrete with salt shields, and painting infrastructure to repel salt. Tan An also launched a public hotline where people can report infrastructure maintenance concerns.
A redundant system has spare capacity so it can accommodate disruption, stresses or surges in demand. It includes diversity, or multiple ways to achieve a particular function.	Soc Trang has great regional waterway connections, so with the new port coming online, waterway freight transport should dominate. Also preserving the city centre river dock would provide water	Cities with overlapping networks of streets, public transit routes, bicycling lanes and sidewalks, and multiple modes of transportation have built in diversity and spare capacity. There are multiple ways to move around town. Bangkok’s Chao Phraya River’s frequent express bus service is an

³⁷ Arup & Rockefeller Foundation. 2015.

	transport access to the city centre which provides an alternative to driving a truck to the market. Soc Trang could further improve their resiliency by adding additional transportation network redundancy with city bus service and a network of bicycle lanes.	additional transport option for its 40,000 daily passengers. Hanoi's urban bus system, including the new BRT route, offer people alternative ways to get around the city besides motorcycle. When Hurricane Sandy flooded several New York City subway tunnels and shut down the system, residents were able to rely on buses, ferries, bridges, commuter rail, bicycles and taxis to get around.
A flexible system can evolve and adapt its response to changing circumstances. This may favour modular approaches to infrastructure, and new technologies.	Taxi services could be utilized for emergencies and to provide vital transport during flooding.	One advantage bus transit has over rail is that the routes are not fixed. Buses can be rerouted or deployed in the event of an emergency. Shared transport modes, such as taxis, shared bicycles can be responsive to demand in a way that privately owned transport cannot. Dynamic road or parking pricing are also flexible.
A resourceful system can quickly find alternative ways to achieve their goals during a shock. It enables the city to restore critical functionality under severe constraints.	DOT is eager to explore creative ways to leverage private sector investment in critical infrastructure. This will ensure Soc Trang can meet their transportation needs even with constrained budgets.	Rotterdam has found an unexpected storm water retention resource in their parking garages. Underground parking garages double as water storage when needed.
An inclusive system emphasizes broad consultation and engagement of communities, especially the most vulnerable groups. Inclusive approaches build sense of shared ownership for a joint vision of resilience.	There are procedural requirements for publically announcing plans and collecting input. Whether these processes lead to broad consultation and engagement in a multi-ethnic community is uncertain. Transportation infrastructure (e.g. high-floor buses) is not universally accessible. Social impacts and equity are not embedded in the transport planning priorities.	During the planning and construction of its bus rapid transit (BRT) system, Johannesburg's Department of Transportation hired a full-time communications and marketing manager. Public outreach and engagement focused on informing people of the project and how the new service would work. A children's play about the BRT was performed in schools near the project. An information booth was set up in a shopping centre along the new route.
An integrated system supports consistent decision-making and ensures all investments support a common outcome. Information shared between systems enables them to function collectively and respond rapidly.	Soc Trang's transportation planning is not yet well integrated with other sectors like water and sanitation, and disaster risk management. Land use and transportation planning are not actively coordinated. The technical capacity and data needed to make coordinated plans are absent. Travel demand forecasting is outsourced to consultants; mode share, vehicle ownership, and emissions data is not collected.	Transit-oriented development (TOD) is an example of coordination between land use and transport. High densities of specific uses (i.e. residential, commercial, office) are clustered around transit stations where there is increased accessibility. Seoul's Green Growth Master Plan, reduced transport sector emissions, reduced car mode share and increased transit and walking through a combination of measures including TOD and aligning spatial planning and transportation.

Gaps, challenges, constraints and barriers

There is a critical shortage of technical capacity in the city, district and provincial departments for leading transport planning analyses – such as travel demand forecasting, mode share surveying – and managing and utilizing consultants’ outputs. This is exacerbated by the practice of repeatedly outsourcing the core technical analysis to consultants, which prevents the public staff from cultivating and practicing their technical skills. Furthermore, there is a gap in awareness of complete street design, which prioritizes the movement of people over vehicles.

There are several key gaps in Soc Trang’s transport plan:

- It is focused on private road transport, primarily motorcycles, and taxis, essentially at the exclusion of other modes like public transit and bicycles. Motorcycles are very affordable and convenient; they are more energy efficient (on a per passenger-kilometre basis) and occupy less road space than cars. However, their prevalence does not eliminate the need for alternative ways of getting around the city, especially during flooding and for people who may want or need an alternative to a two-wheeler.
- There is no integration between land use and transportation sectorial plans, nor technical capacity about the relationships between land uses and travel. Furthermore, the generally held belief that new road investment will automatically catalyse surrounding proposed development is a barrier to more demand-driven planning.
- Funding for new infrastructure investment and maintenance is constrained. At the same time, there is a risk that private sector investment in transportation infrastructure may not be viable. The government may be subsidizing with land swaps, projects which are not economically viable in their own right. Private investment should be encouraged in a competitive and transparent environment, and the government should seek alternatives to relying on land as a subsidy³⁸.

There are several systemic barriers to expanded inland waterway transport in the MRD Region³⁹. First, there is a general lack of adequate infrastructure including low-clearance bridges, piers, docking facilities and signal system. Boats cannot operate at night on the rivers which limits their service hours⁴⁰. Rivers are currently administered by the central, district or city authorities, creating overlapping and inefficient management.

Key recommendations

The highest priority recommendations for improving transport resilience in Soc Trang include:

Transport planning and process

- Ensure ***travel demand analysis*** informs the transport master plan and design of new roadways, especially Ring Road 2. Start collecting reliable city-level transport data on mode share, traffic counts and origins and destinations to have a clearer picture of current travel demand and behaviour. Use travel demand modelling and forecasting with conservative population growth forecasts to predict future demand. Increase DOT staff’s ability to direct consultants’ forecasting and interpret the results.
- Modify master planning process so ***land use and transportation*** plans are developed more in parallel. Look for opportunities for new developments to take advantage of the increased accessibility of existing transportation networks. This can reduce the need for motorized trips, and therefore transport GHG emissions. GIS can be a useful tool for integrating transportation and land use plans.
- Employ more a ***participatory planning process*** to build equity and buy-in in transport plans. Instead of announcing plans after they have been finalized and approved, solicit the public’s

³⁸ Thanh and Dapice 2009

³⁹ Vu Anh 2011.

⁴⁰ Boats cannot operate on the rivers at night because of poor lighting and navigational aids.

opinions early in the process of developing plans and projects. Be certain ethnic minorities and marginalized groups are well-represented in the groups of people the city engages with.

Climate change mitigation

- **Incorporate into Soc Trang’s transport master plan strategies to reduce transportation GHG emissions.** These should include three types of actions: (1) reducing or avoiding trips by developing compact urban areas and co-locating land uses with transport services; (2) shifting trips to more energy efficient modes by providing safe walking and bicycling infrastructure, and frequent and reliable public transport service; and (3) improving energy efficiency of vehicles and fuel technologies⁴¹. Reducing transportation GHGs will diminish (or not worsen) climate change impacts in the MRD Region. It also has important co-benefits including reduced local air pollution, accidents, road maintenance costs, and congestion⁴².
- Soc Trang will benefit from developing a transportation system which does not depend solely on motorcycles, but which offers residents a variety of choices. This will help improve the city’s transport redundancy and flexibility, two key resilience qualities. The city is therefore to be commended for supporting **taxi operations** in the city as it does enhance the diversity of transportation choice, albeit primarily for upper-income residents. Support for taxis should be continued, but not at the expense of local bus service, which serves a very different market – middle and lower-income residents compared to the higher income market served by taxis.
- Create a **public transport development plan** that prioritizes local bus service. With proper prioritization, planning, and investment⁴³, Soc Trang can develop a convenient local bus service that gives people more choices when moving around the city. Focus on providing frequent and reliable service on a few high demand local routes. Urban bus service reduces transport emissions, provides critical mobility for people who cannot ride a motorcycle (i.e. children, seniors, people with disabilities) and redundant transportation during disasters.
- Provide a variety of **waterway freight transport** options in Soc Trang as an important strategy to mitigate climate change. Success of the Soc Trang Port hinges on negotiating a strong operating contract and maintaining good quality port-road connections. As multiple options for water freight transport adds redundancy and improves resilience, reconsider minimal investment in the city centre river dock to maintain and operate it. It serves an entirely different market from the port. The city centre dock, opposite vegetable market, may not have huge demand, but even if only a few farmers use it, it keeps their transport costs low, and provides an alternative to having a truck.
- Explore opportunities to expand **passenger water transport**, or at least tourist transport. This could be important to growing an eco-tourism industry in Soc Trang. Prioritize passenger transport terminals that serve key tourist routes and destinations.
- Measure the **bicycle mode share** in Soc Trang with simple travel surveys or bicycle counts. This will help clarify the current bicycle mode share and preferred routes. Prioritize separated bicycle lanes or pathways along preferred cycling routes to ensure existing riders’ safety and possibly attract new riders.

⁴¹ Avoid unnecessary generation of vehicle kilometres travelled (VKT) by integrating land use and transportation planning, and locating new urban development around areas of highest accessibility. Promote compact urban areas with a variety of uses, road pricing and parking management. Shift to or prevent a shift away from more efficient modes like public transit, bicycling and walking. Public transit needs to be reliable, frequent and accessible to be competitive. Safe and protected bicycle infrastructure helps retain or increase bicycle mode share. Improve vehicle and fuel technology to improve their energy and fuel efficiency. Improved fuel economy, alternative fuel and vehicle technologies, and increased vehicle occupancy rates as well. Dalkmann, D. and Ko Sakamoto. 2012.

⁴² Dalkmann, D. and Ko Sakamoto. 2012.

⁴³ The government does not subsidize nor invest in Soc Trang’s regional bus network. Instead, privately owned bus operating cooperatives capitalize the bus fleets and operate the service.

- Develop plan to **implement restrictions on motorized vehicle** usage. This might include motorcycle parking restrictions, paid car parking, eliminating government employee fuel allowance (or converting it to transit benefit).

Climate change adaptation

- **Revise transport master plan** to reflect latest climate change risks and scenarios including flooding, salt intrusion, and subsidence.⁴⁴ Ensure frequently flooded roads are mapped, and measures are identified to limit impacts on people's mobility during flooding.
- Depending on the results of MOT's regional salinity study, Soc Trang's **infrastructure design and maintenance** processes may need to address salt intrusion and subsidence risks. This might include more infrastructure inspections, or use of different construction materials. These and other adaptations should be codified in DOC's construction standards.

Infrastructure Design and Finance

- **Design streets according to demand** (sized to actual demand and not overbuilt), and in ways that increase safety for bicyclists and pedestrians. Robust travel demand forecasts can help guide more appropriate road widths, and shifting motorized trips to bicycling, and buses can eliminate the need to widen roads.
- **Improve roadway permeability and drainage, and incorporate green infrastructure** elements to discharge floodwaters and preserve mobility during flooding. There are several good examples of bioswales in Soc Trang. Incorporating drainage, and permeable materials and landscaping into roadway design allows more rainfall to be absorbed and minimizes flooding⁴⁵. Prioritize incorporating these design elements into new and upgraded roadways.
- **Enforce restrictions against filling in canals**, even small ones, for roads in order to preserve their important hydrological function.
- **Improve accessibility of streets and public transportation**. Reducing the width of roads to shorten crossing times would be an important step. As would the introduction of low-floor buses, obstruction-free sidewalks and curb ramps at intersections.
- Develop city and provincial knowledge of **different infrastructure financing and investment mechanisms**, especially technical and policy awareness of the implementation. **Land value capture** is an option for financing transportation infrastructure, but its economics, and limitations need to be well understood. There are also transportation financing tools available from local, national and international sources which can provide critical funding for local authorities to reduce transport sector GHG emissions⁴⁶. These could, for instance, help fund expansion of public transit or purchase of low-emissions fleet.

Priority Actions

⁴⁴ MONRE 2016.

⁴⁵ Roads can include a planted median, although care should be taken to keep overall road widths narrow to shorten pedestrians' crossing times. Bioswales, trees and landscaping along bikeways and sidewalks reduce the volume of concrete and asphalt, providing more surface area that can absorb water. In 2014, New Orleans implemented several green infrastructure projects including transforming vacant lots into rain gardens, and incorporating green roofs, bioswales and pervious pavement materials throughout the city. (NACTO 2016; City of New Orleans 2015)

⁴⁶ International climate funds or mechanisms have been a source of financing for sustainable transportation, including Global Environment Fund (GEF), Clean Development Mechanism (CDM), and Climate Investment Funds (CIF). The GEF-funded \$10.15m USD Hanoi Urban Transport Development project included a BRT feasibility study and preliminary design; as well as studies about pedestrian and cyclist access to bus rapid transit, and integration of land use and transport planning. The \$100b USD per year Green Climate Fund (GCF) is a new source of funding for nationally appropriate mitigation actions (NAMAs) countries implement to reduce GHG emissions, to which Vietnam will contribute \$1million USD between 2016-2020. (Dalkmann and Sakamoto 2012; Soc Trang PPC 2016)

The following eight priority actions, focused on building transportation planning capacity, will significantly advance the key recommendations:

- **Initiate technical training for city, district and provincial staff on travel demand forecasting, and the dynamics between land use and transportation.** This should include discussions of transport data and data collection methodologies, as well as an introduction to GIS as a tool for facilitating integrated planning. Support developing a bundle of consultant terms of reference.
- **Develop bus transit planning training** for DOT staff focused on demand forecasting, network planning, routing, contracting, regulating and financing. This will enhance Soc Trang’s capacity to better oversee the private bus operating company, and being offering local bus service as alternative mobility including during flooding.
- **Provide technical assistance in waterway port operating contracts,** regulations and management to help support successful Soc Trang Port operations contract negotiations.
- Review key roadway expansion and upgrade projects for opportunities to include safe **bicycling infrastructure.** Guidance on designing bicycle infrastructure could be offered, based on global design guidelines (see NACTO 2013, 2016).
- Train DOT and DOC staff about **sizing roads to travel demand** – using Ring Road 2 as a case study. **Include green infrastructure design guidance** demonstrating examples of road designs that cost less, improve drainage and reduce emissions.
- Hold workshop and case study analysis about different **infrastructure finance** options, such as land value capture, and leveraging private sector investment in public infrastructure.
- **Explore infrastructure construction and maintenance methods** in high salinity and heat areas should be explored (See DRM Sector recommendations), for instance using salt resistant paint and more permeable paving materials (See Water Management Sector recommendations).
- Provide guidance on developing and implementing a **participatory planning process** best practices, including the benefits of such a program.

PART 4. DISASTER RISK MANAGEMENT, CLIMATE CHANGE AND INSTITUTIONAL CAPACITY

Background

Soc Trang City is affected by floods, drought and SWI, although these are not so prevalent; SWI was most severe in 2016. High tides occur in early September and mid-December. Inundation is caused by a combination of heavy rainfall, rapid urban infrastructure development an outdated and incomplete drainage infrastructure (with a lack of connectivity to natural drainage), and high tides. Sea level rise will impact on the province. Land subsidence, because of groundwater extraction is likely to be a problem.

The City's water supply is based on groundwater, levels of which have declined, become salinised and polluted. The PM Decision No. 2140/QD-TTg on water supply plan for MDR to 2030 aims to restrict the use of groundwater in MRD provinces. Further, an incomplete and unconnected, old and degraded drainage, water discharge are the main contributing factors causing local flooding and blocked water run-off in several inner-city canals. Doubts exist to the threat posed by upstream damming of the Mekong River and land subsidence due to groundwater extraction.

In 2011, the province issued a Climate Change Action Plan (CCAP) for the period 2011-2015. This has not been revised because of financial limits and support from central government. A Natural Disaster Prevention and Control (NDPC) Plan for period 2017-2020 was developed in 2016 using a 'bottom-up approach' and sent to all related departments and local administrative levels for implementation.

Main findings

Minimal human vulnerability

Access to safe drinking water. The city's water supply is dependent mainly on groundwater (GW). The GW has reduced by 10 to 11m since the 1990s and might be contaminated by saltwater and pollutants.⁴⁷ Surface water (SW) is salty in the dry season. About 99% of households receive piped water, which is provided by seven WTPs, among that one is using SW source that occupies 20% of total providing capacity of 50,000m³ each day. This means about 10,000m³ of water each day is provided from surface water, taken from the Hau River during low tides ⁴⁸ when the water is less salty. Salinity increases for three to five months during the dry season. In 2016, SWI intruded 50km upstream of the Hau River. The tidal regime means that canals are impacted for one to two hours with saltwater whereas the rest of the day the water remains mainly fresh.

Soc Trang proposes to access water transferred from the 100,000 m³/day Aquaone WTP in future, once transfer pipeline is completed. This is under the Water Supply Master Plan for Mekong Delta Region to 2030, vision to 2050 approved under the Prime Minister's Decision No. 2140/QD-TTg dated November 8, 2016. In addition, DoNRE, funded by GIZ, monitors GW in the province and has surveyed locations where GW extraction is restricted, or not allowed, and others where it is permitted. There is a plan how to use GW sustainability, but not for surface water. Some pilots on the use of rainwater have been carried out for households and schools near the coast.

Effective sanitation. The KWF has funded ten pumping stations for collecting wastewater (WW) and transferring to wastewater treatment plant (WWTP) and the drainage for the city. All WW in the centre of the City (around 320ha) is collected and transferred to the WWTP which has a capacity of 13,180 m³/day. The second phase for WWT has been approved with a capacity of 24,000m³/day. Wastewater is collected and separated from storm water (in the rainy season) by CSO separated drainage. Wastewater is collected from the main roads and transferred to the WWTP. In some areas, WW is discharged directly into the environment. Most people have septic tanks. Wastewater is not collected

⁴⁷ See Bui Tran Vuong, Dang Thanh Lam, Le Thi Mai Van, Groundwater Issues and Hydrogeological Survey of the Mekong River Basin in Vietnam <http://unesdoc.unesco.org/images/0024/002436/243616E.pdf>

⁴⁸ Surface water can be taken from Quoi Lo River and Phuy Hiep Canal (north of Soc Trang City)

from small roads and canals. The City would like to collect and treat all WW better to protect water and the environment. Canals are polluted in some residential areas. Wastewater treatment is included in the water supply fee collected by the company providing water (who repay URENCO, responsible for WWT). This is a complex needing competent human resources.

Reduced exposure and fragility

Comprehensive hazard and exposure mapping. Soc Trang City is affected by floods, drought and SWI from November to May each year, although these are not so prevalent; SWI was most severe in 2016. High tides occur in early September and mid-December. Inundation⁴⁹ is caused by a combination of heavy rainfall, rapid urban infrastructure development an outdated and incomplete drainage infrastructure (with a lack of connectivity to natural drainage), and high tides. Inundation in parts of the city can be up to 20 to 40cm, take several hours to drain, and has caused breaching of embankments.⁵⁰ Sea level rise will impact on the province.⁵¹ Anecdotal comments suggest it has been hotter in recent years. Whirlwinds (because of storms) also occur. Land subsidence⁵² has decreased by 40cm compared to 1980s levels.⁵³ The province has developed a flood risk map under the provincial Committee for NDPC. There has been hydrological modelling of the Maspero Canal.

Appropriate codes, standards and enforcement. The Dai Nai monitoring station, national level data,⁵⁴ and local water level stations are used to decide the building codes for Soc Trang. These are of 2.2 to 2.5m above MSL. This applies to all development, including roads. This creates a problem as the current building codes are only 1.2 to 1.7m above MSL, including many households and small roads. Such households will need to raise their ground floor levels by some 50cm plus to ensure they are not flooded, specifically those downstream and close to the sluice gates.⁵⁵

Effectively managed protective ecosystems. The City Master Plan includes developing two new lakes one of 54ha and the other of 37ha for water retention and freshwater storage for the city. There is only one freshwater lake in the city (Ho Nuoc Ngot) and freshwater is drawn from the Hau River. There are few natural canals or ponds remaining in the city. Canal 8M is threatened with infilling for road and residential development. Several canals are heavily polluted. Knowledge of sustainable urban drainage,⁵⁶ for example, permeable surfaces, filter strips and drains, swales, water retention areas, preserving wetlands needs improving, to incorporate into the urban design.

Robust protective infrastructure. The City has two main canals, Maspero and Saintard and another nine branch canals. The canals are for irrigation, urban drainage and waterway transport. The Maspero has protective riverbank. In Ward 8, with the Saintard, there is also embankment and regulation gates

⁴⁹ Some areas where inundation occurs will be improved under a KWF funded project. Some others are proposed under the SUUP

⁵⁰ Black points include around Phu Loi, Le Hong Phong, Nguyen Thi Minh Khai, Bien Phong, Le Loi, Nguyen Hue, and Nguyen Trung Truc

⁵¹ See MoNRE January 2017 Climate change and sea level rise scenarios for Viet Nam, See http://www.imh.ac.vn/files/doc/KichbanBDKH/KBBDKH_2016.pdf (Full Vietnamese version) and <http://www.imh.ac.vn/khoa-hoc/cat20/424/CLIMATE-CHANGE-AND-SEA-LEVEL-RISE-SCENARIOS-FOR-VIET-NAM> (Summary for policy makers in English)

⁵² See 'Assessing the potential of the multi-aquifer subsurface of the Mekong Delta (Vietnam) for land subsidence due to groundwater extraction', P. S. J. Minderhoud, G. Erkens, V. H. Pham, B. T. Vuong, and E. Stouthamer, (2015)

⁵³ This conflicts with a written response from the Water Supply Company, which states that land subsidence has not yet been monitored

⁵⁴ Several national building standards, e.g. QCXDVN2008, 2016, TCVN2012 are being applied for construction works in the city

⁵⁵ SUUP canal dredging and new sections of drainage will help to address this

⁵⁶ Sustainable drainage systems (SuDS) are drainage solutions that provide an alternative to the direct channelling of surface water through networks of pipes and sewers to nearby watercourses. By mimicking natural drainage regimes, SuDS aim to reduce surface water flooding, improve water quality and enhance the amenity and biodiversity value of the environment. SuDS achieve this by lowering flow rates, increasing water storage capacity and reducing the transport of pollution to the water environment. The need for alternative drainage such as SuDS is likely to increase to meet environmental challenges such as climate change and population growth.

for SWI protection. Some sluice gates or outlets do not have sluice gates to prevent SWI. There are incomplete embankments for SWI. At high tide, the rivers may overtop the embankments into the surrounding fields. The Saintard suffered recently from SWI. Embanking the Maspero and Saintard was financed by central government.

Effective provision of critical services

Flexible infrastructure. Soc Trang City has the best solid waste treatment plant (SWTP) in the 7 MRD cities. The plant is managed URENCO and could be used as a model for other similar cities in the MRD. Solid waste is collected manually from bins along streets, which is taken to collection points and then transported to the SWTP. There is no separation at source, although informal sector sorting occurs before solid waste is taken to the SWTP. The City produces 160 tonnes of solid waste/day almost all of which is collected. The new SWTP⁵⁷ will expand as the population of the city expands. There are mechanised facilities for separation of solid waste at the new site, making of fertiliser (which is marketed), the proper lining of landfills, and leachate collection.⁵⁸ A site visit to the SWTP noted a large volume of mixed organic and non-organic waste in landfill even after separation by mechanised facilities and waste sorters. This can be improved by carrying out a comprehensive public awareness raising campaign and providing basic equipment for the '3R' linked to the GGAP.

Effective leadership and management

Suitable government decision-making and proactive multi-stakeholder collaboration. The Committee for NDPC, the Red Cross, and the Youth Union, CARE, IUCN, GIZ, Can Tho University and Utrecht University have organised training events on DRM and there has been training on integrating DRR/CCA into SEDP. The PPC issued an implementation plan and set up a group of 20 people trained in CBDRM under the national programme by CARE or GIZ. This number has been reduced because of natural wastage. Hence, there is a need to review and strengthen this network to support rolling out of CBDRM and community-based disaster risk assessment. In the LIA, the SUUP actions are based on expressed needs.

Comprehensive hazard monitoring and risk assessment. The City hydro-meteorological stations are not automated and do not provide real-time information. Eight permanent points exist for measuring SWI every day two are combined with the three hydrological stations. There is a need to automate four of the eight stations.

Comprehensive government emergency management. Committees for NDPC have set up at all administrative levels. The NDPC Plans are reviewed and developed each year. The City PC issued an NDPC Plan for period 2017-2020 in February 2017.

Empowered stakeholders

Widespread community awareness and preparedness and effective mechanisms for communities to engage with government. Some public consultation takes place, such as surveys, meetings with local people, for example, for the SUUP PFS, 12 meetings were held over a three-month period, from local to provincial levels. The public announcement was made by the CPC website and over TV and radio. Public consultation is challenging.

Integrated development planning

Comprehensive city monitoring and data management. It is difficult to collect and collate data, as data is held in different departments. It is necessary to go around to each to collect information. For example, for the SUUP, consultants could not directly get data from a focal point agency but had to visit all the departments for data and information collection. This was time-consuming and complicated. Gaps in data exist and costs were incurred as data had to be purchased (HMS and elevation data). This GSO data was inadequate for any planning as it was too basic. Focal points for collecting and collating information suggested could be the DPI, as they have the capacity and all projects have to go through the DPI for approval, alternatively, DoIT.

⁵⁷ Ward 7 had a dumpsite which was closed properly in 2016

⁵⁸ Financial support came from KWF and Norway, the SWTP is equipped with Belgian machinery

Consultative planning. The current City Master Plan to 2030 with a Vision to 2050, was revised and approved in 2011. This plan has not yet considered CC. The DoC is reviewing and revising the City Master Plan to 2030 with a Vision to 2050. Urban planning is not yet informed of a natural hazards map or climate risks. Besides DoC, DoNRE, DARD, DoT, Water Supply Company and URENCO are involved in the urban planning.

Appropriate land use and zoning. Land use zoning is basic and aims to ensure there are zones for urban development and for agricultural land. The 2011 City Master Plan has not yet taken into considering CC. In 2015, the PPC agreed on a revision of the City Master Plan to include CC.

Resilience qualities

The following resilience qualities were assessed:

Integrated - Natural hazard mapping and hydraulic and hydrological modelling are necessary to ensure risk-informed decision-making for the City Master Plan, and sectors, and to improve disaster readiness. Integrated, risk-informed planning based on potential risks of CC and disaster risk, is still lacking at city and provincial level, because of an absence of clear guidance and knowledge of technical staff. Integrating CC and DRR based on the CCAP and NDPC, into City Master Plan and sector plans, face challenges.

Inclusive - Local people have been informed and invited to take part and contribute their ideas and comments to the project proposals and decision-making for project development. Community-based DRM has had limited roll out in rural areas and not in urban areas. Capacity building on CCA and DRM, and strengthening the provincial and local CBDRM networks is needed – as departmental capacity is limited and CBDRM knowledge and personnel restricted – which limits inclusive, integrated risk-informed planning.

Reflective – Building codes and standards applied are based on national level regulations and guidance. These codes and standards do not reflect potential climate change impacts. The 2017 MoNRE CC and SLR scenarios should be reflected in the forthcoming amendment of the CCAP and then guide the revision of the City Master Plan and sector plans.

Resourceful - Institutional arrangements exist for emergency management but research and mapping of existing ecosystems (green areas, canals and waterways, and water retention basins) is needed. Existing canals and natural waterways should be reserved, dredged and upgraded to support the water discharge capacity and to contribute to the urban landscape and environment. Filling up canals for road and housing development should be avoided. Further, limited engagement of local people in CBDRM reduces opportunities for increasing resourcefulness. The NDPC Funds should be brought into operation to raise disaster readiness.

Robust – The city has a robust protective infrastructure, with embankments on both sides of key canals running through the city. Mainly hard structural solutions are applied. For a long-term and sustainable approach, these should be augmented with bioengineering and green structure solutions. Canals and water runways in some LIAs are not well managed cause waterways to become blocked and polluted, so maintenance and dredging of canals need improving.

Flexible - A more comprehensive hazard risk monitoring is needed to monitor effectively natural hazards and CC. Monitoring and risk assessment needs strengthening through improved hydro-meteorological facilities. Limited knowledge of upstream damming and of land subsidence, leads to concerns for DRM in the city, province and the region. Therefore, a comprehensive study on the impacts of upstream damming, and of land subsidence on the city, province and MRD is needed.

Cross-cutting issues

Natural hazard and climate risk-informed decision-making are needed to help fulfil the ambitions of Soc Trang City authorities to achieve Class 2 city status. Urban planning in Soc Trang City is a cross-cutting issue in itself. All sectors will benefit from more coordinated and collaborative master planning.

Natural hazards and climate change have a **gender aspect** impacting differently men, and women, boys and girls. Because women spend more time than men in the home and neighbourhood, they are also more directly exposed to environmental hazards of poor sanitation—such as diseases caused by poor drainage, contact with human faeces and decaying rubbish. Attention to gender issues in the design

and implementation of urban water and sanitation programmes can bring wide health, social and economic benefits to women and their communities. Greater appreciation of these differential impacts, through improved stakeholder dialogue and community-based approaches to DRM, would help accessibility and strengthen protection.

Poor people living in LIA's are impacted by the local flood, lack of access to water and sanitation, suffer from poor sewage, and pollution, which hinders run-off by blocking drainage. This also reveals the cross-cutting nature of **flooding** itself, which is interrelated with road infrastructure design, mobility, drainage, equity and urban planning.

Statistics show between 7.5 to 15 per cent of the Vietnamese **people is living with disabilities**, which could mean as many as 20,700 residents in Soc Trang.⁵⁹ Further, the number of **older people** is growing in Viet Nam - one of the fastest ageing countries in Asia. By 2050, the number of people 60 years and over will triple from 8.9 per cent to over 30 per cent or 32 million people. The number of people over 80 will also triple to over 6 per cent of the population.⁶⁰ Provincial and city authorities need to ensure the needs of these vulnerable groups are considered.

Gaps, challenges, constraints and barriers to improvement

Access to safe drinking water – The city's water supply is dependent on GW. The GW has reduced, and might be contaminated by saltwater and pollutants. The Prime Minister's Decision No.2140 aims to reduce GW use in MRD cities.

Effective sanitation – The City needs to develop a WWM plan, where centralised and non-centralised WWT should be used to increase the ratio of treated before discharge to the environment. The WWM plan should consider the effective use of natural drainage areas (lakes, canals) to regulate stormwater and to reduce localised flood in the city, by revising its drainage plan; there is an incomplete drainage to cope with the flood.

Natural hazards and mapping – Digitised maps, describing natural hazards (notably floods, SWI, erosion) and extreme events, do not exist for the City. These are essential for the risk-informed sector, spatial planning and zoning. Although the GoV needs a flood risk map for cities, this has yet to be developed. So far (as with other MDR cities) no hydraulic or hydrological modelling has taken place. It is essential for the city and province (and for other MDR cities) to prepare flood risk maps before raising roads and canals and to inform the City Master Plan and sector plans.

Appropriate codes, standards and enforcement – A key challenge is the building codes and standards have not yet been adjusted to respond to CC.

Effectively managed protective ecosystems – Groundwater is reducing, while there are few SW sources of freshwater.

Robust protective infrastructure – Investment in upgrading the pumping stations to prevent flood is necessary when the water level in the rivers becomes higher due to high tides. Sluice gates should be also installed for water regulation between the city and rivers. All city infrastructures have a low capacity for CC and disaster resilience. Knowledge of green infrastructure and bioengineering solutions, including sustainable urban drainage, for example, permeable surfaces, filter strips and drains, swales, water retention areas, preserving wetlands, needs improving, to incorporate into the urban design.

Flexible infrastructure – While having an exemplary SWTP, the City lacks a sludge treatment management facility, so after dredging the canal the sludge is not treated before dumping. Public awareness raising and proper solid waste separation at source could make a great contribution to improve SWM complementing the investment in the SWTP.

⁵⁹ Palmer M, Groce N, Mont D, Nguyen OH, Mitra S (2015) The Economic Lives of People with Disabilities in Vietnam. PLoS ONE 10(7): e0133623. doi:10.1371/journal.pone.0133623

⁶⁰ See <http://ageingasia.org/ageing-population-vietnam1/#keyfacts>

Appropriate government decision-making – Trained trainers need further skill strengthening and more trainers needed as numbers have reduced. Disaster risk management, CCA training and capacity building, specifically on integrating CCA and the DRR into the SEDP and sector plans for key government staff is requested.

Proactive multi-stakeholder collaboration – No CBDRA has been carried out in the City, and only one of the 109 communes and wards in the province has had a CBDRM programme.

Comprehensive hazard monitoring on risk assessment – Real-time SWI information is crucial and needs to be automated.

Appropriate land use and zoning – The current City Master Plan (2011) do not consider CC. Updating of the Plan to integrate CCA and DRR, based on the MoNRE 2017 CC and SLR scenarios, is needed.

Recommendations

The key priority recommendations for improving urban resilience in Soc Trang City include:

Natural hazards and mapping – Develop digitised natural hazards, and carry out hydraulic and hydrological modelling for the whole province; this is essential for the risk-informed sector, spatial planning and zoning.

Appropriate land use and zoning – Update City Master Plan to integrate CCA and DRR, based on the MoNRE 2017 CC and SLR scenarios.

Access to safe drinking water – Carry out a comprehensive review of integrated water resource management (IWRM) including SW, GW, and rainwater sources to develop a strategic plan to transition from GW to SW.

Effective sanitation – Develop a WWM plan, where centralised and non-centralised treatments should be used to increase the ratio of WWT before discharge to the environment. The WWM plan should consider the effective use of natural drainage areas (lakes and canals) to regulate stormwater and to reduce localised flood in the city. Facilitate capacity building for HR of URENCO, the Water Supply Company, and WWT companies.

Effectively managed protective ecosystems^{61&62} – Research, develop and protect ecosystems within Soc Trang City.

Robust infrastructure⁶³ – Facilitate training and capacity building on green infrastructure and bioengineering solutions, including sustainable urban drainage systems (SuDS)⁶⁴.

⁶¹ Which ecosystem services in a city are most relevant varies depending on the environmental and socio-economic characteristics of each site. For example, natural barriers to buffer environmental extremes are critical for cities located in or close to coastal areas (e.g. New Orleans); air quality regulation can be of significance in cities severely polluted due for instance to topography of heat inversions (e.g. Santiago de Chile), but may be of secondary importance in cities where atmospheric pollution is favoured by topography, as well as policy (e.g. Helsinki). Similarly, while urban green areas will generally play a secondary role in tourism, city parks can be an important part of the portfolio of attractions valued by city tourists (e.g. the Central Park in New York). See ‘Classifying and valuing ecosystem services for urban planning’ Erik Gómez-Baggethuna and David N. Barton, *Ecological Economics*, Volume 86, February 2013, Pages 235–245, *Sustainable Urbanisation: A resilient future*. Available at

<http://www.sciencedirect.com/science/article/pii/S092180091200362X>

⁶² See Chapter 11 Urban Ecosystem Services, Erik Gómez-Baggethun , Åsa Gren , David N. Barton , Johannes Langemeyer , Timon McPhearson , Patrick O’Farrell , Erik Andersson , Zoé Hamstead , and Peleg Kremer. Available at http://download.springer.com/static/pdf/546/chp%253A10.1007%252F978-94-007-7088-1_11.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Fchapter%2F10.1007%2F978-94-007-7088-1_11&token2=exp=1485141573~acl=%2Fstatic%2Fpdf%2F546%2Fchp%25253A10.1007%25252F978-94-007-7088-1_11.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Fchapter%252F10.1007%252F978-94-007-7088-1_11*~hmac=0b7defef98a57c54c935a8784badacd9cb9fd82b80b54696f67199ada6ee8a75

⁶³ See ‘Multi-layer safety and water robust building’, Urban green-blue grids for sustainable and resilient cities, available at <http://www.urbangreenbluegrids.com/water/flood-risk-management/>

⁶⁴ See Woods Ballard, et al, *The SuDS Manual*, CIRIA©, 2015, <https://ciria.sharefile.com/share?#/view/eeb1c6de1f444fa2>

Suitable government decision-making – Facilitate DRM, CCA training and capacity building, specifically on integrating CCA and the DRR into the SEDP and sector plans.

Proactive multi-stakeholder collaboration⁶⁵ – Speed and scale-up fulfilling the CBDRM program to cover the province and city, providing the necessary human and financial resources. Ensure linkages between community-based disaster risk assessment, and integrating key DRR and CCA issues into the SEDP, and sector planning.

Comprehensive hazard monitoring and risk assessment – Automate monitoring of SWI at four critical points along the Hau River and develop necessary HR capacity.

Priority Actions

The following priority actions will significantly advance the recommendations:

1. Commission a **comprehensive review of IWRM** including surface water, groundwater, and rainwater capture to develop a **strategic plan to transition from GW to SW**, with DoNRE, the CPC, and other key departments.
2. Develop a **wastewater management plan for Soc Trang City**, with the centralised and non-centralised treatment of wastewater before discharge to the environment, and the effective use of natural drainage areas. Incorporate **capacity building for HR** of URENCO, the Water Supply Company, and DoNRE. Draft ToR and hire consultancy team to carry out research, capacity building needs assessment, and provide tailored training and capacity building.
3. Carry out **hydrological and hydraulic modelling of the whole province**. Draft ToR for consultancy team to carry out hydrological and hydraulic modelling for the whole province; ensure this includes capacity building for key staff.
4. Commission **research to map, develop and protect ecosystems** within and around Soc Trang City. Draft ToR for consultancy team to work closely with DoNRE and the CPC to carry out research.
5. Facilitate **training and capacity building** on:
 - a) **Green infrastructure and bioengineering solutions, including SuDS**. Develop ToR for consultancy team, carry out a needs assessment and facilitate training and capacity building events, targeting DoNRE, DARD, DoC, CPC other relevant stakeholders.
 - b) **Disaster risk management, CCA, CBDRM, and on integrating CCA and DRR** into the SEDP, the City Master Plan and sector plans.
6. **Speed and scale-up fulfilling the CBDRM program** to cover the province and Soc Trang City, including **community-led risk-assessment (CBDRA) of urban wards**. Provide the necessary human and financial resources. Ensure linkages between CBDRA, and integrating key DRR and CCA issues into the SEDP, and sector planning. Draft ToRs for Vietnam Women’s Union and Vietnam Red Cross, for capacity building and training of PMU, CPC, DoC, DPI and other key departments.
7. **Automate monitoring of SWI** at four critical points along the Hau River, including developing necessary HR capacity of DoNRE, HMS, DARD, other relevant stakeholders. Develop ToR for a package of automatic SWI monitoring equipment and HR development.
8. **Update City Master Plan to integrate CCA and DRR**, based on the MoNRE 2017 CC and SLR scenarios. Draft ToR for consultancy team to work with the CPC, DoNRE and other departments.
9. Provide technical assistance to **carry out public awareness raising and provide basic equipment for piloting the ‘3R’s’**, in selected urban wards and then scaling up to the whole city.

⁶⁵ The International Association for Public Participation does excellent work around the world in researching and describing a process of public decision-making, using the continuum of: 1. Inform, 2. Consult, 3. Involve, 4. Collaborate, 5. Empower. Here informing implies the least involvement of people in decisions that affect their futures, and empowering grants the greatest say in decision-making.

PART 5. WATER MANAGEMENT

Background

Soc Trang Water Supply One Member Ltd Company (WSC) is the agency responsible for water supply in Soc Trang city and province. The company is in the process of equitization in 2017 with 51% shareholding proposed for the State, and other shareholdings by staff and private investors. Management of city drainage and the wastewater system is the responsibility of the Soc Trang Urban Works One Member Ltd Company (STDC) which is also under the process of equitization. STDC's mandate includes drainage, wastewater management, solid waste collection, septage disposal, drain and septic tank desludging, parks and electric lighting. The actual management of the under-construction solid waste landfill and composting plant is STDC.

Main Findings

Hydrological Implications of urban land development. A review of the hydrology of land development plans and improved planning for sustainable urban drainage is required. There is a need to formulate development plans that incorporate an integrated approach to the management of the urban water cycle. In relation to storm water management, implementation of sustainable drainage initiatives is needed which involves a proactive process recognizing the opportunities for urban design, landscape architecture, and storm water management infrastructure to be intrinsically linked.

Water supply. 50,000 m³/day capacity is available for water supply to the city from seven water treatment plants - six groundwater source plants supplying a combined 40,000 m³/day, and one surface water source plant supplying 10,000 m³/day from 30/4 Canal, a branch of the Hau River. Actual production from all sources is 45,000 m³/day to supply 38,178 connected households. The six groundwater plants are supplied from a total of 28 boreholes abstracting groundwater from two layers- 87-120m deep and 450- 470 m deep. Additionally, 3,000 m³/day is supplied from surface water for the An Nghiep Industrial zone. Water supply coverage is 99% in Soc Trang and leakage and non-revenue water has been reduced to 15%. The WSC follows the City Master Plan for water supply expansion.

Salination is a serious threat to Soc Trang's water supply in the dry season from February to June each year. Peak salination levels are 350-400 mg/l. In the event of a salination event production of the surface source WTP is reduced and groundwater/surface sources are blended. Salination also affects 6 of the 28 boreholes. The measures, proposed by the WSC to combat increasing salination of the city water supply, include improving groundwater abstraction, constructing sanitation control buffer zones near borehole plants, and upgrading the pre-sedimentation process at the surface WTP.

The WSC prepares 1 year and 5 year plans, and has plans in place to meet coverage targets. The WSC would benefit from capacity building for improved management of the water distribution system, introduction of automation, improving the water treatment process at the groundwater plants, human resources (HR) strengthening and asset management plan preparation.

A water transfer scheme for salination prone cities in the south of the delta is planned by the government for cities such as Soc Trang, Bắc Liêu and Ca Mau but the funding and timing of commissioning of the water transfer scheme is not certain. Soc Trang may take transfer water from the Aquaone WTP but this depends on construction of the transfer pipeline. In the meantime, Soc Trang will need to manage their existing groundwater and surface water plants to match population growth. Demand for new household connections is running at about 5% per year. Currently the Ministry of Construction (MoC) is working on the Mekong Delta Region(MDR) regional water supply system and aims to develop a regional surface WTP in 3 phases to cover the entire MDR.

A comprehensive Integrated Water Resource Management plan is required for Soc Trang which should include surface water, groundwater and rainwater sources. The objective would be to develop a strategic plan to transition from groundwater to surface water sources but the plan would also need to take into consideration the regional water transfer scheme currently under preparation. A consultancy team would be required to carry out detailed research with the WSC, DONRE and other key departments to develop the strategic plan.

Drainage. Flooding occurs to a depth of 20 cm during the wet season in Soc Trang in five major flooding areas in Wards 2, 3 and 6. The flooding typically lasts 2 hours either side of high tide and in conjunction with heavy rainfall. The flooding is severe in Nguyen Trung Truc and Phu Loi in Ward 2 (severe 40 cm depth), Thi Minh Khia , Le Hong Phong and Le Duan in Ward 3 and in Le Loi and Ngo Gia Tu in Ward 6. Embankment raising was undertaken in the past along the Maspéro River but for proactive flooding control during high tide further improvement of the drainage system and installation of flap valves on some combined system sewer outfalls are required.

A combined system of drainage exists comprising 3,400 manholes, 21 km B200-B3000 pipes and culverts and 51.7 km of D300-D1500 pipes all of which discharge to the river and canals. Many of the concrete pipes in the existing system are undersized and under-capacity for the increased runoff following urbanization. The urban drainage system needs major upgrading and improvement. Upgrading of the combined drainage system in the central core area of the city is also urgently required to reduce the effects of flooding. While Phase 1 of the wastewater project addressed some of the drainage issues more work on drainage is required.

Sanitation

Phase 1 of a 13,000 m³/day wastewater collection and primary treatment system funded by KfW was completed in 2013. The project covered 7 wards in the city center and comprised construction of 10 pump stations, combined sewer overflows, sewers and pressure pipes to a wastewater treatment plant providing primary treatment only - screening and sedimentation. Treated effluent quality is quite good from 38-60 mg/l BOD₅ which is close to compliance with Schedule B of Discharge Standard QCVN 40:2011.

Phase 2 of the wastewater project, which is also funded by KfW, comprises a 24,000 m³/day aerated lagoon extension to the existing WWTP and is in bidding at present and scheduled for completion in 2019. The focus of the second project is extension of tertiary sewers and households' connections to improve wastewater collection. Limited funding is to be provided for materials under the phase 2 project for household wastewater connections and capacity building support is required by STDC for IEC program implementation and further public awareness raising to support the Phase 2 household connection program.

The sanitation situation in Soc Trang has clearly improved since the completion of the first phase of the wastewater project. The sanitation related diseases of foot, hand and mouth disease, malaria, dengue fever, diarrhoea and skin disease have shown a decreasing trend since 2012 with the exception of dengue which is again on the increase.

A septic tank desludging service is offered by STDC with two 3.5 m³ desludging trucks available. Septage is currently disposed by dumping untreated at the new landfill. Improved faecal sludge management (FSM) is required and regular desludging of all city septic tanks on a rotation basis every 3-5 years. A septage treatment system should be established at the new landfill producing dried disinfected septage sludge. The sludge be used beneficially by being mixed with the composting plant product currently being produced at the landfill.

Resilience qualities

Water management resilience qualities

The resilience qualities required for water management include the provision of safe, reliable and affordable distribution of potable water, effective drainage and an affordable sanitation system to households across the city; planning for back-up water supplies; existence of a long-term robust strategic plan for providing water, drainage and sanitation to the city; diversity and spare capacity within the city's water supply treatment & distribution systems; water supply demand management strategies in place, and the existence of asset management planning covering monitoring, maintenance, renewal programs, service continuity and emergency response for both water supply and drainage.

For water supply in Soc Trang, 99% of the city's population receives a treated water supply from 7 WTPs - 6 based on groundwater sources and 1 on surface water sources. There are three reserve WTPs in place - My Xuyen 1, My Xuyen 2 and Ke Sacs providing 5,000 m³/day backup water supply and roof rainwater storage could also be brought to bear in an emergency particularly in communes and peri-urban areas. There are specific 1 Year and 5 Year Plans in place but there is little spare capacity within the city's water supply systems and there is a need for asset management planning for maintenance and renewal programs and emergency response plans.

There are seven qualities of resilience that cities should aim to achieve in the planning of water management systems. The systems should embody the qualities of being Reflective, Robust, Redundant, Flexible, Resourceful, Inclusive and Integrated⁶⁶. A brief summary of how Soc Trang meets these qualities of resilience is discussed below with some examples of how resilience qualities are met in Soc Trang, elsewhere in MDR cities and internationally.

A Reflective system learns from past experience and accepts the possibility of uncertainty and change. Standards and norms should be based on emerging evidence. In Soc Trang the water supply management system is reasonably reflective in terms of accepting increased risk, and the salination increases in recent years have been quite well managed by commissioning of the new surface water WTP and by careful management of the water abstracted from the 28 boreholes which supply the 6 groundwater treatment plants. A good example of how reflective system changes were introduced internationally resulted from *Hurricane Sandy in US which in 2012 challenged the operations of drinking water, wastewater treatment and stormwater management for 9 million people in New York*⁶⁷. 10 of the 14 wastewater treatment plants and 42 out of 96 pumping stations were damaged or lost power. Based on the results of a risk assessment, NY developed a portfolio of strategies to protect wastewater assets from flooding impacts. Strategies include: dry flood-proofing buildings with watertight windows and doors, elevating equipment, making pumps submersible and protecting electrical equipment with watertight casings, constructing external flood barriers, installing sandbags temporarily, and providing backup power generation to pumping stations.

A Robust system should preferably not over-rely on just one asset and each asset should be strong enough to resist damage and hazards without loss of function. Soc Trang has a reasonably robust water supply system with 7 assets supplying water but with surface water plants increasingly threatened by salination.

A Redundant system should be designed to have spare capacity so that the system can accommodate disruption, extreme pressures or surges in demand. There seems to be no lack of spare capacity in the Soc Trang water supply system at present but an over reliance on groundwater sources exists. There is an absence of redundancy in the storm water drainage systems at present which are undersized and insufficient to cope with storm rainfalls. An international example of a water supply system seriously lacking in redundancy is found in Wellington New Zealand which is seriously affected by earthquakes. Wellington has three water supply plants serving 1,400km² area and the water network has long supply lines that cross known earthquake faults. In comparison, the New Zealand city of Christchurch has 55 borehole water supply plants serving a slightly larger area but the water network has short supply lines. In Wellington, it could be up to 70 days before normal supply is resumed to most areas if an earthquake struck the city. Wellington is a city which needs additional spare capacity urgently to rapidly respond to an earthquake.

A Flexible system is one that adapts well to changing circumstances. This type of system may favour decentralized and modular approaches. For example, looking elsewhere in Vietnam in the planning of a wastewater management system in Tan An, one option to serve its Wards 1, 2, 3 and parts of 4 and 6 with a reticulated sewerage system might be a centralized Wastewater Treatment Plant (WWTP) 6,000 m³/day in capacity with a 65km network and 7 pump stations. A second option might be four smaller 1,500 m³/day decentralized package plants at different locations in the city with a 55-km length network and 5 pump stations.

⁶⁶ City Resilience Index, July 2015, Arup, Rockefeller Foundation

⁶⁷ EPA, Office of Water, Adaptation Guide for Water Utilities, February 2015.

The advantage of the second option is that it is a low energy, “green” approach with a smaller sewer network, reduced pumping costs, a lower operating cost and the ability for one or two of the decentralized plants to keep functioning in the event of a disastrous event such as flood, cyclone or tornado.

A Resourceful system finds different ways to meet goals and helps a city to restore functionality of critical systems under severely constrained conditions. In Tan An, the multi-faceted approach to securing water security is resourceful – Canal Nguyen Van Tiep and Bao Dinh River/Reservoir are proposed as primary water sources and a backup source would be the 10 groundwater boreholes, two or three of which could be held in reserve. A good example internationally of a Resourceful system would be how a *New Jersey, US Utilities Authority*⁶⁸ is responding to rising energy costs, climate change and population growth. They have improved system efficiency and resilience through sustainable or “green” initiatives. Sewer infiltration has been reduced by inflow reduction; gravity connections replace some municipal pumping stations; electricity peak shaving has been implemented; a 1.8 MW solar panel provides 10% of energy needs at the wastewater treatment plant and a digester at the plant produces enough biogas to meet 60% of the utility’s power needs.

An Inclusive system requires broad consultation and engagement with communities’ including vulnerable groups. Little community consultation appears to have been undertaken in Soc Trang on water supply, drainage and sanitation. An example of good public consultation in the river basin sector is in France at the Rhône Méditerranée RBD⁶⁹. Each RBD has a Comité de Bassin (river basin committee) that brings together a range of stakeholders and government offices. The Comités de Bassin adopt key documents for river basin management, including the RBMPs: thus, they have decision-making powers. In the Rhône Méditerranée basin, as in other French RBDs, extensive efforts were made to raise public awareness and gather public opinion for the 2009 RBMP. This work included a communication campaign involving a travelling exhibition, public forums, conferences and workshops, as well as posters and brochures. Two rounds of questionnaires were prepared for the public (the second round was mailed to inhabitants, and numbered over 6 million with the questionnaires).

An Integrated system requires alignment between city systems and ensures investments are mutually supportive. More work is required to truly integrate Soc Trang’s systems. Rotterdam, the largest European port, has an integrated climate change adaptation approach⁷⁰ marked by (i) a strengthened, robust system of flood, storm water surge and sea-level rise defences; (ii) an adapted urban space to combine its three functions: ‘sponge’ (water squares, infiltration zones and green spaces), protection (dykes and coastal protection) and damage control (evacuation routes, water-resistant buildings and floating structures); (iii) increased city resilience through integrated planning; and (iv) actively fostering the opportunities that climate change brings, such as strengthening the economy, improving the quality of life, and increasing biodiversity. It has built water storage spaces, including the Museum Park car park underground water storage with capacity of 10,000 m³, and is integrating Blue-Green Corridors into the urban landscape.

Cross Cutting Issues

Hydrology of land development. The practice of some commercial land developers in Soc Trang of infilling large water bodies for the purposes of sale of housing plots is affecting the hydrology of the area. By eliminating long standing water bodies and water courses this practice is interfering with the natural hydrological regime resulting in increased storm water runoff and flooding. The practice needs to be halted and sustainable drainage systems designed for urban land developments aimed to reduce storm runoff and damage and to replicate natural hydrological systems by using basins, rain-gardens, swales, filter drains, bio retention basins, reed beds, and other wetland habitats.

Road development effects on drainage. The infilling of silted-up canals for the purposes of road development In Soc Trang impacts upon drainage. This practice should not be undertaken without completion of hydraulic modelling of the city drainage system and also assessment of regional flooding trends. Major storms and typhoons are more likely as a result of climate change requiring all existing small canals and watercourses to be dredged and made available for rapid dissipation of flood waters.

Water supply salination. The salination of the treated water system occurs periodically between February and June each year in Soc Trang. This is currently managed by reducing the production from

⁶⁸ EPA, Ibid

⁶⁹ European Environment Agency, Public Participation: Contribution to Better Water Management, 2014

⁷⁰ C40 Cities Climate Leadership Group, Climate Change Adaptation in Delta Cities, February 2016

the surface water plant and blending it with water from groundwater sources. 80% of the water supply is supplied from underground borehole sources. Salination affects the poor, elderly and disabled who may be more susceptible to the unpleasant taste and less able to afford to buy replacement bottled water during the salinity event. While the high salinity is stated to not be a danger to health, at salinity concentrations greater than 250 mg/l the taste is discernible⁷¹ and is described as unpleasant and nauseous. Additionally, the saline intrusion has an effect on bridge piers, abutments, masonry canal linings and transport and drainage infrastructure with concrete subject to degradation by the salty water. This requires more frequent inspection by road and bridge maintenance staff to monitor bridge piers, abutments and drainage systems for degradation.

Over reliance on groundwater abstraction. There is an over reliance on groundwater abstraction for city water supply in Soc Trang with up to 40,000 m³/day being used from the 28 groundwater boreholes. Over abstraction of groundwater elsewhere in the MDR has led to land subsidence and also falling groundwater levels.⁷² 0.30 – 0.70 m/year subsidence was reported in Can Tho. Soc Trang’s groundwater boreholes are all deeper than 100 m, and this represents mining of groundwater as the groundwater is not replenished. Groundwater abstraction in Soc Trang should be reduced to reduce likelihood of subsidence and also to comply with Prime Minister’s Decision 2140.

Recommendations

- Preparation of an Integrated Water Resources Management (IWRM) study of surface, ground and rainwater sources to develop a strategic plan to transition from groundwater to surface water reliance. This will provide increased city water supply resilience and improved disaster risk management. The city’s water supply is 80% dependent on groundwater at present and there is a need to reduce this dependency. Confirmation of reliance on the proposed water transfer scheme from Aquaone WTP and further development of the city’s own surface sources closer to Soc Trang needs investigation by the IWRM study.
- Hydro-meteorological and hydrological modelling of urban land development for housing and resettlement areas. Planning for “green” and sustainable urban drainage systems with the aim of replication of natural hydrological systems by using basins, rain-gardens, swales, filter drains, permeable pavements and bio retention basins.
- Capacity building support for the WSC to (i) improve water supply network management, and introduction of automation, SCADA and an improved groundwater treatment process for the six groundwater WTPs; (ii) strengthen Human Resources (HR) management; and (iii) implement Asset Management Planning (AMP). The groundwater WTPs will clearly be providing the bulk of Soc Trang’s water supply for the foreseeable future until the water transfer scheme pipeline to Soc Trang is completed. On completion of the water transfer scheme some of the groundwater boreholes should be retained as back up to improve the city’s water supply redundancy.
- Capacity building support for the Urban Works Company (STDC) to prepare a catchment wide hydraulic model of Soc Trang’s existing storm water drainage system and subsequently to prepare a Drainage Master Plan for upgrading the existing drainage network. Sustainable urban drainage system components should be included in the Drainage Master Plan including storm water retention ponds and permeable pavements both of which would assist in attenuating flood peaks and the duration of flooding during heavy rainfall.
- Capacity building support for STDC in implementation of Phase 2 of the KfW funded wastewater project is also proposed to assist with connection of households to the tertiary wastewater collection system. An IEC program and enhanced public awareness efforts are required to support the Phase 2 household wastewater connection program. The Phase 2 project’s focus is secondary and tertiary wastewater collector construction and the household

⁷¹ Guidelines for Drinking-water Quality FOURTH EDITION, WHO, 2011.

⁷² Mekong Delta Plan, MONRE, MARD, Dutch Government, Royal Haskoning DHV, December 2013.

wastewater connection component requires raising of public awareness of the benefits of connection to the wastewater scheme - particularly in the narrow lanes and alleys.

- Additional capacity building support is proposed for URENCO for improved FSM.

Priority Actions

-Integrated Water Resources Management study of surface, ground and rainwater sources.

-Capacity building at WSC for network management, improved groundwater treatment process for the six groundwater WTPs, HR strengthening and AMP preparation.

-Capacity building at STDC for hydraulic modelling, Drainage Master Plan preparation, improved FSM;

-IEC program for household wastewater connection program.

-Hydro-meteorological and hydrological modelling of urban land development proposals.

PART 6. GEO-SPATIAL DATA INFRASTRUCTURE

Background

Effective governance of cities requires data at disaggregated levels. The Department of natural resources and environment at the CPC presently manages registration of land and land management through cadastral database on a Microstation platform. This database when updated regularly may provide the necessary platform for the creation of a more extensive geo-spatial data infrastructure. Currently, partial cadastral data is available. Other sectors have databases in Auto Cad format. As a first step, integrated urban planning and development would require preparing a minimum database, needing primary data collection, concerning the use of land and physical and social infrastructure sectors. Since a database does not presently exist, initiating such a project for Soc Trang Province and the City would demand a pedagogic approach, with short and mid-term targets, planned carefully with the concerned authorities and target teams. In the medium and long-term, a robust data infrastructure for Soc Trang Province and City, including a documentation of detailed data, will aim to capacitate relevant public institutions to govern the city's development in an integrated manner.

Main findings

- Master Plan 2030 is presently under implementation; however, the master plan incorporates several road sector proposals, which have been challenging to implement. Further, Soc Trang has received directives with Decree No. 423/QĐ-TTg, for revising their master plans to suit growth requirements for achieving a Grade II City status. Preparations for revision of the master plan are underway. ***The CPC at Soc Trang, is engaged with the DoC in the preparation of the revised master plan.***
- ***Gaps in planning process:*** Several issues emerged in both Master Plans for Soc Trang: (1) Integration between socio-economic plans and spatial master plans; (2) Cross sectoral approach to understanding issues and challenges faced for city's growth; (3) A regulatory environment that enables adaptability and flexibility for changing needs of the people.
- ***Strong institutions enable inter-sectoral coordination.*** Measuring institutional capacity provides an indication of a systemic understanding of issues, and contradictions between various stakeholders. Institutional capacity facilitates measurement of spatial and non-spatial data related to social, economic, physical, environmental, infrastructure and transportation sectors. Institutional capacity also reflects in technical and managerial capacity as well, in planning, developing and managing land, land use, and infrastructure⁷³.
- ***Cross-sectoral approach:*** While sectoral plans have been juxtaposed on the master plans, they do not address cross cutting issues that face Soc Trang city. For example, phasing of urban expansion needs to be linked to municipal finance and available investments – public or private. Similarly, measures for prevention of flooding need to address urban design of public spaces, canal front as well as the road and transportation and drainage sectors.
- ***GIS for integrated approach to planning:*** The city presently uses digital platforms that do not permit multi-criteria analysis. A GIS platform would allow complex data analysis.

⁷³ Soc Trang demonstrated varying institutional capacities across the various departments in charge of managing land and infrastructure services. For example, URENCO supplied water efficiently to almost 100% of the city, while urban land management entails challenges of reconciling supply and demand. On the other hand, despite varying capacities, visits to areas occupied by traditional settlements indicated a fairly good level of maintenance. Capacity building programmes proposed for Soc Trang shall have to consider this aspect. At the same time, technical capacities in using geo-spatial databases would be essential in all the departments at all levels of disaggregation.

- **Data availability:** *Spatial data concerning natural hazard risk*, such as digital terrain data, mapping of watersheds, areas prone to flooding, drought and saltwater intrusion and other natural hazards, required for urban planning and implementation in Soc Trang, are unavailable. Further, non-availability of disaggregated data makes planning for the worst-case scenario difficult. *Disaggregated data for socio-economic indicators* are available on a yearly basis, as non-spatial data, at the ward and commune levels⁷⁴.
- **Water sector data:** URENCO has digital data available, however, in AutoCAD format. While this data platform is adequate for sectoral service delivery, it does not permit cross sectorial analysis.
- **Parallel projects:** The central government has commissioned research institutes at the centre to process LiDAR data, which will in turn help generate digital terrain models and disaster risk simulation models. However, the DoC and the CPC had no information of availability of Lidar data for parts of the city of Soc Trang. Data sharing and information sharing platforms need to be enhanced between the centre, province and city levels.
- **Data compatibility and formats:** Cadastral data is available in Microstation, a format compatible with the GIS platform. However, the spatial parcel objects does not link with population and employment and socio-economic indicators for Low Infrastructure Areas. Preparation of a data base for LIAs require institutional coordination between DoC, DoNRE, DSO/ PSO and local people. The macro level spatial data for the Master Plan is only available in AutoCAD format (master plan data and data with URENCO). Master plan data is not linked with non-spatial-socio-economic data (age, gender and areas of inhabitation of physically challenged persons). In other words, the available master plan is not organized in form of geo-spatial database.
- **Institutional coordination for data sharing** between sectors in Soc Trang is fairly good.
- **Capacity building needs:** Presently, within the DoC and CPC, none of the staff members is trained in the domain of GIS. The officials in charge shared the need for receiving training in GIS enabled urban planning.

Resilience qualities

- **Integrated:** The development of the GIS data infrastructure as a management tool is in a nascent stage in Soc Trang (an elementary GIS database with the Department of Natural Resources and Environment within the CPC). Presently, cross-sectoral coordination in urban planning is weak. As a result, integrated, data driven planning is not currently practiced. **Inclusive:** There is no digital data available for the Low Income/ Infrastructure Areas. Cadastral data, which is the first step towards planning for urban places, is unavailable for LIAs. Population, employment, work force and other socio-economic data is also partially documented posing an impediment to inclusionary planning practices.
- **Reflective:** An industrial development, An Nghiep, completed in the year 2000 is till date occupied only up to 20%. Most of the land, originally sub-divided and developed to attract investors in the industrial sectors has been leased out to agri-cultivators. These must generate much less revenue and employment than planned. Newer residential developments also bear the same issues of low occupancy rates. However, the CPC has not reflected upon adaptive use of under-utilized developed land. Again, data driven assessments would help arrive at solutions that meet changing trends and demand in making effective use of valuable land resource.

⁷⁴ While decadal census captures household level data, the PSO conducts limited sample surveys, on an annual basis. The number of indicators documented follows a national decree. For annual data updates, at the ward and commune levels, the PSO officials derive statistical estimates for the indicators from a hierarchical system of data extrapolation. The sample frequency is variable based on the project requirements – it is not a fixed parameter. Further, the GSO at the central government level determines the sample area. The local PSO or DSO does not have a say in this process. However, the DSO or the PSO conduct surveys for specific areas, if required. This data is not linked to any spatial data currently available with the CPC, at household, ward or commune levels.

- **Resourceful:** The provincial authorities' approach to annexing adjoining jurisdiction for meeting Grade II City status exacerbates inefficient use of water, land and infrastructure investment. This is not reflective of resource optimization, viz., provision of extended infrastructure to urban and industrial clusters located as distant as 10 km.
- **Robust:** While land management practices do not present replicability, URENCO has adopted efficient service delivery and management of water supply, which demonstrates robustness. Absence of evidence based transportation planning also does not help building replicable models for design of streets.
- **Redundant:** As in other cities of the MDR, incomplete data, particularly, data pertaining to socio-economic profile of the city at house-hold levels and disaster risk management and climate change does not enable the city to address worst-case scenario and fast track urban systems management, before-during-after disaster.
- **Flexible:** Institutions responsible for water supply and port development demonstrate ambition. However, normative planning principles that the master plan adheres to have not permitted adaptations to failed policies and development initiatives, such as the industrial and residential expansion sites or the S-Road. A shift to demand and data driven planning approach is imperative.

Cross-cutting issues

- **Planning for Climate Change:** Like other cities of the MDR, while institutions of Soc Trang city are aware of considerations in the Climate Change Action Plan at Province level, they still need to understand how these could be integrated into mainstream land use planning and design of infrastructure⁷⁵.
- **Deviating from Road Based City Expansion:** Presently engineering projects determine growth orientations, rather than an understanding of multiple needs – social, economic, ecological, financial and institutional. The S-Road proposal demonstrates this approach. Visits to industrial and residential sites developed with wide road networks and with large vacancy rates were testimony to a need for building capacity for conducting financial feasibility analysis for growth models adopted in master planning.
- **Management Information System for monitoring and evaluation of plan and project implementation:** The CPC's Department of Natural Resources and Environment has commenced setting up a GIS database. Cadastral data, the first requirement of such a database is already complete. Given that preparation of GIS database in Soc Trang is at a nascent stage, it was premature to discuss possibility of setting up a monitoring and evaluation system.
- **Augmenting institutional capacity:** The DoC, CPC and DoNRE staff at Soc Trang are capable of gaining further technical understanding of how various urban systems integrate with one another. The Director of DoC expressed interest in a capacity-building programme to be supported by The World Bank. They wish to use the GIS platform for the upcoming revision of the master plan.

⁷⁵ We showed the staff and officials GIS based Land Suitability Analysis conducted for other cities in the world, for understanding ecological concerns, superimposed with social vulnerabilities. This helped generate a more specific set of lacunae in their current data sets and capacities in urban planning, especially concerning zoning of land for urbanization. We discussed the benefits of using the geo-spatial data platform for this purpose. Measurable parameters, from macro to micro level (such as topographic data, to socio economic data at household level) are presently either unavailable or not integrated into a common database; these need to be integrated into the geo spatial database. While the Doc and CPC officials shared their visions and aspirations for augmenting public open space in the city, they had not linked these initiatives with preservation of ecologically sensitive areas or design of sot infrastructure.

- **Approval process and enforcement:** Components of the Master Plan include preparation of existing land use map, proposed zoning, proposed development regulations including land use zone, number of floors in a building, ground coverage, parking regulations etc.⁷⁶.

Gaps, challenges, constraints and barriers to improvement

Enforcement of Master Plans

- **Mapping grey areas in planning parameters:** Through discussions with officials in various cities of the MDR, several grey areas were identified in master plan implementation. These grey areas often are perceived sensitive by public institutions and private land owners. These generally pertain to details of land conversions – from agricultural to non-agricultural lands, ownership, existing and proposed developments on ecologically sensitive areas implementation of land use prescriptions, regulations pertaining to number of floors, building ground coverage, etc.⁷⁷
- **Data for LIA is partly available:** Discussions on the site visit to the LIAs revealed that these areas were partly documented. Since the occupancy of land was informal, along the water courses, cadastral data was partially available – for buildings located beyond the easement areas along water courses. Population was also recorded partially, for some households. These areas also housed unregistered population. Socio-economic conditions, income, type of construction, conformity or deviance to national planning norms related to decent living conditions and work conditions, etc., were not documented. This poses a challenge for implementation of Area Improvement Schemes or projects for improvement of Sites and Services. The officials mentioned that primary surveys shall be commenced for this purpose shortly.
- **Data for promoting industrial investments:** Soc Trang aspires to be an industrial centre for the province and the region. A specific visit to an industrial site located at An Nghiep towards the north-western part of the city revealed the low level of demand for industrial activity. While land was available, industrial development needs several other favourable conditions to support industrial growth. These include regulatory conditions to attract investors, institutional transparency, relevant skillsets, clustering of similar economic activities and relevant infrastructure. Soc Trang is also desirous of strengthening its port infrastructure (see, transport sector). With its targets for achieving Grade II status, this vision would only take on greater significance if backed with data.
- **Willingness for public access to data:** Officials at the CPC, Soc Trang, shared that they have conducted several consultative workshops with other public stakeholders on the preparation of the master plan. This was highly positive and opens up a new arena for application of GIS for consultative planning – and highlighting trade-offs (ecological, economic, infrastructure and

⁷⁶ As in the other cities, once prepared, the enforcement of the master plan is handled by two agencies: the DoNRE provides land use certification while the CPC and DoC are in charge of building permits depending on the scale of the building/building complex. Each of these certificates have a procedural requirement to adhere to, which is sometimes time consuming. Further, integration of considerations for risk proofing Soc Trang would also add to the no objection certificates to be obtained for proceeding with construction and occupancy of buildings. Presently, the approval process is elaborate and differentiated across many departments. A single window clearance would help optimize on time and maximize resources for the public agencies as well. The Department of Natural Resources and Environment within the CPC currently manages the cadastral data and records land use change and land registration. It was very interesting to learn that with availability of accurate cadastral data they often play the role of mediator in land disputes.

⁷⁷ Officials at Soc Trang did not elaborate upon this aspect. However, site visits to LIAs showed that areas occupied by original settlers, who have been living in these localities for more than 40 to 50 years are not mapped. Socio-economic data does not exist for these areas. However, on examination of the concerned site, the team found that these areas lacked in provision of basic infrastructure, which forms the main criteria for prioritizing LIAs.

social impacts) against choices made for urban plans and projects. They have also held public workshops for seeking suggestion and comments on the master plan⁷⁸.

- **Absence of Single Window Clearance** for approval of building construction and occupancy and land use certification: Building permits are granted partly by the CPC and DoC. For smaller building construction, the CPC is in charge. Larger complexes are approved by the DoC. The coordination was fairly good between DoC and CPC.

Availability of Partial Data

- **Satellite Imagery:** Statutory Landuse Master Plans and Sectorial projects don't use satellite imagery, such as Cartosat, Landsat, VNREDSAT etc., and remotely sensed satellite images for preparation of base maps.
- **Cadastral Data:** The cadastral map, one of the important datasets for urban development, is available with the department of natural resources and environment, within the CPC. Unlike other cities of the MDR, this database has not been scaled up for management at province level, yet. The data is also in Micro-station format and permit linkage on the vector base with non-spatial data such as socio-economic data. However, there is not yet any activities for that.
- **Data for Disaster Risk Mitigation and Management:** (1) Maps pertaining to disaster risk mitigation have been prepared at the City level; however, these are general at a macro level. (2) Soc Trang is a flat plain; hence, while the topographic data is unavailable. the terrain map can be derived from available cadastral map or LiDAR data. The cadastral map of Soc Trang city is available in scale 1:1,000 that cover the entire planning area⁷⁹; (3) Spatial data regarding pollution, key to assessing climate change, viz., air, water and ground water are available but at a macro level, and not spatially linked; (4) As in the other cities of the MDR, spatial socio-economic data for areas with potential social vulnerability during disaster is unavailable⁸⁰.

The Master Plan database⁸¹

The Master Plans prepared for Soc Trang City comprises of vector data⁸², mapped at an output scale of 1:10,000. The revised Master Plan 2035-2050 requires to be elaborated upon to receive statutory

⁷⁸ We shared the importance of GIS in conveying possible decisions and trade-offs. We also shared several samples from other projects, on how data can be processed through maps, graphs, spread-sheets to elicit public response. While the CPC presently has an internal portal for data sharing they do not have this provision for external parties/ agencies. The CPC officials were keen to explore possibilities.

⁷⁹ We shared the importance of GIS in conveying possible decisions and trade-offs. We also shared several samples from other projects, on how data can be processed through maps, graphs, spread-sheets to elicit public response. While the CPC presently has an internal portal for data sharing they do not have this provision for external parties/ agencies. The CPC officials were keen to explore possibilities. Institutional arrangements for data sharing are limited in a multi-level organization system. Hence, the local City authorities have no information that the LiDAR data (scale 1: 2.000) is being generated and processed for Soc Trang City by MoNRE. Consequently, they are not familiar with the benefits of LiDAR data for disaster risk mitigation and adaptation. We discussed the potentials of LiDAR data.

⁸⁰ In particular, data in the LIAs under the SUUP project of the World Bank are available, but a detailed mapping of physical locations of households with physically challenged persons remains yet to be documented. Alternatively, data from the decadal census needs to be transferred onto the GIS database. Similarly, streets, public spaces and public buildings inadequately or unequipped with amenities for universal accessibility are not mapped either. Age and gender profile at household levels would also be essential, also may be derived from decadal census, for purposes of cost optimization on conducting surveys.

⁸¹ The national law for Urban and Regional Planning prescribes plans to be undertaken at four scales: at the macro level, regional plans at an output scale of 1:25,000, at the City level, master plans at 1: 10,000 scale, zonation plan at 1: 2,000 scale, zonation detailed plan at 1:1,000 scale and urban design plan at 1: 500 scale. However, the DoC has presently only prepared statutory Master Plans at the 1:10,000 scales. Plan preparation was outsourced to external consultants, viz., Southern Institute of Agriculture and Urban Planning.

⁸²For city master plan, the digital plan data was designed based on decision No. 04/2008/QĐ-BXD promulgating the Vietnam building code on regional and urban planning and rural residential planning issued by the Minister of construction pursuant to the government's decree No. 17/2008/NĐ-CP of February 4, 2008.

approvals. For purposes of assessment of capacity, the vector data base available in the Master Plan 2025 is described here: (1) The spatial data available covers multiple sectors, including geography, location and regional spatial relationship, existing land use, existing landscape, existing social infrastructure (i.e. education, health care, etc.), existing technical infrastructure facilities and environment, existing transportation, existing water supply system, existing drainage network, existing drainage system for waste water, existing landfill and cemetery, existing communication network, existing electricity and utilities; however, this is available only at primary and secondary levels. Disaggregated data is unavailable and poses barriers to planning for risk proofing Soc Trang; (2) Non-spatial data includes population at commune/ward level; however, this is not spatially linked in the current database, prepared on AutoCAD format; the official from PSO shared that this data is based on extrapolation of a limited 2% random sample survey, the sample for which was determined by the GSO at the central government level; (3) One of the most significant lacunae in the Master Plan database is the absence of non-spatial data; socio-economic data, such as Census data (population, density, type of occupation, employment, household size, household income and assets), which are essential to understand urban growth dynamics and growth potential, have not been linked to spatial database; data pertaining to hazard risk, including areas prone to flood and land subsidence, are available in very small scale; (4) Proposals for spatial development include the spatial development strategy until 2030, proposed land use plan for a horizon period of 2030, transportation plan, water supply plan, utilities and communication plans, drainage system plan, sanitation plan, social infrastructure plan, technical infrastructure plan, strategic environment plan; however, the master plan is not accompanied by an investment plan for master plan implementation; (5) Under the Decree 423-TTg, the Doc and CPC at Soc Trang are now preparing to revise its current master plan; it is an opportunity to use the geo-spatial data platform for the preparation of the revised plan and introduce the shift towards integrated planning approach. However, inadequate technical, human resource capacities and investments may not permit this initiative in the short-term.

Data discrepancies

- Most of the databases available with the various line departments and the DoC, CPC are in AutoCAD format. DoNRE and Department of Natural Resource and Environment of CPC has data in Microstation software. Varied data formats make compatibility of data difficult, sometimes resulting in duplication of data base generation. This may cause issues for implementation and enforcement of plan.
- Difficulties for standardizing spatial data for integration between sectors: Contour, cadastral, land use, population density, population growth rate, number of registered and unregistered workers, number of households, age distribution, number of institutions, commercial enterprises, industries, number of schools, health care provision, open spaces, other amenities, meteorological data, hydrological data, soil condition, DRM locations, DRM according to different climate change scenarios, location of exposure persons, etc. have been prepared with varied technical standards and precision, making integration time consuming.

Coordinate System Compatibility

- The coordination systems used for creation of the AutoCAD data of Soc Trang is in compliance with the national standard coordinate system (VN2000)⁸³. Hence, this is favourable for data integration.
- Accuracy and level of detail of spatial data (especially cadastral data) needs to be improved in

⁸³ The spatial data is obliged to designed according to “Regulations of national geographic information standards” in Decision No. 06/2007/QĐ-BTNMT issued on February 27th 2007 and Decision No. 05/2008/QĐ-BTNMT dated August 26th 2008 by Ministry of Natural Resources and Environment, and the geo-reference is obliged to follow GIS National standard coordinate system of VN2000.

order to plan for disaster risk proofing.

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Institutional Capacity

- Officials of the DoC and CPC are motivated and engaged in the process of master plan preparation. However, an integrated planning approach needs to be introduced by using the data platforms.
- Augmentation of technical skillsets and human resource capacities require financial support from the government, which are limited.
- Institutional cooperation is fairly good and needs to improve for facing challenges of scaling up.

Data sharing

- The databases currently exist in independent formats within DoC, DoNRE, CPC, URENCO. Their integration will require government instructions and procedural mandates for data sharing.
- Central government organizations have conducted several studies relevant to the Mekong Delta and Mekong cities, including for Soc Trang. However, the assessments and results are often not accessible to provincial or local organizations. While inter sector operability within Soc Trang is moderately good, interoperability between the city-provincial undertaking and the central government seems weak.

Equipment

- Our discussions revealed lack of availability of appropriate computer equipment, software, hardware, and connectivity to support effective use of spatial data for master planning across provincial and local governments, in the CPC, DoNRE and DoC. The data centre at the CPC at Soc Trang presently only has one computer with requisite software and one trained person to handle the data base.
- Data, software and equipment maintenance recurring costs will add burden to the concerned authorities.

Key recommendations

Soc Trang has called for proposals from external consultants for preparation of the revised master plan. This is a good opportunity to undertake GIS based urban planning. In order to demand sound assessments and proposals from the external consultants, it would be desirable to commence the process of augmentation of the GIS data base at the CPC/ DoNRE offices and train the officials and staff of Soc Trang on the potentials of GIS software for urban planning needs. Considering the technical and human resources capacities are weak, at the city, a pedagogic approach to the capacity building programme would be essential.

Key recommendations include the following:

- ***Commence GIS enabled Master Planning in 2017, along with Capacity Building Programme.*** Soc Trang City has committed to undertake the revision of its Master Plan in 2017.
- ***The creation of a GIS database first requires design of a data model and data structure.*** Populating this data model and data structure, with real time data, will span more than a term of five years, at the minimum. It is therefore recommended here that a data structure first be established for Soc Trang. Considering the nascent stage at which the data base currently exists, care may be taken at the very beginning, in forming a data base with no data discrepancies: (1) the data structure of the current master plan and other current/ allied plans

need to support spatial database creation. This implies that they need to be unified to meet MoNRE's regulation of following the VN 2000 projection system. (2) the coordinate system of spatial data in master plans must be forced to follow VN2000 that required in MoNRE's regulation of geographic maps.

- **Adaptation of planning processes towards greater flexibility and reflection:** (1) Using the opportunity that Soc Trang is presently preparing the terms of reference for the revision of the master plan, it is recommended that they develop a framework for GIS enabled planning process; (2) Within the current planning legislation, prepare a framework for incremental-integrated planning (to address urban growth dynamics); (3) Identify possible pilot projects for preparation of local plans or detailed plans. The Vice Chairman, DoC, at Soc Trang expressed specific concern for augmenting public space infrastructure for the city. In alignment with this, and linking this concern with disaster risk mitigation, identify urban design schemes for public spaces, parks and gardens, urban watersheds and green streets plan using the Sustainable Drainage Systems (SuDs) framework and a corresponding dataset.
- **Data for integrated planning:** Need for a framework for integration of province level CCAP into Statutory Master Plans of Soc Trang city and accordingly, corresponding data integration into primary data base; further, framework for integration of province level CCAP into Sectorial Master Plans for Soc Trang city and integration of corresponding data with primary database. This involves: (1) *Primary data collection and creation:* establish minimum data requirements list; *Data integration:* Integration of multiple spatial and non-spatial data sources from multiple governmental, non-governmental organizations, and World Bank funded projects, is essential and feasible in avoiding duplication of efforts. These include: (1) LIDAR data from ongoing project of MoNRE for Mekong delta region; (2) Satellite images (VNREDSAT1) from Remote Sensing Department of MONRE; (3) The results of salt water intrusion from ongoing project funded by World Bank; (4) DRM database structure form project funded by World Bank; (5) DRM map atlas from Integrated Disaster Risk Management Project funded by World Bank.
- **Data Management:** In the long term, real time updating of spatial and non-spatial data is essential in order to develop a reflective and flexible approach to addressing disaster risks.
- **Data Monitoring and Evaluation:** Creating an M&E system is useful, especially when integration of measures for climate change adaptation; it is essential also towards the practice of evidence driven planning practice; however, this platform is data intensive and necessitates regular/ real time data collection. Constructing a geo-data model and populating it for Soc Trang, as mentioned earlier, will entail a few years of methodical data accretion. Accordingly, an M&E system may be planned.
- **Training and Capacity Building Programme:** Creation of this data base may be accompanied by a capacity building programme for the officials and staff of the various public authorities. This combined process, it is anticipated will help embed the public authorities within the new approach to master planning and also provide them the necessary ownership to implement it.

Priority Actions

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| <ul style="list-style-type: none"> - MoC to lead and initiate discussions with other ministry level offices and corresponding province level departments, for kicking off an 'integrated urban planning and development' project in the MDR; Establish required protocols with MoNRE, MoC, GSO, MoT and other ministry level offices to explore the possibility of setting up a GIS Data lab at Soc Trang, in the medium term. - Formulate action plan for initiating integrated master planning at Soc Trang, including setting up of an elementary GIS Data centre, evolving cost effective methodologies for collecting a minimum data set, conducting situation analysis through multi-criteria assessments; formulate vision for the city's development with long term, mid-term and short term objectives, proposals and conducting simultaneously, a Capacity Building Programme. |
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- Alternatively, propose pilot projects delineating specific planning areas within the core area of the city or urban peripheries; use GIS platform at a smaller scale, for planning, enforcement and monitoring of plan implementation and evaluation of planning outcomes.
- Estimate financial value of the project preparation and establish a funding agency for supporting the project to be commenced in 2017.