TRANS-SECTORAL MODELLING OF SUPPLY AND DISPOSAL INFRASTRUCTURES IN FAST GROWING CITIES – THE CASE OF DA NANG, VIETNAM

1. Introduction

Planning activities for highly dynamic metropolises involve numerous analyses and decision making regarding the planning and management of natural and technical resources. Most of these tasks are complex due to the dynamics of demographic variables and the complexity of natural and urban supply and disposal infrastructure systems, consisting of many components and processes. Trans-sectoral modelling of supply and disposal infrastructures of the water, wastewater, food/urban agriculture, waste and energy sectors can significantly contribute not only to the identification and evaluation of effective measures for resource conservation and efficient utilisation of technical infrastructures, but also to the quantification of effects of planning decisions in fast growing cities such as Da Nang (Vietnam). This poster presents some preliminary results of integrated modelling of the water, wastewater, energy and waste sectors of Da Nang city with focus on the water and wastewater sector.

2. Trans-sectoral modelling of supply and disposal infrastructures of the city of Da Nang

2.1. Objectives

- Evaluation of impacts of population development on natural resources, technical infrastructures and material and energy flows
- Assessment of resource consumption and disposal (city district level) under scenarios of population development
- Quantification of interactions and of potential synergies between sectoral infrastructures
- Evaluation of effective measures under different criteria to achieve a more efficient and sustainable use of resources

2.2. Da Nang

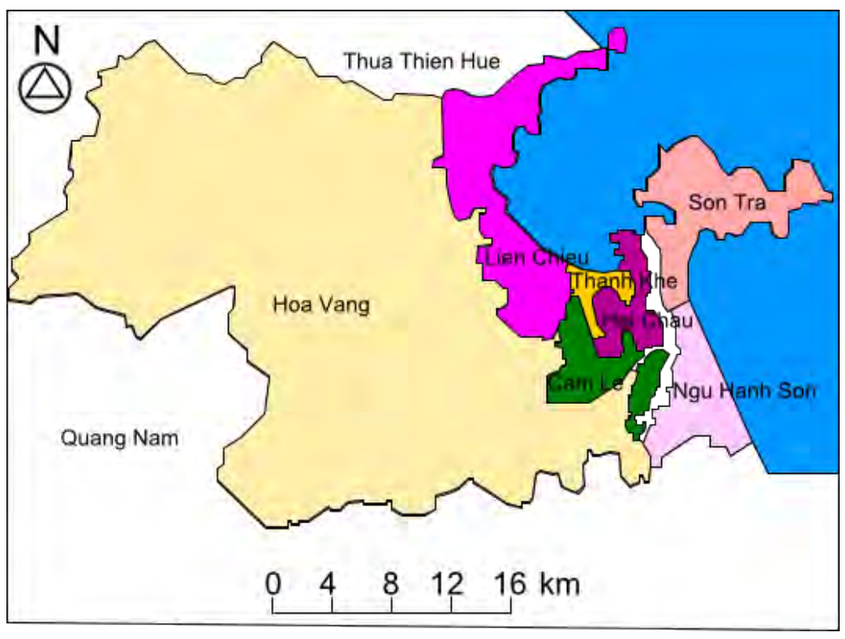
The city of Da Nang is located in the central part of Vietnam and borders to Thua Thien Hue Province in the North, to the East Sea in the East and to Quang Nam Province in the Southwest. With 1,007,700 inhabitants in 2014 and a total land area of 1,295 km², Da Nang is considered the sixth most populated city in the country. Da Nang is divided into six urban districts (255 km²), which account for 87% of the city population, and two rural districts (1,040 km²) (see Figure 1).

The water and wastewater sector

Da Nang Water Supply Company (DAWACO) is responsible for the water supply of the city. DAWACO manages four drinking water treatement plants with a total installed capacity of 210,000 m3/d. The plants are Cau Do (170,000 m3/d), Son Tra (5,000 m3/d), San Bay (35,500 m3/d) and Hai Van (5,000 m3/d). 89 % of the population is connected to the drinking water network. The rest of the population is supplied by private groundwater wells. The average water consumption of the city accounts of 130 litres per capita and day.

The wastewater collection and treatment is managed by Da Nang Waste Water and Treatment Company (DWTC). 82 % of the population is connected to onsite septic tanks. The effluent of these septic tanks is discharged into the ground. Approximately 14 % of the population is connected to the sewer network. The wastewater discharged into the sewer network is preliminarily treated in onsite septic tanks. The rest of the population discharges their wastewater into soak pits or does not have any treatment facility. The wastewater collected by the sewer network is treated in four wastewater treatment plants with a total installed capacity of 123,938 m3/d. The plants are Hoa Cuong (43,781 m3/d), Phu Loc (44,200 m3/d), Son Tra (20,700 m3/d) and Ngu Hanh Son (15,257 m3/d). Hoa Cuong, Son Tra and Ngu Hanh Son use anaerobic pond technology. Phu Loc was recently rebuilt from anaerobic ponds to Sequencial Batch Reactor technology (SBR).

Figure 1: Administrative borders of Da Nang



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2.3. Trans-sectoral modelling

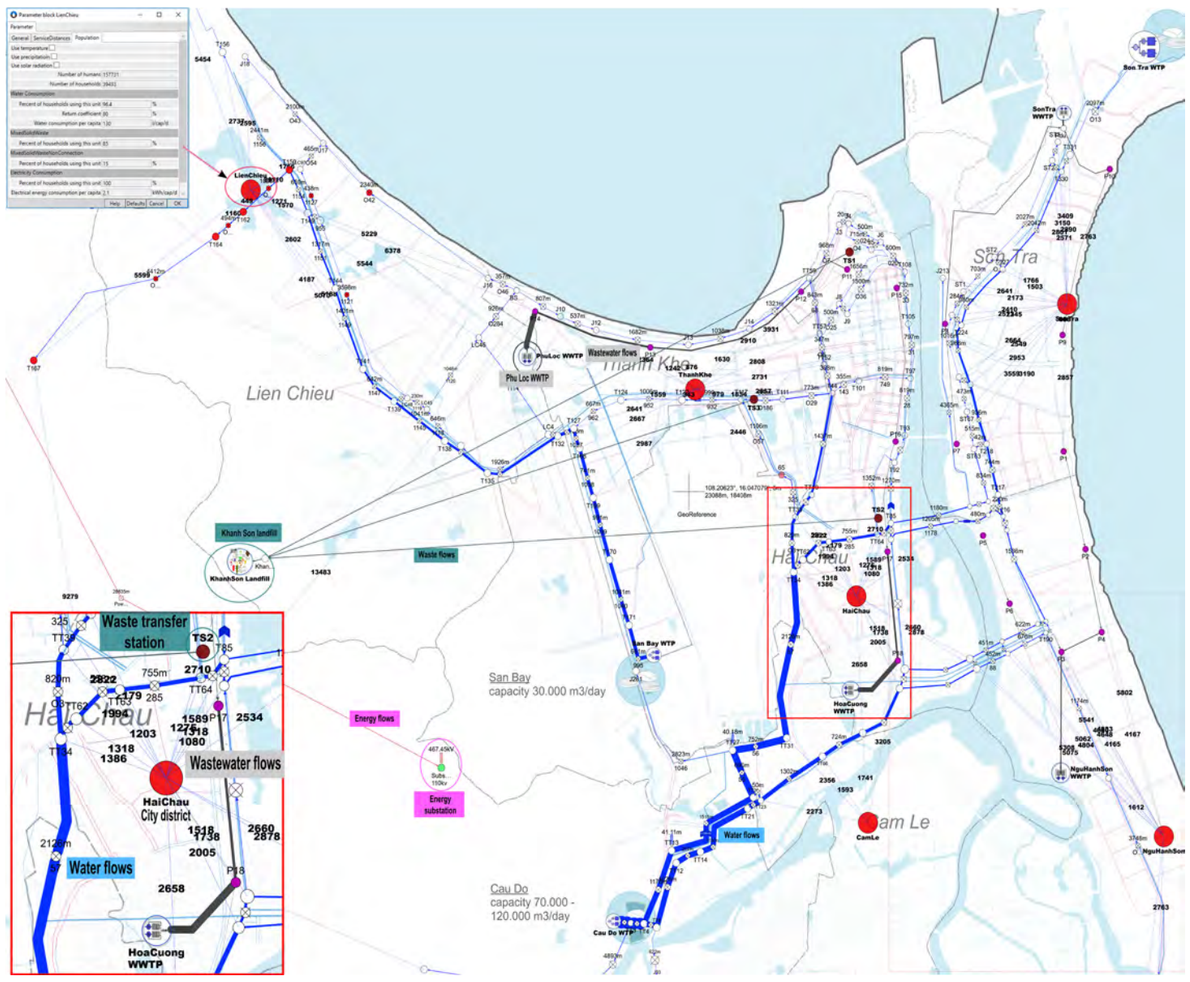
For the integrated analysis of the infrastructures of the water, wastewater, energy and waste sectors of the city, the curent version of the RP Simulator has been used. Modelling of the supply and collection infrastructure of the four sectors is based on the sectoral maps generated by TU Berlin. Missing data and information of the infrastructure of the water and wastewater sector have been obtained directly from DAWACO and DWTC within a Master thesis carried out in close cooperation with Ostfalia University of Applied Sciences. Additional information has been compiled from literature.

Figure 2 illustrates the trans-sectoral model of the water, wastewater, energy and waste sectors of the city

3. Base case and scenario analysis

The water and wastewater sector and the development of the water and wastewater flows of the city have been analysed for the base case (2014) and under two differents scenarios of population development and water consumption patterns (low growth case and high growth case) for the period 2015 to 2030. The low growth case is based on DAWACO estimations. Whereas, the high growth case is based on the Master Plan for Da Nang. DAWACO expects 1.6 Mio. inhabitants in 2030 and a water consumption per capita of 120 l/cap/d. As opposed to this, the Master Plan expects 2.5 Mio. inhabitants and a water consumption of 180 l/cap/d. Additionally, planned water and wastewater infrastructures according to the Master plan and DWTC until 2030 have been considered (see Figure 3 and Figure 4).

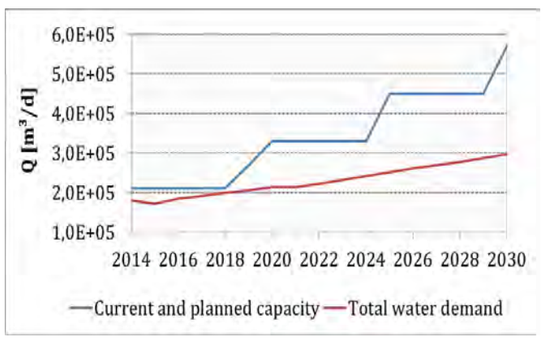
Figure 2: Trans-sectoral model of the water, wastewater, energy and waste sectors of Da Nang



4. Results so far

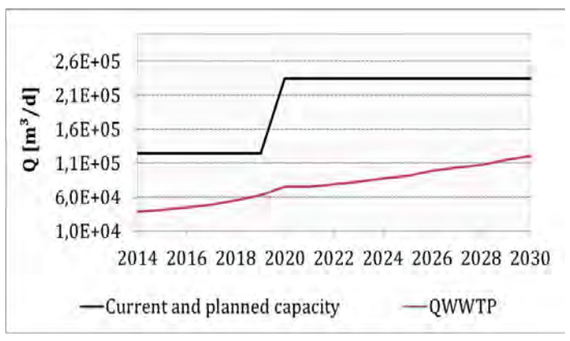
Figure 3 shows the total current and planned capacity of the water treatment plant and the simulated water demand of the city. Note, that the calculated water demand following the low growth case scenario is far below the projected demand within the Master plan. Figue 4 illustrates the total current and planned capacity of the wastewater treatment plants and the simulated inflow to the treatment plants. The significant difference between the wastewater inflow and the total capacity is due to the connected sewer network. Because the wastewater is discharged together with the storm water the WWTP receives a lot more water than simulated. The simulation results does not considered the storm water.

Figure 3: Total capacity of water treatment plants and water demand for the low scenario (2014 - 2030)



source: Peters (2017)

Figure 4: Total capacity of wastewater treatment plants and wastewater inflow low scenario (2014 - 2030)



source: Peters (2017)

5. Conclusion and outlook

Within the implementation of the RP Simulator, the current state of supply and disposal infrastructures of the sectors water/wastewater, waste and energy of the Da Nang have been modelled in an integrated way. In addition, the supply and collection infrastructures of the water and wastewater sector have been analysed under two different scenarios of population development and water consumption patterns. The scenario analysis also considered the implementation of measures according to the master plan of the city and DWTC. On this basis, the water and wastewater flows through the city and the utilization of water supply and wastewater collection capacities have been quantified.

Future work includes the extension of the trans-sectoral model by the inclusion of the food/urban agriculture sector and the analysis of resource consumption and disposal patterns, taking into account different socio - economic levels of the population and building structure types, respectively. Other activities include integrated modelling and analysis of the energy, waste and food/urban agriculture sectors under different scenarios. In addition, the interactions and potential synergies between the sectors will be also quantified. On this basis, technical and non-technical measures will be evaluated taking into account a set of criteria.

6. Acknowledgements

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7. Literature

Peters, G. (2017): Setup of an integrated model of the water supply and wastewater system of Da Nang City, Master Thesis, Ostfalia University of Applied Sciences, Suderburg, ifak, e. V. Magdeburg

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