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Climate Change Mitigation and Adaptation as a Sustainable Regional Development Strategy: Lessons from the Selangor River Basin, Malaysia

Perubahan Iklim Mitigasi dan Adaptasi sebagai Strategi Pembangunan Wilayah Lestari: Pengajaran daripada Lembangan Sungai Selangor, Malaysia

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ABSTRACT

Spatial planning practice in Malaysia has given greater prominence to environmental matters since the amendment of the Town and Country Planning Act 1976 in 1995, in which sustainable development has become the core emphasis of all planning policies and plans. However, climate change elements, which are necessary to be addressed in strategic planning, have not been explicitly incorporated in spatial plans that cover urban and rural areas at state and local levels. This paper presents a framework to evaluate the extent of spatial planning responses to climate change adaptation and mitigation across various critical components that defines the quality of plan, including facts, analysis, goals, policies and implementation, in the case of the Selangor River Basin, a river basin that can be considered as a life support in the Kuala Lumpur Conurbation, the biggest urban mega region in Malaysia. A content analysis of national, state and local level spatial plans reveals that quality of plans is higher at the national level but gradually decline towards the lower tiers plans, and that generally equal emphasis has been paid to both climate change mitigation and adaptation. The findings support the argument that spatial planning provides a platform for coordinating mitigation and adaptation responses through its sustainable development policies, however the scope of sustainable development in Malaysia need to be reframed for this purpose.

Keywords: Spatial planning; spatial plan; plan evaluation; climate change

ABSTRAK

Amalan perancangan spatial di Malaysia telah diberi keutamaan yang lebih besar kepada hal-hal alam sekitar sejak pindaan Akta Perancangan Bandar dan Desa 1976 pada tahun 1995, di mana pembangunan mampan telah menjadi penekanan teras semua dasar dan pelan perancangan. Walau bagaimanapun, unsur-unsur perubahan iklim, yang perlu diberi perhatian dalam perancangan strategik, belum jelas yang diperbadankan di rancangan spatial yang merangkumi kawasan bandar dan luar bandar di peringkat negeri dan tempatan. Kertas kerja ini membentangkan rangka kerja untuk menilai sejauh mana jawapan perancangan spatial dengan iklim perubahan penyesuaian dan pengurangan dalam pelbagai komponen kritikal yang menentukan kualiti rancangan, termasuk fakta-fakta, analisis, matlamat, dasar dan pelaksanaan, dalam hal Lembangan Sungai Selangor, lembangan sungai yang boleh dianggap sebagai sokongan kehidupan di Kuala Lumpur Conurbation, rantau yang terbesar bandar mega di Malaysia. Analisis kandungan pelan spatial di peringkat kebangsaan, negeri dan tempatan mendedahkan, bahawa kualiti rancangan adalah tinggi di peringkat kebangsaan tetapi beransur-ansur merosot ke arah peringkat pelan yang lebih rendah di mana penekanan yang sama umumnya telah diberikan kepada kedua-dua iklim mitigasi dan adaptasi perubahan. Hasil kajian menyokong hujah bahawa perancangan spatial menyediakan platform untuk menyelaraskan mitigasi dan adaptasi respons melalui dasar-dasar pembangunan yang berterusan, bagaimanapun skop pembangunan mampan di Malaysia perlu dirangka semula untuk tujuan ini.

Kata kunci: Perancangan spatial; pelan spatial; merancang penilaian; perubahan iklim

INTRODUCTION

In Malaysia, the National Policy on Climate Change 2009 (NPCC), was approved by the Malaysian Cabinet in November 2009 and serves as a framework to mobilize and guide government agencies, industries, communities as well as other stakeholders in addressing the challenges of climate change in an integrated manner. One of the objectives of NPCC is to integrate climate change responses through national policies, plans and programmes. Spatial planning practice in Malaysia has given greater prominence to environmental matters since the Town and Country Planning Act

1976 was amended in 1995, to make sustainable development the core emphasis of all planning policies and plans (Bruton 2007). Nonetheless, climate change is still considered as a new challenge to be engaged in spatial planning.

The aim of this paper is to present a framework to evaluate the extent of current spatial planning in responding to climate change adaptation and mitigation in the case of Selangor River Basin, Malaysia. Two research questions are addressed in this paper: 1) To what extent do spatial plans in Selangor River Basin have prepared for climate change? Are there variations between spatial plans at the national, state and local levels? 2) Do the spatial plans pay equal attention to climate change mitigation and adaptation? The answers to these questions will identify gaps in the existing spatial planning responses towards climate change, as well as providing guidance for future reviews of spatial planning policies. This paper commences with a brief discussion on the linkages between spatial planning and climate change, followed by an explanation of the conceptual framework for spatial plan evaluation based on the linkages, and the methodology used in the research. Finally, this paper describes the results of its application in Selangor River Basin.

CLIMATE CHANGE AND SPATIAL PLANNING

Spatial planning is a tool or decision making process to steer land use changes and future distribution of activities in space, by coordination of different relevant socio-economic and environment objectives (European Commission 1997). It is a generic term that refers to various kinds of planning practices at different planning levels or spatial scales (Schmidt-Thome 2006). With the emerging issue of climate change, spatial planning has a vital role to play in responding to both the causes of climate change (through climate change mitigation) and the impacts of unavoidable climate change (through climate change adaptation) (Davoudi 2009). Spatial planning, through its organization of land uses, can help to reduce greenhouse gases emission particularly in the planning of land use, transportation, and waste management (Robinson 2006; DCLP UK 2007; Wheeler et al. 2009; Blanco & Alberti 2009; Savacool & Brown 2010). On the other hand, planning for the unavoidable impact of climate change can be reached particularly in water, flood and coastal management (Boult 2009; Wilson & Piper 2010; Nicholls 2011; Erol & Randhir 2012). However, this may require a reframing of spatial planning interventions, with a renewed and revised interpretation of sustainable development (Wilson and Piper 2010). Initially, climate change was mainly integrated into spatial planning in the form of mitigation strategies (Robinson 2006; Levett 2006). The focus is starting to shift from mitigation to adaptation strategies in this century. Scholars have also discussed the possible role of spatial planning in coordinating and developing effective mitigation and adaptation options in an integrated manner through sustainable development policies (Bulkeley 2006; Biesbroek et al. 2009). Previous studies have empirically examined the linkages between sectors under spatial planning and climate change. The summary of these linkages is summarized in Table 1.

TABLE 1. Linkages between spatial planning and climate change based on literature

Policies in Spatial Planning	Literature
Land Use	
1. Disaster resistant land use and building code (A)	Tang et al. (2010), Boult (2009), Keeffe (2009), Kabat (2009)
2. Mixed use /compact development (M)	Tang et al. (2010), Brown et al. (2009), Sovacool & Brown (2010), Wheeler et al. (2009)
3. Control of urban service/growth boundaries/ concentrated development/ reduce urban sprawl (M)	Tang et al. (2010), Wheeler et al. (2009), Robinson (2006)
4. Urban regeneration/ infill development/ brown field development (M)	Tang et al. (2010), Wheeler et al. (2009), Robinson (2006)
5. Land use and urban design that retain natural area (M&A)	Jusuf et al. (2007), Wong and Chen (2005)
6. Development away from vulnerable area (A)	Schmidt-Thome (2006), Keeffe (2009), Peltonen et al. (2005), Bulkeley (2006)

Biodiversity	
7. Creation of conservation zones or protection areas (forest, natural habitat, food, etc.) (M&A)	Wilson & Piper (2010), Wendea et al. (2010), Escobedo et al. (2010), Tang et al. (2010)
8. Reforestation/ Reduce land clearing (M&A)	Wilson & Piper (2010), Driscoll et al. (2010)
9. Creation of ecological linkages (M&A)	Wilson & Piper (2010), Opdam (2009), Barbour (2012)
10. Expand parks and other green spaces in/ around cities, plant trees/ gazette parks (M&A)	Wendea et al. (2010), Akbari (2002), Keeffe (2009)
Coast	
11. Coastal zone protection (A)	Blanco & Alberti (2009), Fleishhauer and Koh (2009), Nicholls (2011)
Transportation	
12. Transit-oriented development and corridor improvements (M)	Brown et al. (2009), Wendea et al. (2010), Tang et al. (2010)
14. Alternative transportation strategies / rail and bus network planning/ Integrated transportation system (M)	Brown et al. (2009), Sovacool & Brown (2010), Wheeler et al. (2009), Bulkeley (2006), Tang et al. (2010), Levett (2006)
15. Parking standards adjustment (M)	Levett (2006), Tang et al. (2010)
Energy	
16. Energy efficiency planning (M)	Wendea et al. (2010), Wheeler et al. (2009), Tang et al. (2010)
18. Renewable energy planning (M)	Tang et al. (2010), Bulkeley (2006), Brown et al. (2009), Sovacool & Brown (2010), Wendea et al. (2010), Blanco & Alberti (2009)
Water	
19. Water use efficiency planning (A)	Wilson et al. (2010)
20. Watershed based land management/ River basin management/ Ecosystem based land management (A)	Biesbrock et al. (2009), Wilson & Piper (2010), Tang et al. (2010)
21. Storm water management/ Flood mitigation (A)	Blanco & Alberti (2009), Fleishhauer and Koh (2009), Boult (2009), Wilson & Piper (2010), Tang et al. (2010), Erol and Randhir (2012)
22. Water demand management planning (A)	Beck & Bernauer (2011)
23. Water supply management planning (A)	Beck & Bernauer (2011)
Urban Design/ Building	
24. Green building codes/ standards (with climate resistant and energy efficiency/ capture natural climate) (M&A)	Wilson & Piper (2010), Brown et al. (2009), Wendea et al. (2010), Wheeler et al. (2009), Blanco & Alberti (2009), Fleishhauer and Koh (2009), Tang et al. (2010)
25. Urban design that reduce urban heat island effect (M&A)	Giridharan et al. (2007), Stone (2005)
Waste	
26. Planning for landfill with methane capture strategy (M)	Wheeler et al. (2009), Tang et al. (2010)
27. Planning for zero waste reduction and high recycling strategy (M)	Tang et al. (2010)

M = Mitigation; A = Adaptation; M&A = Mitigation and Adaptation

CONCEPTUAL FRAMEWORK

The spatial plan evaluation exercise has evolved from choosing several alternative plans as a part of the plan making process to evaluating plans based on the definition of high quality plans. The evaluation of planning is a necessary exercise, since it can contribute to better planning practice. It may also guide an evaluation of existing plans, preparation of new plans or updating of existing plans (Berke and Godschalk 2009). For spatial plan quality evaluation in this research, a conceptual framework that recognizes the plan components emphasized by Kaiser et al. (1995): facts component, goals component, policies component and an evaluation component, is proposed, on the basis that a plan is a document outcome from the planning process. In addition, a separate parameter is proposed on analysis component, based on the Planning Process Model (Baer 1997), as one finds that spatial plan

preparation pays a favorable attention to analyzing past trend, future trend, land suitability analysis and other multi criteria data analysis (Figure 1).

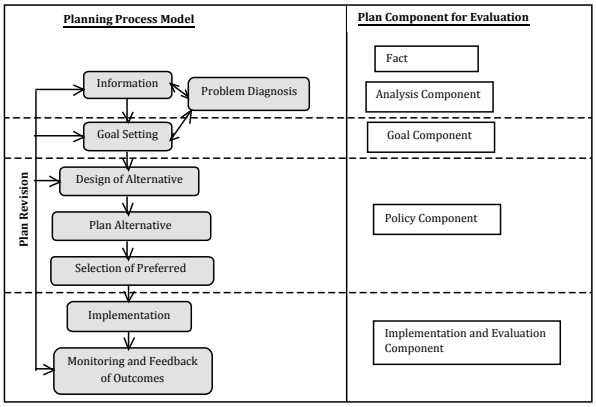

FIGURE 1. A conceptual framework of planning process and plan components

Source: Planning Process Model adapted from Baer 1997

Figure 1 shows five components in plan component for evaluation: (1) The fact component refers to the presentation of data and spatial implication of climate change, either explicitly or implicitly. Indicators for the fact component are identified based on the projected climate change stipulated in NPP2 Malaysia, i.e. temperature rise, changing rainfall amount (increase or decrease in different locality), changing rainfall intensity and sea level rise; (2)The analysis component refers to the analysis of climate change scenarios at the local level and the impact of activities at regional and local scale contributing to climate change and vulnerability assessment at the local level; (3)The goal component of spatial plans is evaluated based on its emphasis towards six sustainable development principles set out by Berke and Conroy (2000) i.e. harmony with nature, liveable built environment, place based economy, equity, polluter pays and responsible regionalism; (4) The policy component is measured through a series of indicators or linkages between spatial planning and climate change (mitigation and adaptation) that allow for quantitative assessment and analysis of plan quality; and lastly (5) the implementation and evaluation involves setting of timelines for actions, identifying responsible organizations for actions, sources of funding and setting criteria for plan monitoring.

METHOD

The population of this study involves 6 spatial plans at 3 administrative levels in the Selangor River Basin, Malaysia, i.e. NPP1 (2005) and NPP2 (2010) at the National Level, the Selangor State Structure Plan (SSSP) at the State Level, and the Selayang Municipal Council Local Plan (SMCLP), Kuala Selangor District Local Plan (KSDLP) and Hulu Selangor District Local Plan (HSDLP) at the local level. The Selangor River Basin is located in the State of Selangor, Peninsular Malaysia, with an area of 2,200 km^2. It is the third largest river basin in Selangor after the Langat River Basin and Bernam River Basin (Selangor State Government 2007). This river basin was selected as it is the most important water resource in Selangor State that provides over 60% of water used in the Klang Valley (the most developed corridor in Peninsular Malaysia). The main challenges for Selangor River Basin Planning and Management is the increasing demand for water as a result of rapid population growth and brisk economic development, coupled by rainfall decreases, monthly river flow decreases and water supply decreases (NRE 2011).

For plan evaluation, firstly, the characteristics of a high quality spatial plan with climate change elements were defined. This was followed by the construction of a plan quality evaluation protocol based on the conceptual framework defined earlier (Figure 1). Spatial plans were evaluated based on the 5 plan components set out in Figure 1 with 46 indicators. Indicators for each plan component were scored on a 0–2 scale or 0–1 scale. A content analysis was applied to calculate the plan component quality and total plan quality for each spatial plan. Higher summed scores indicate that the plan places more emphasis on relevant components. Following the plan quality evaluation approach from previous studies (Berke 1996, 1998; Berke and Conroy 2000; Brody 2003a, 2003b, 2006; Norton 2008; Tang Z. et al. 2010), there are three steps in the calculation of an index for each plan component. First, the equation for plan component quality was done by summing up scores for each of the indicators (I_i) within each of the plan parameter. Second, the sum of the scores is standardized by dividing the possible score in each plan component ($2m_j$ or m_j) and multiplying the fractional score by 10 to place the component on a 0 to 10 scale.

For plan components which are scored on a 0 – 2 scale,

$$PC_j = \qquad (1)$$

For plan components which are scored on a 0 – 1 scale,

$$PC_j = \qquad (2)$$

Where PC_j is the plan quality for the *jth* component, and m_i is the number of indicators within the *jth* component.

Finally, the total plan quality (*TPQ*) was gained by summing up all the plan component quality indices. The maximum score for each plan is 50.

$$TPQ = \qquad (3)$$

Data were further analyzed using descriptive statistics to assess the quality of spatial plans based on three different levels: national, state and local. The result was then verified by senior staff members of the Department of Town and Country Planning, the agency responsible for the preparation of spatial plans at the three spatial scales. To increase reliability, the plans were evaluated by two coders independently, and each spatial plan was evaluated three times. The evaluations were compared, and inconsistently scored criteria were revisited to yield an agreed score.

RESULTS

TO WHAT EXTEND DO SPATIAL PLANS IN THE SELANGOR RIVER BASIN HAVE PREPARED FOR CLIMATE CHANGE? ARE THERE VARIATIONS BETWEEN SPATIAL PLANS AT THE NATIONAL, STATE AND LOCAL LEVEL?

Figure 2 shows the overall result from the spatial plan evaluation in Selangor River Basin. Spatial plans at the national level score the highest in total plan quality, followed by the state and local levels. The pattern is also echoed in the analysis based on each plan component. The state level plan scores as high as the national level in goal and policy components, while at the second place in fact component. Overall the local level scores the least in all plan components, except in implementation component. Among all the plan components evaluated, the goal component scores the highest, followed by policy, implementation, fact and analysis component. All the three levels score fairly weak in analysis and fact components, with the plan quality ranging from 0 to 0.83 for the analysis component, and 0.48 to 3.93 for the fact component (highest possible score of 10). This indicates that the plans evaluated cover not more than 8.3% of the indicators in analysis component, and not more than 39.3% of the indicators in fact component. The result indicates that the spatial plans generally provide rooms for climate change integration, particularly in goal, policy and implementation components, as the plans have held sustainable development as the guiding principles in the plan making process, and there are close connections between climate change management and sustainable development. However, the scope of sustainable development in this country has not included climate changes. This has caused the assessment in fact and analysis integration becomes relatively low.

FACT COMPONENT

The fact component scores relatively low compared to the other plan components. As discussed earlier, the spatial plans at the national level is more advanced in presenting the fact component, followed by state and local level (Figure 3). A comparison between the sub-components: explicit and implicit references show that most of the facts in relation to climate change are presented implicitly in terms of rainfall data. Only the national level plan presents explicit references to climate change, covering 41.7% of the indicators, however, less attention has been paid to the spatial implications of climate change. On the other hand, the state and local levels completely do not explicitly recognize climate change as an issue and presenting data in relation to climate change. In terms of implicit references, the national level also scores the most, covering 37.5% of the sub-component indicators, followed by the state level (14.3%) and local level (4.8%). The temperature and rainfall intensity information are ignored at all three levels. The state and local level plans also do not cover sea level rise as one of the impending issues in spatial planning. The result is not surprising because NPP2, which was prepared after the other 5 spatial plans, is the first spatial planning document in Malaysia to acknowledge climate change, this impending issue is believed to have spatial implications and should therefore be considered at the early stage of spatial planning.

ANALYSIS COMPONENT

The analysis component scores the least compared to other plan components. The spatial plans at the state and local levels completely do not undertake analysis in relation to climate change. Only spatial plans at the national level include little vulnerability assessment due to sea level rise, based on secondary data from other studies (Figure 4). The analysis of downscaling climate change scenario and impact of regional and local activities that contribute to climate change are also absent at the national level.

GOAL COMPONENT

Goal component is the highest plan component being considered by the spatial plans in the study area. Sustainable development is cited explicitly at all three levels, particularly at national and state levels and recognized as the guiding principle for the spatial plans. Figure 5 shows that the national and state level spatial plans present a full score in goal component while local spatial plans get an average score of 3.33 (out of 10). The lower score in local level spatial plans is due to the emphasis of two spatial plans on economic developments and city liveability. For the objective sub-component, spatial plans at all levels score fairly equal with more emphasis on the sustainable principles of: 1) harmony with nature; 2) livable built environment; 3) place-based economy; and 4) equity. Two principles that are completely disregarded by all the spatial plans are the polluters pay principle and the responsible regionalism principle. A comparison between the two sub components: goal statements and objectives indicate that the national and state levels spatial plans excel in goal statement, however it weakens in the objective sub-components. On the other hand, the local level spatial plans score low in goal statement, but stronger in the objective sub-components.

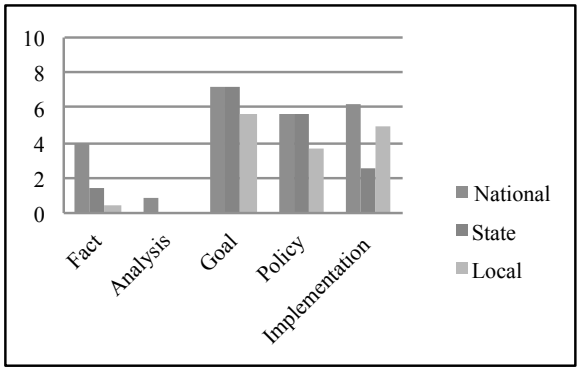

FIGURE 2. Total plan quality for climate change planning

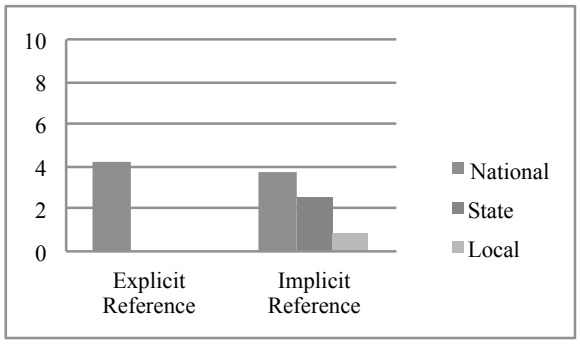

FIGURE 3. Plan quality for fact component

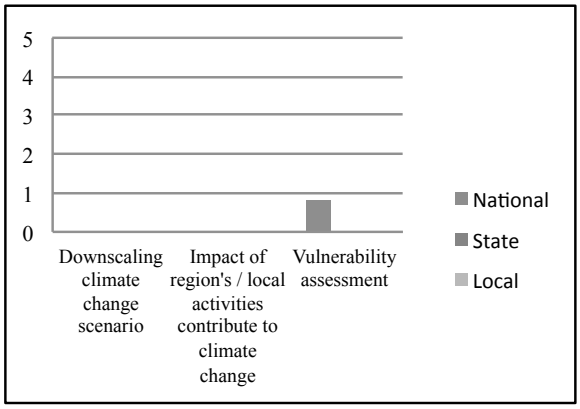

FIGURE 4. Plan quality for analysis component

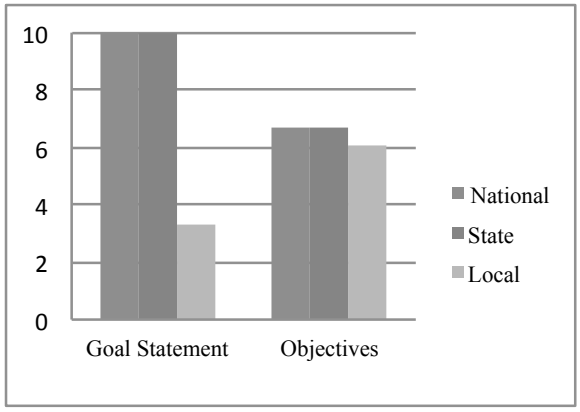

FIGURE 5. Plan quality for goal component

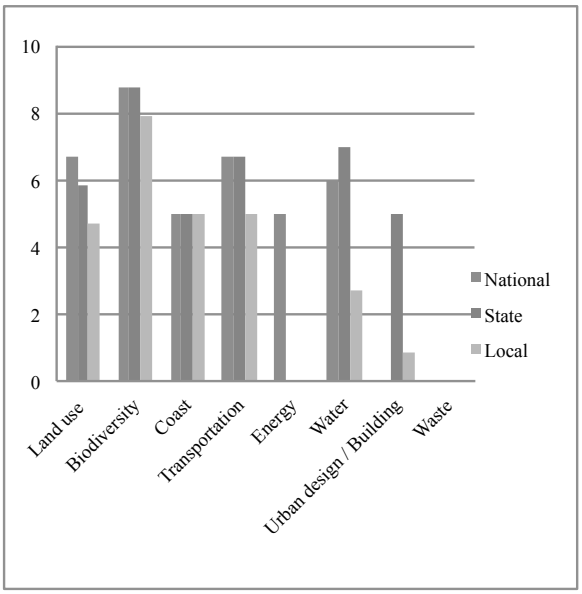

FIGURE 6. Plan quality for policy component

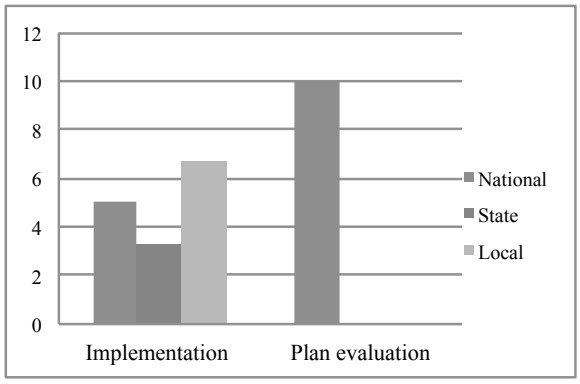

FIGURE 7. Plan quality for implementation and evaluation component

However, the local level plans score slightly lower than the upper two levels, only covering 36.7% of the indicators. Figure 6 shows the plan quality for policy component based on standardized score for each plan sub-component. From Figure 6, a general pattern is observed where the national and state level plans include more policies in relation to climate change than the local level (except in the sub-component of urban/building designs). Biodiversity is the most emphasized sub-component, followed by transportation, coastal planning and land use planning. Nonetheless, planning for wastes, which include promoting landfills with methane-capture strategy and waste-reduction developments are completely ignored in all spatial plans. The energy plan sub-component is only considered in spatial plans at the national level, but absent at the state and local level. The state level spatial plan advances in water resources planning, slightly higher than the national level.

IMPLEMENTATION AND EVALUATION

The implementation and evaluation component scores average, with spatial plans at the national level plan covering 62.5% of the indicators, local level plans 50% and state level pelan 25%. The implementation sub-component is advanced at the local level plans, followed by the national and state level plans (Figure 7). The state level plan lacks in setting up timelines for actions and identifies sources of funding. For the sub-component of plan evaluation, only spatial plans at the national level include criteria and policy indicators for plan evaluation, while it is absent at the state and local level.

DO THE SPATIAL PLANS PAY EQUAL ATTENTIONS TO CLIMATE CHANGE MITIGATION AND ADAPTATION?

Collectively, all three levels of spatial plans pay equal attentions to both climate change mitigation and adaptation (Figure 8). Among the three types of responses, spatial plans place more attentions to policies that integrate climate change mitigation and adaptation, accounting for 44% of the total responses. Figure 9 shows the focus of spatial plans at different levels, by standardizing the scores between climate change mitigation, climate change

adaptation, and both mitigation and adaptation. The differences between climate change mitigation and adaptation are not much, ranging from only 2% (national and local level) and 3% (state level). All three levels consistently show emphasis on integration between both climate change mitigation and adaptation. Comparatively, the national level plan is more advanced in mitigation measures due to its attention to the energy aspect. On the other hand, the state level pelan achieves more in adaptation, as a result of its focus on the water efficiency and water supply planning. The almost equal attentions to both responses support the argument that spatial planning can actually coordinate effective mitigation and adaptation responses in an integrated manner through sustainable development policies (Biesbroek et al. 2009).

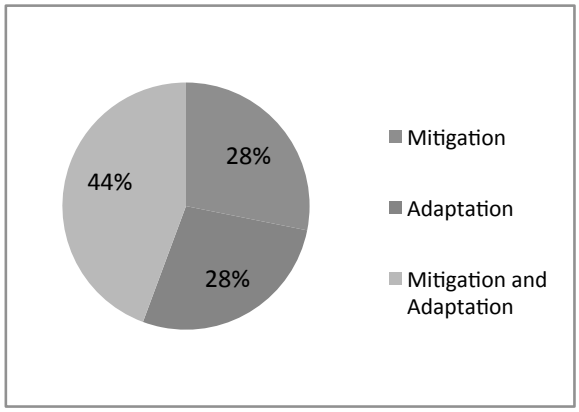

FIGURE 8. Overall planning responses to climate change

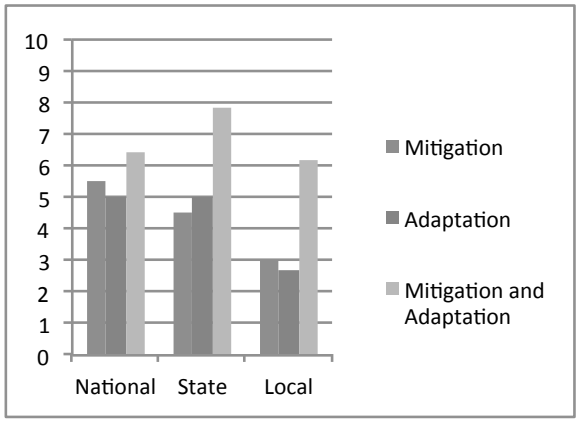

FIGURE 9. Comparison of planning responses to climate change at national, state and local levels

THE GAPS

By referring to figure 2, generally the main gaps for all the spatial plans are in fact and analysis components. This is most apparent at the state and local levels. Besides, the other three plan components: goal, policy and implementation components also need to be strengthened by the reframing of sustainable development. All spatial plans fail to utilize temperature and rainfall intensity data in shaping its future land use developments. The spatial implications of climate change due to the changing of temperature and rainfall patterns also need serious attentions. In terms of analysis, spatial plans at all levels need to be improved on vulnerability assessment as a result of climate change, the impact of local activities which can contribute to climate change, and the application of downscaling climate change scenario in its future land use planning. Additionally, all spatial plans need to include waste planning, which include the promotion of landfills with methane capture strategy and waste reduction development in the future plan review, to effectively responding to climate change. Compared to the others, spatial plans at the national level are lacking in the promotion of green neighborhood and urban design that can reduce urban heat island (UHI) effect. Relatively, spatial plans at the state and local levels are deficient in terms of planning for disaster resistant communities, water demand management and include criteria/ indicators for plan monitoring/evaluation.

CONCLUSION

This paper provides a systematic evaluation of how well spatial plans in the Selangor River Basin response to climate change across various critical components, that define the quality of plans, including facts, analysis, goals, policies and implementation. The first findings reveal that the plan quality is higher at the national level but gradually declining towards the lower tiers. This finding is not surprising because NPP2, with the explicit consideration of climate change, was prepared after the other plans. Nonetheless, the lower plan quality at the local level compared to the state level may need serious attentions, as why some of the state level data, analysis or policies are not being utilized and refined at the local level. The second finding shows that generally all the spatial plans

pay equal emphasis to climate change mitigation and adaptation. This supports the argument that spatial planning provides platforms for coordinating mitigation and adaptation responses through its sustainable development policies (Biesbroek et al. 2009). This paper extends the literature of plan quality evaluation by incorporating the Rational Planning Model as the basis for the plan assessment process. In addition, the assessment involved three levels of jurisdiction compared to the previous studies which mostly focus at only one level of planning. The indicators, plan evaluation protocol and the quantitative assessment of plans can be used by planners in the future to track changes in plans overtime and the degree to which this change leads to improved outcomes. It can also be adapted to the plan evaluation of other river basins, as an input for the preparation of the first generation of climate change integration in spatial planning.

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