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論 文 内 容 の 要 旨

Rapid urbanization in developing countries in Asia is creating a number of challenges. Many of these cities are facing difficulties in providing basic infrastructure and services even to their current inhabitants, when urban population is growing. Climate change is added as a new challenge, with higher temperature, more intense and frequent rainfall, and sea-level rise, among others. Thus, in order to make development achievements effective and sustained, developing country cities need to adapt to climate change. This requires integration of climate change adaptation into development processes, which is commonly referred to as ‘mainstreaming,’ defined as integrating climate change adaptation into development planning, policies, strategies, and projects.

Despite a general agreement on the need for mainstreaming climate adaptation, there is limited research on how successful developing countries and their cities are in mainstreaming and why. This research, therefore, intends to answer four key questions: (i) to what extent are the developing countries in South and Southeast Asia successful in mainstreaming, by developing an analytical framework including factors affecting the success of mainstreaming; (ii) what is the progress of mainstreaming at city level, and what are the key factors in promoting mainstreaming; (iii) how is mainstreaming at project level taking place, and what considerations are needed to make the proposed adaptation measures robust under uncertainties; and (iv) what is the status of mainstreaming in a particular city; and how can the city make its development projects more effective and sustainable through mainstreaming? As to the last research question, flood management systems in Bangkok, Thailand, are analyzed in depth.

Based on a review of literature and characteristics of adaptation, an analytical framework, comprising six factors and two perspectives, for evaluating mainstreaming at country level, is proposed and applied to six least developed countries (LDCs) in South and Southeast Asia, namely Bangladesh, Bhutan, Cambodia, Lao People’s Democratic Republic (PDR), Maldives, and Nepal. The analysis reveals that these countries have different levels of climate adaptation mainstreaming. Bangladesh is considered successful

in mainstreaming, with their adaptation priorities well integrated into development plans, and the development priorities being discussed in the context of climate change adaptation. The level of mainstreaming in other countries is still limited (Lao PDR, Maldives, and Nepal) or minimal (Bhutan and Cambodia). Out of the proposed six factors that would determine the success of mainstreaming, the analysis reveals that four factors are closely associated with the overall level of mainstreaming: (i) coordination among relevant agencies, particularly between the environment ministry, and finance and/or planning ministries; (ii) recognition of the need for mainstreaming; (iii) monitoring and evaluation, and (iv) time compatibility between development plans and adaptation plans.

At city level, no comprehensive data are available to enable comparative analysis on the level of mainstreaming, particularly for developing country cities, but the relevant literature is rapidly growing. Some pioneer cities such as Durban, South Africa, initiated adaptation planning and implementation on their own, but many others, some of which are being supported by development partners, are still in an early stage of planning or implementation of climate change adaptation. Review of the literature identified important determinants to advance mainstreaming, which include (i) a solid knowledge base on climate impact and vulnerability; (ii) leadership and championship; (iii) good governance of local governments; (iv) internal collaboration; and (v) existing problems linked with climate. There is high overall coherence among key factors affecting mainstreaming at country and city levels, accentuated by different approaches and priorities due to scales in question.

Mainstreaming at project level is often termed ‘climate-proofing,’ referring to the explicit consideration and internalization of climate change to deliver intended services of a proposed intervention at acceptable levels over the expected life of the intervention. Climate-proofing does not only mean adjustments in the infrastructure design, but also includes non-structural measures such as institutional and social interventions to ensure long-term service delivery. The review of the seven studies of climate-proofing in developing countries in Asia confirms that quantitative assessments based on downscaled climate projections and impact assessments could help identify adaptation measures with quantitative information on costs and benefits which would be useful for decision-making. Among the four criteria of effectiveness, efficiency, equity, and legitimacy proposed by Adger et al (2005) to evaluate successful adaptation, effectiveness and efficiency have been addressed well in the seven cases, while the assessments are generally weak in terms of consideration to equity and legitimacy. Moreover, the optimal engineering design derived from the assessment may not be robust to deep uncertainties, so an additional analysis becomes necessary.

To further verify effectiveness among the four criteria, another set of four criteria is derived from Hallegatte (2009): (i) no-regret, (ii) reversible and flexible, (iii) safety margins, and (iv) synergies among options. The proposed adaptation options for the improvement of water supply and urban drainage systems in Khulna, Bangladesh (two cases among the seven) are further analyzed to see if they meet these four criteria. While each adaptation option does not always meet all four criteria, consolidated measures as a whole meet all the criteria and are evaluated as robust to uncertainty. This highlights the need to review not only each option individually, but compatibility between options. Institutional

arrangements to ensure collaboration among agencies concerned, with strong leadership and championship, would be a key to make mainstreaming happen in Khulna.

Bangkok, Thailand is studied for the last research question. Mainstreaming in Thailand is considered to be limited, by applying the above country-level framework. The level of mainstreaming in Bangkok is also found to be still limited. However, Bangkok Metropolitan Administration (BMA) initiated the process for developing a climate change master plan. Applying the five key factors for adaptation mainstreaming to Bangkok's status, the following aspects will need further attention: (i) preparing a risk assessment by integrating hazard, exposure, and vulnerability assessments to serve as a solid knowledge base; (ii) involving the public in consultations to solicit public support, ensure equity, and enhance legitimacy in the output; (iii) establish an effective internal collaboration system; and (iv) top-level support and commitment to climate change adaptation. If these issues are addressed adequately, the development of a master plan could be a game changer in promoting mainstreaming in Bangkok.

An assessment of Bangkok's flood management systems, which is the biggest challenge in climate change adaptation in Bangkok, reveals that BMA is implementing key flood risk mitigation measures, and flood management and drainage infrastructure improvement intends to be strengthened to manage a flood equivalent to the devastating 2011 floods. However, no measures explicitly consider climate change, so there is a need to identify and carry out increments to each measure through climate-proofing. Too much focus on structural options needs to be balanced by putting in place more non-structural options that are compatible, such as land-use planning, building codes, and early warning systems, to make overall measures more robust under uncertainty. Institutional arrangements will require transformational adaptation, by establishing a collaborative mechanism among relevant departments in BMA under strong leadership.

The findings of the research will provide important insights on approaches and specific measures to be adopted by the governments of developing countries, their cities, as well as development partners in promoting and supporting the mainstreaming of climate change adaptation.

論文審査の結果の要旨

気候変動は、途上国、とりわけ急速な人口拡大と開発の進む都市部において大きなリスク要因になると指摘されている。本研究では、アジアの開発途上国を対象に、国、都市、開発プロジェクトの 3 つのレベルで、気候変動適応策を総合的に計画・実施するための主流化の課題について分析し、その推進方策について検討したものである。

第一に、国レベルでは、南・東南アジアのバングラデシュ、ブータン、ラオス、モルジブ、ネパール、タイを対象にして国家適応戦略における主流化の状況を分析した。評価指標として、国際的な研究に基づいて、連携、認知度、モニタリング・評価、財政的可能性、実施の経験、時間対応性の 6 つの指標と 2 つの視点を抽出し、それを用いて各国の現状を評価した。対象国のなかでバングラデシュがもっとも進んでいる要因が、国家適応戦略と国家開発計画の時間フレームの同期、援助国の財政的、政策的支援の効果等にあることを見いだした。さらに、関連する府省の連携、政府トップのリーダーシップなどの行政組織における条件も抽出している。第二に、都市レベルでは、広範な文献調査に基づいて、現時点で気候変動適応策を立案している都市はほとんどなく、都市開発計画が気候変動とは別に検討されているという現状認識を得た。これを克服するために、都市・地域レベルの影響評価、首長のリーダーシップ、住民・関係者との連携が重要なことを示した。さらにバンコクにおける防災対策を対象にした現状分析を行い、2011 年の甚大な洪水被害にもかかわらず、気候変動適応の主流化が遅れていることを明らかにすると共に、防災計画における行政部局間の調整に関する提言を示している。第三に、開発プロジェクトレベルでは、バンコク、ホーチミン、マニラ、クルナ、バングラデシュにおけるインフラ整備プロジェクトを分析し、プロジェクト設計における不確実性の取り扱いに課題があることを指摘した。それに対する戦略として、no-regret 戦略、柔軟対応戦略、余裕設計、施策相互の摩擦と相乗効果への考慮等があることを提示した。以上を通して、本論文では、途上国の気候変動主流化の現状を国、都市、プロジェクトの 3 レベルで把握し、それぞれの課題と改善方策を提示している。

気候変動の影響は途上国で厳しく、アジアはその焦点となる地域である。今後、アジアでは人口増加と経済成長を背景にして都市化が一層進むため、長期的な視点で都市開発計画の中に気候変動対策を組み込むことは重要な課題である。本研究は、こうした課題認識を背景にして、国、都市、開発プロジェクトの3つのレベルで、気候変動適応策の主流化について総合的に分析したものであり、アジアを対象にした研究として新規性と有用性が高い。適応策の主流化は、まさに始まりつつある段階であるが、その現状を把握し教訓や改善方策を導いたことは、今後の途上国における政策展開に対して重要な学術的貢献を行うものであると判断されることから、本論文は博士（学術）の学位論文として合格であると判定する。