

学 位 論 文 要 旨

論文題名

Basic study on flood management assessment in Metro Manila, Philippines

(フィリピン・メトロマニラにおける洪水マネジメント評価に関する基礎的研究)

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(学位論文要旨)

Flooding is the most frequent and damaging natural hazard worldwide. The resulting impact of flood disasters on society depends on the economic strength of the affected country prior to the disaster. The larger the disaster and the smaller the economy, the more significant is the impact. This is very clearly seen in developing countries, like the Philippines, where weak economies become much weaker after a devastating flood event. In 2009, tropical storm Ondoy, brought heavy rainfalls that produced destructive floods in the northern islands of the Philippines, leaving inconceivable damages, especially in Metro Manila, which caused the Philippine government to re-evaluate its decades' worth of flood management strategies.

Deliberate strategies for flood damage reduction, as well as environmental protection, may aid a country (or a community) to efficiently manage scarce resources for flood mitigation. Nevertheless, many governments lack an adequate institutionalized system for applying cost effective and reliable technologies for disaster prevention, early warnings, and mitigation, mainly due to lack of systematic and reliable flood management assessment strategies. In Metro Manila, important decision elements, such as stakeholders' perception and environmental protection are often overlooked in the development of sustainable flood mitigation plans. Stakeholders can significantly contribute in achieving the desired level of prevention and protection in flood disaster-prone regions. Knowledge of the local conditions and understanding of the public's perception can significantly help address the prioritization issues involved in flood management planning. However, the integration of the stakeholders' perception in the appraisal of flood management systems has not yet been clearly established. In the case of environmental protection, environmental impact assessment (EIA) can provide a certain level of awareness on the benefits of environmentally sound and sustainable urban development. However, the common practice of EIA in the Philippines is generally qualitative and lacks clear methodology in evaluating multi-criteria systems. A study that deals with flood management assessment in Metro Manila is thus necessary to find solutions that may help cope with these inadequacies.

This study focuses on the following main objectives: 1) to develop a heuristic analytical strategy that helps identify priority concerns in the flood management systems of Metro Manila using a perception-based appraisal, and 2) to develop a systematic and rational evaluation scheme that would help incorporate environmental assessment in the appraisal of flood mitigation measures. To achieve the first objective, an analytical assessment approach was developed to identify and

analyze the flood management gaps using the questionnaire-based stakeholders' perception obtained during the aftermath of the tropical storm Ondoy. For the second objective, a quantitative analytical approach was developed for EIA to further enhance the evaluation process in the planning of flood mitigation projects.

This dissertation is composed of six chapters:

Chapter 1 is the introduction, which contains the background, motivation, and objectives of this study. A comprehensive review of literature and a description of the scopes and methods were presented in this chapter.

Chapter 2 focuses on the performance of the flood management systems in Metro Manila. A brief description of the flood management systems used in Metro Manila, before and during the aftermath of tropical storm Ondoy, was provided. The nature and characteristics of the tropical storm, as well as its effects on the flood management systems, were presented in this chapter. A multi-criteria gap analysis technique was developed to examine the flood disaster risk reduction (FDRR) management systems, which is demonstrated using a questionnaire-based database to obtain an explicit representation of the systems' strengths and weaknesses. In this study, 14 out of 17 municipalities in Metro Manila were investigated. Results revealed that small to medium scale flood management gaps exist within the 14 assessed municipalities.

Chapter 3 further explores the potential of a multi-criteria gaps assessment technique in the evaluation of FDRR management systems in Metro Manila. Perception-based assessment is inherently vague and imprecise, which often operates in a fuzzy environment. To cope with this, a fuzzy-based analytical approach was proposed to handle the uncertainties in the evaluation process of flood management gaps. The new approach is demonstrated using the same database in Chapter 2. The results reveal that the municipal-based FDRR management systems in Metro Manila are insufficient in terms of flood disaster prevention, preparedness, response and recovery. Larger gaps were found in the emergency response mechanism of the disaster preparedness management system.

Chapter 4 deals with the EIA of nine planned structural flood mitigation measures (SFMMs) in Metro Manila. A modified rapid impact assessment matrix (RIAM) technique was proposed to systematically and quantitatively evaluate the socio-economic and environmental impacts of the planned SFMMs. The distribution of impacts of each SFMM was estimated for each environmental component of the 4 environmental categories. Based on the results, most of the negative and positive impacts of SFMMs occur during their construction and operation phases, respectively. The modified RIAM approach provided a clear panoramic view of the environmental impacts of each assessed SFMM.

Chapter 5 presents a new EIA approach that provides enhancement to the modified RIAM technique in Chapter 4. A utility-based assessment approach using the RIAM technique, coupled with a recursive evidential reasoning approach, was proposed to rationally and systematically evaluate the ecological and socio-economic impacts of 4 planned SFMMs in Metro Manila. This new approach quantitatively characterized the overall impact of each of the planned SFMMs which can provide the means for benefit maximization and optimization. Results show that the overall environmental contributions of each of the planned SFMMs is generally positive, which indicate that the utility of their positive impacts would generally outweigh their negative ones. The results also indicated that the planned river channel improvements have higher environmental benefits than the planned open channels.

Chapter 6 presents the overall conclusions and recommendations for the assessment of flood management systems in Metro Manila, including the future research works.

研 究 業 績 一 覧

*印は、本論文に直接関係するものを示す

1. 論文（査読あり）

No.	論文名	掲載誌	巻, 号, 頁	発行年	著者名
1*	Multi-criteria gap analysis of flood disaster risk reduction management in Metro Manila, Philippines	Journal of Japan Society of Civil Engineers, Ser. B1 (Hydraulic Engineering)	No. 68(4) pp. I_109-I_114	2012.2	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa
2*	Environmental assessment of flood mitigation structures in Metro Manila, Philippines using the rapid impact assessment matrix (RIAM) technique	Journal of Japan Society of Civil Engineers, Ser. B1 (Hydraulic Engineering)	No. 69(4) pp. I_7-I_12	2013.2	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa
3*	Gap analysis of the flood management system in Metro Manila, Philippines: A case study of the aftermath of Typhoon Ondoy	International Association of Hydrological Sciences (IAHS) Publication	No. 357 pp. 32-40	2013.2	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa
4*	Environmental impact assessment of structural flood mitigation measures by a rapid impact assessment matrix (RIAM) technique: A case study in Metro Manila, Philippines	Science of the Total Environment	No. 456-457 pp. 137-147	2013.4	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi D.D. Bui
5*	Fuzzy-based gaps assessment of the flood disaster risk reduction management systems in Metro Manila: A retrospective analysis of the impacts of tropical storm Ondoy	Natural Hazards	Submitted	Not decided	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa
6	Hydrogeochemical assessment of groundwater quality during dry and rainy seasons for the two main aquifers in Hanoi, Vietnam	Environmental Monitoring and Assessment	Submitted	Not decided	T.T. Nguyen A. Kawamura T.N. Tong N. Nakagawa H. Amaguchi <u>R.L. Gilbuena</u>
7*	Environmental impact assessment using a utility-based recursive evidential reasoning approach for structural flood mitigation measures in Metro Manila, Philippines	Journal of Environmental Management	Submitted	Not decided	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi

2. 国際会議					
No.	論文名	掲載誌	巻, 号, 頁	発行年	著者名
1*	Gap analysis of the flood management system in Metro Manila, Philippines: A case study in the aftermath of Typhoon Ondoy	Proceedings of the 5 th International Conference on Flood Management (ICFM5), Tokyo, Japan	CD-ROM	2011.9	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi
2*	Assessment of the flood forecasting and warning systems in Metro Manila, Philippines	Proceedings of the IHP Symposium on Extreme Events: "Meteorological Hydrological and Tsunami Disasters: Social Adaptation and Future", Kyoto, Japan	pp. 72-79	2011.10	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi
3*	Water Quality assessment during river channel alteration for flood mitigation in Metro Manila, Philippines	Proceedings of the World Environmental and Water Resources Congress 2012, Albuquerque, USA	pp. 580-591	2012.5	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi
4*	Assessment of management gaps in the flood mitigation and flood preparedness strategies in Metro Manila, Philippines	Proceedings of the 2 nd International Conference on Water Resources, Langkawi, Malaysia	ID: 189	2012.11	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi
5*	Environmental impact assessment of structural flood mitigation measures in Metro Manila, Philippines using an analytical evidential reasoning approach	Proceedings of the 6 th International Conference on Water Resources and Environment Research, Koblenz, Germany	p. 293	2013.6	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina N. Nakagawa H. Amaguchi
6	Temporal changes in the hydrochemical facies of ground water in two main aquifers in Hanoi, Vietnam	Proceedings of the 6 th International Conference on Water Resources and Environment Research, Koblenz, Germany	p. 369	2013.6	T.T. Nguyen A. Kawamura N. Nakagawa H. Amaguchi <u>R.L. Gilbuena</u>

3. 口頭発表

No.	論文名	掲載誌	巻,号,頁	発行年	著者名
1	Comparison of bioactive contents of the different parts of selected ornamental plants	Angeles University Foundation - College of Arts and Sciences Digest	Vol. IV, No.3 pp. 256-276	2004.6	R.R. Bituin I.G.Q Galang <u>R.L. Gilbuena</u> R.V. Tolentino
2	Physico-chemical and bacteriological analysis of water samples obtained from selected in Angeles City	Angeles University Foundation - College of Arts and Sciences Digest	Vol. IV, No.3 pp. 277-304	2004.6	C.A. Arbotante E.M. Bamba R.D. Bundalian C.L. Cunanan M.R.Y. Espino <u>R.L. Gilbuena</u> I.P. Herrera C.D. Liwanag D.J. Manlapaz C.M. Samson P.B. Tagarro R.V. Tolentino P.D. Victoria
3	Phytochemical screening of selected indigenous plants in Zambales	Angeles University Foundation - College of Arts and Sciences Digest	Vol. IV, No.4 pp. 97-111	2005.6	M.R.Y. Espino C.A. Arbotante R.R. Bituin <u>R.L. Gilbuena</u> E.L. Goce I.P. Herrera M.C. Oronce
4	Bioautographic analysis of the different parts of selected ornamental plants	Angeles University Foundation - College of Arts and Sciences Digest	Vol. IV, No.3 pp. 240-255	2005.6	R.R. Bituin I.G.Q. Galang <u>R.L. Gilbuena</u> R.V. Tolentino
5*	Urban flood in the Philippines: An overview of the flood management in Metro Manila sub-basins during and after the experience with TS Ketsana	Proceedings of the 38 th Kanto Branch Annual Conference of JSCE	CD-ROM: II-42	2011.3	<u>R.L. Gilbuena</u> A. Kawamura H. Amaguchi N. Nakagawa
6*	Structural flood mitigation in Metro Manila: Consequences and implications on urban flood and the environment	Proceedings of the 2011 Annual Conference of Japan Society of Hydrology and Water Resources, Kyoto, Japan	pp. 16-17	2011.8	<u>R.L. Gilbuena</u> A. Kawamura H. Amaguchi N. Nakagawa
7	An overview of groundwater quality in Hanoi, Vietnam	Proceedings of the 39 th Kanto Branch Annual Conference of JSCE	CD-ROM: II-16	2012.3	T.T. Nguyen A. Kawamura H. Amaguchi N. Nakagawa <u>R.L. Gilbuena</u>

8*	フィリピン・メトロマニラにおける洪水リスク減災マネジメントの多基準ギャップ解析	第39回土木学会 関東支部研究発表会講演集	CD-ROM: II-41	2012.3	山地秀幸 河村 明 <u>R.L. Gilbuena</u> 天口英雄 中川直子
9*	Rapid impact assessment of structural flood mitigation measures in Metro Manila, Philippines	Proceedings of the 2012 Annual Conference of Japan Society of Hydrology and Water Resources, Hiroshima, Japan	pp. 68-69	2012.9	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa
10*	Environmental sustainability of structural flood mitigation measures in Metro Manila, Philippines	Proceedings of the 2013 Annual Conference of Japan Society of Hydrology and Water Resources, Kobe, Japan	Submitted	2013.9	<u>R.L. Gilbuena</u> A. Kawamura R.R. Medina H. Amaguchi N. Nakagawa

上記のとおり相違ありません。

平成 25年 6月 26日

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※講演も記載すること。著者名は全員記載し、ご本人に下線を引いてください。

ご本人のローマ字入力のお名前も下線をお願いいたします。

主要論文に*など印をつけてください。

【英文の表記について】

英語タイトルの大文字と小文字を研究業績一覧の中で統一すること。

1つの単語が2行にわたる場合は、必ず音節（シラブル）で区切りハイフン（-）を入れて、次の行に送ること。

履 歴 書

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- 1 平成 9年 3月25日 フィリピン科学技術高等学校本校卒業
- 2 平成 9年 5月 1日 フィリピン大学 工学部 化学工学科入学
- 3 平成15年 4月26日 フィリピン大学 工学部 化学工学科卒業
- 4 平成16年11月11日 フィリピン大学 大学院工学研究科修士課程環境工学専攻入学
- 5 平成20年10月10日 フィリピン大学 大学院工学研究科修士課程環境工学専攻修了
- 6 平成22年10月 1日 首都大学東京大学院都市環境科学研究科
博士後期課程都市基盤環境学域入学
- 7 平成25年 9月30日 首都大学東京大学院都市環境科学研究科
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- 1 平成19年7月17日 ウッドフィールドコンサルタント株式会社 入社
- 2 平成22年9月30日 ウッドフィールドコンサルタント株式会社 退社

受 賞 歴

なし

上記のとおり相違ありません。

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