UNIPA Springer Series

Mariano Anderle *Editor*

Innovations in Land, Water and Energy for Vietnam's Sustainable Development

UNIVERSITÀ DEGLI STUDI DI PALERMO

Springer

UNIPA Springer Series

Editor-in-Chief

Eleonora Riva Sanseverino, Department of Engineering, University of Palermo, Palermo, Italy

Series Editors

Carlo Amenta, Department of Economics, Management and Statistics, University of Palermo, Palermo, Italy

Marco Carapezza, Department of Human Sciences, University of Palermo, Palermo, Italy

Marcello Chiodi, Department of Economics, Management and Statistics, University of Palermo, Palermo, Italy

Andrea Laghi, Department of Surgical and Medical Sciences and Translational Medicine, Sapienza University of Rome, Rome, Italy

Bruno Maresca, Department of Pharmaceutical Sciences, University of Salerno, Fisciano, Italy

Giorgio Domenico Maria Micale, Department of Industrial and Digital Innovation, University of Palermo, Palermo, Italy

Arabella Mocciaro Li Destri, Department of Economics, Management and Statistics, University of Palermo, Palermo, Italy

Andreas Öchsner, Department of Engineering and Information Technology, Griffith University, Southport, QLD, Australia

Mariacristina Piva, Department of Economic and Social Sciences, Catholic University of the Sacred Heart, Piacenza, Italy

Antonio Russo, Department of Surgical, Oncological and Oral Sciences, University of Palermo, Palermo, Italy

Norbert M. Seel, Department of Education, University of Freiburg, Freiburg im Breisgau, Germany

The **UNIPA Springer Series** publishes single and co-authored thematic collected volumes, monographs, handbooks and advanced textbooks, conference proceedings, professional books, SpringerBriefs, journals on specific issues of particular relevance in six core scientific areas. The issues may be interdisciplinary or within one specific area of interest. Manuscripts are invited for publication in the following fields of study:

1- Clinical Medicine;
2- Biomedical and Life Sciences;
3- Engineering and Physical Sciences;
4- Mathematics, Statistics and Computer Science;
5- Business, Economics and Law;
6- Human, Behavioral and Social Sciences.

Manuscripts submitted to the series are peer reviewed for scientific rigor followed by the usual Springer standards of editing, production, marketing and distribution. The series will allow authors to showcase their research within the context of a dynamic multidisciplinary platform. The series is open to academics from the University of Palermo but also from other universities around the world. Both scientific and teaching contributions are welcome in this series. The editorial products are addressed to researchers and students and will be published in the English language.

More information about this series at http://www.springer.com/series/13175

Mariano Anderle
Editor

Innovations in Land, Water and Energy for Vietnam's Sustainable Development

UNIVERSITÀ DEGLI STUDI DI PALERMO

Springer

Editor
Mariano Anderle
Embassy of Italy to Vietnam
Hanoi, Vietnam

ISSN 2366-7516 ISSN 2366-7524 (electronic)
UNIPA Springer Series
ISBN 978-3-030-51259-0 ISBN 978-3-030-51260-6 (eBook)
https://doi.org/10.1007/978-3-030-51260-6

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2021
This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The recent steep economic growth of South East Asia, and particularly of Vietnam, poses challenges to land, water and energy management as well as to urban environment and nature protection. In the last years, the Italy–Vietnam research cooperation supported by the governments of the two countries has explored these hot topics underlining the existing close linkages between the various sectors.

The aim of this manuscript is thus to show what the most innovative trends in land, water and energy management are, using also advanced information and communication technologies developed by Italian and Vietnamese researchers.

Vietnam is a fast-growing country with an average gross domestic product (GDP) increase each year of around 7%. At the same time, investments in higher education, research and industrial innovation have been increased.

Fundings in research and development are around 0.40% of the GDP. In respect to all other national public spending, the amount dedicated to science and technology is around 1.6% with a workforce involved in research of 700 full-time researchers per million inhabitants.

Alongside research, Vietnam also invests in the higher education sector. Indeed, estimates by the Ministry of Education and Training in August 2018 show a total of 0.5% of the GDP for that sector.

Italy enjoys Vietnamese's respect and recognition. This recognition, where properly oriented, allows the research system to be focused on areas advantageous for the development of economic and commercial partnership between the two countries. Particularly relevant in this sense are the applied researches in the agri-food, medicine and health, biotechnologies and genomics, nanotechnologies, energy and environment, physics and space.

Moreover, the mature competences of the Italian research system, accustomed to international visibility, have backed up Vietnamese researchers and allowed them to enter in scientific organizations promoting research dissemination.

Bilateral cooperation in science and technology between Italy and Vietnam is regulated by an Agreement on Scientific and Technological Cooperation, signed in Hanoi on January 5, 1992. Since then, executive protocols for scientific and technological cooperation have supported, on a regular deadline schedule, the

implementation of bilateral projects. The last one, valid for the period 2017–2019, was signed in Rome in November 2016 between the Ministry of Science and Technology of Vietnam and the Ministry of Foreign Affairs and International Cooperation of Italy. In the framework of this executive protocol, a call for bilateral projects is typically launched and a few projects are selected and financed. During this last triennium—with the seal of the "1st Italy–Vietnam conference on science and technology-bilateral research experiences and projects: results and perspectives" held in Hanoi on November 17, 2017, and organized by the Embassy of Italy in Vietnam with the collaboration of Vietnamese Ministry of Science and Technology—all of the funded projects have shown a very intense activity in terms of scientific results achieved, efficacy of the bilateral collaborations and potential impact. It is also evident how the bilateral scientific activities between the two countries have indeed acquired a great visibility, increasing the creation of international networks, and, ultimately, eased the access to funds.

In this scenario, there are more than 100 signed and operative Memorandum of Understanding between Italian and Vietnamese scientific and higher education institutions, while the dissemination activity on the research topics ranges from local events to international conferences.

This book, comprising the most important scientific projects and results of the bilateral cooperation in the last three years, has been structured in three main sections: Environment, Climate Change and Land Management in Vietnam; Energy for Vietnam; and Cities and utilities in Vietnam.

In the first part, Environment, Climate Change and Land Management in Vietnam, a few chapters concentrate on water systems in Vietnam, including rivers and seacoasts. An efficient flood forecasting model shows the weakness of the delicate ecosystem of the rivers in China, Laos and Vietnam. The model allows flood control downstream, to prevent catastrophes in the heavily populated Northern Delta of the Red River and close to the Ca river, the Vinh area, both experiencing rapid development and increasing urbanization.

The worldwide famous Ha Long Bay is also a weak marine ecosystem, severely jeopardized by intensified tourism and climate change effects. The bilateral research puts into evidence the unique richness of this area witnessed by sedimentological and microfossil content of sediment samples.

Other studies in the area of agri-food explore new ways to fight against rice pathogens. Italy is indeed the largest Japonica rice producer in Europe, and Vietnamese rice belongs to the same variety. Both countries are under biotic and abiotic stresses related to drought, climate changes and pests.

Finally, the land and environment management with a Global Navigation Satellite System (GNSS) created within a framework of bilateral scientific cooperation is presented. The chapter describes the GNSS technology that easily allows precise determination of position, velocity and time (PVT) enabling hundreds of different applications in almost any field of modern life, from transportation to logistics, from surveying to disaster management, from natural resources monitoring to services for citizens.

Second part, Energy for Vietnam, is focused on energy and water. The steep growth of the country is a great challenge for the Vietnamese government that has to face the reinforcement of the electrical infrastructures. An overview about the measures the Vietnamese government is planning to take in the medium-short term is provided together with their impact on the Vietnamese power system. In this scenario, high-voltage direct current (HVDC) transmission is considered to reinforce the connections with China and other neighbouring countries.

New architectures for renewable energy installation, such as microgrids, are also considered. These being analyzed both as urban energy districts and as islanded systems.

In the same part, the reader is given a brief overview of the conventional biological wastewater treatment (WWT) plants and processing steps, with a specific focus on their solid residues such as sewage sludge. The latter could be valorized by anaerobic digestion (AD), converting it into valuable commercial products such as biogas and fertilizers, applying hence the important concept at the base of circular economy.

Finally, third part, Cities and Utilities in Vietnam, is focused on cities. Urbanization is also a consequence of the steep economic growth of the country, and a study on the urban morphology of the Vietnamese metropolis, with special attention to Hanoi and Ho Chi Minh City, is provided. The same technology proposed for environment and land management is in this section considered for road applications, enabling consistent improvements in traffic management and monitoring. According to the proposal, in Vietnam, public transport vehicles and lories should be equipped with black boxes to enable traffic management and control. Other contributions focus on the telecommunication infrastructures. In countries like Vietnam, where wired communication systems are not sufficient for satisfying the continuously increase of user demand, the development of a highly efficient wireless communication network is mandatory. A good solution to this problem is represented by the 5th-generation mobile network or simply 5G in which the design of antennas is a strategic element.

Hanoi, Vietnam Mariano Anderle

Contents

Environment, Climate Change and Land Management in Vietnam

A Hydrometeorological Flood Forecasting Chain for the Red and Ca rivers (China, Laos and Vietnam) Part I—Investigated Areas and Model Setup 3
Roberto Ranzi, Lê An Ngô, Thanh Tùng Hoàng, Hoàng Sơn Nguyễn, Stefano Barontini, Giovanna Grossi, Baldassare Bacchi, Andrea Buzzi, Silvio Davolio, Oxana Drofa, Piero Malguzzi, Lê Thuy Đỗ, Van Hoa Võ, and Minh Cát Vũ

A Hydrometeorological Flood Forecasting Chain for the Red and Ca Rivers (China, Laos and Vietnam) Part II—Applications and Results 15
Lê An Ngô, Thanh Tùng Hoàng, Hoàng Sơn Nguyễn, Minh Cát Vũ, Lê Thuy Đỗ, Van Hoa Võ, Silvio Davolio, Oxana Drofa, Stefano Barontini, and Roberto Ranzi

Ha Long Bay (Viet Nam) Sediment and Microfaunal Background Assessment for Future Monitoring Actions 27
Alessandra Negri, Cong Do Thung, Caterina Morigi, Anna Sabbatini, Simona Giunta, Antonietta D'Agnessa, Vu Tran Ngoc Cam, and Massimo Sarti

Marine Biodiversity in Ha Long Bay and Cat Ba Archipelago (VietNam) 37
Do Cong Thung, Nguyen Dang Ngai, Dau Van Thao, Nguyen Van Sinh, Dao Minh Dong, Barbara Calcinai, and Carlo Cerrano

The Ha Long Bay Marine Ecosystem. An Unprecedented Opportunity for Evolutionary Studies on Marine Taxa 45
Carlo Cerrano, Giorgio Bavestrello, Marco Bertolino, Maurizio Pansini, Laura Núñez-Pons, Massimo Sarti, Do Cong Thung, and Barbara Calcinai

Pathobiome Studies as a Way to Identify Microbial Co-operators and/or Antagonists of the Incoming Plant Pathogen 53
Cristina Bez, Hang Dinh Thuy, Minh Nguyen Hong, Iris Bertani, and Vittorio Venturi

Sustainable Methods to Control *Pyricularia oryzae*, the Causal Agent of Rice Blast Disease 67
Luca Sella, Van V. Vu, Alessandra Quarantin, Rocco Caracciolo, Rakshita Govind, Angela Bolzonello, Silvio Tundo, Marta De Zotti, Francesco Favaron, Hoang D. Nguyen, Quynh L. Le, Trung T. Nguyen, Le T. Do, and Hung M. Nguyen

Collaborative RTD for Precise and Reliable GNSS Based Positioning for Land Management 83
Tung Hai Ta, Vinh The La, Hiep Van Hoang, Matteo Vannucchi, Gabriella Povero, and Gustavo Belforte

Energy for Vietnam

Sustainable Energy Supply in Vietnam 97
Eleonora Riva Sanseverino, Ninh Quang Nguyen, Gaetano Zizzo, and Rossano Musca

Challenges and Opportunities for Renewable-Based Microgrids Integration in Vietnam 109
Eleonora Riva Sanseverino, Quynh Thi Tu Tran, Binh Doan Van, Hang Thi Thuy Le, and Ninh Nguyen Quang

Study of Interconnections in Vietnam Power System with Asynchronous Back to Back HVDC Links 129
Tran Quoc Tuan, Le Quoc Anh, Nguyen Van An, Duong Viet Duc, and Nguyen H. Long

The Bioenergy-Fertilizer Nexus: A Challenge Achievable from Municipal Wastewater 143
Enrico Camelin, Giulio Cristina, Elisabeth Simelton, Debora Fino, and Tonia Tommasi

Cities and Utilities in Vietnam

The Last 150 Years of Urban Mutations in Hanoi: An Investigation About Form and Morphology of the Vietnam's Capital City 169
Matteo Aimini, Ngyuen Dang Giang, and Do Binh Minh

Water Resources Planning and Management in a Changing Climate and Society 197
Andrea Castelletti, Matteo Giuliani, and Rodolfo Soncini-Sessa

GNSS-Based Solutions for Road Applications in Vietnam 217
Hiep Van Hoang, Thuan Dinh Nguyen, Tung Hai Ta, Gabriella Povero, and Micaela Troglia Gamba

Blockchain for Smart Cities: Applications for IoT and Video Surveillance Systems 227
Pierluigi Gallo, Uy Quoc Nguyen, Suporn Pongnumkul, and Giorgia Barone

Innovative Antennas for Next Generation of Communication Systems in Vietnam 249
Andrea Massaccesi, Michele Beccaria, Ho Manh Linh, Nguyen Huu Trung, Nguyen Khac Kiem, and Paola Pirinoli

Optimization Strategies for Efficient Antenna Design 267
Michele Beccaria, Ho Manh Linh, Andrea Massaccesi, Alessandro Niccolai, Nguyen Huu Trung, Nguyen Khac Kiem, Riccardo Zich, and Paola Pirinoli