Cases on the Diffusion and Adoption of Sustainable Development Practices

Helen E. Muga
University of Mount Union, USA

Ken D. Thomas
Auburn University, USA

Information Science
REFERENCE

Managing Director: Lindsay Johnston
Editorial Director: Joel Gamon
Book Production Manager: Jennifer Yoder
Publishing Systems Analyst: Adrienne Freeland
Development Editor: Austin DeMarco
Assistant Acquisitions Editor: Kayla Wolfe
Typesetter: Christina Henning
Cover Design: Nick Newcomer

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Cases on the diffusion and adoption of sustainable development practices / Helen E. Muga and Ken D. Thomas, editors.
p. cm.
Includes bibliographical references and index.
Summary: "This book is a collection of case studies on the concepts and theories of successful sustainable practices as well as identifying key mechanisms and strategies that have allowed the successful diffusion of these practices into communities, regions and nations around the world"--Provided by publisher.
ISBN 978-1-4666-2842-7 (hardcover) -- ISBN 978-1-4666-2843-4 (ebook) -- ISBN 978-1-4666-2844-1 (print & perpetual access) 1. Sustainable development--Case studies. I. Muga, Helen E., 1977- II. Thomas, Ken D., 1982-
HC79.E5C3744 2013
338.9'27--dc23

2012032803

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Editorial Advisory Board

List of Reviewers

Table of Contents

Section 3
Environmentally Responsible Sustainable Development

Foreword

Human civilization in its current form exacts a heavy toll on the environment. We know, for example, that a significant fraction of the world's accessible fresh water supply has been contaminated by human activities; roughly one-sixth of the global population lacks access to safe drinking water. Many of the temperate forests around the globe have been cleared to provide land for food production, resulting in loss of habitat, depletion of nutrients from the soil, and erosion. Marine ecosystems have been altered by overfishing, threatening entire populations of fish and other sea life. And we increase the risk of major changes in climate by pumping carbon dioxide and other greenhouse gases into the atmosphere. These impacts have a direct bearing on our livelihood: We depend on ecosystem services, yet we continue to destroy ecosystems providing these services.

Despite widespread belief that the current trajectory is likely to cause hardship for future generations, we have not made great strides in moving toward a sustainable civilization. This is true both in developed countries where per capita resource consumption is highest and in the developing world where the environmental impact of each person is much less. In developed countries, people are reluctant to give up the luxuries of life they have worked hard to obtain. Persuading millions of the wealthiest people to live in more modest homes, purchase more modest cars, and travel less could reduce environmental damage considerably, but we don't know how to accomplish this in a free society with the current economic and political systems. In the developing world, people are eager to improve their lifestyles even if there is associated environmental damage, especially when wealthy nations have been enjoying better lifestyles at the expense of the environment for decades. And in the poorest countries, human survival on a day-to-day basis must have the highest priority. Furthermore, in countries rich and poor, persuading political and corporate leaders to make unpopular decisions that reduce environmental impact has been shown to be extremely difficult.

There are diverse opinions on how best to move society toward eco-friendly activities, but many authorities feel that we need to achieve a combination of changes. Examples include improved technologies with higher efficiencies, incentives for people to change their behavior to reduce resource consumption and waste disposal, and major changes in the design of communities.

This important and timely volume is a major contribution to understanding one vital aspect of movement toward sustainable development, namely how changes are adopted by society and diffuse through society. Whether we are talking about a new technology, activity, or community design, somehow society must accept and adopt the change. The way change is accomplished can impact how quickly it diffuses through a region. The individual chapters here offer several examples of this, and a look at the chapter topics illustrates the point.

One of the most important concerns for the future, namely food production, is addressed in a chapter on "aquaponics" or year-round indoor agriculture and fish production in cold climates. A chapter on public health describes a new program for producing and distributing antiretroviral drugs for the Human Immunodeficiency Virus (HIV); the new program is serving as a model for addressing this serious health problem around the world. Another chapter on public health describes new methods for adopting wireless technology that can assist health care providers.

Climate change mitigation and adaptation are the focus of several chapters reporting specific activities. For example, cities are improving their public transit systems to reduce the use of private automobiles and associated carbon emissions. Vulnerable coastal communities are being helped through interventions that enable the population to better manage storm surges, sea level rise, and limited availability of freshwater. Installation of hydrology-meteorology sensor networks can help water resource managers optimize water use as the climate changes, and inexpensive treatment methods such as biosand filters can improve the quality of the water reaching domestic users. Some environments pose special challenges: Island nations are increasingly dependent on rainwater harvesting and water conservation, and methods for promoting the diffusion of rainwater harvesting throughout island populations are becoming important. In addition, studies of human perception of climate change are helping us increase rates of adoption of new technologies for adaptation and mitigation.

Other chapters in this volume deal with construction of housing and infrastructure in developing countries. As with new technologies for coping with climate change, new methods of construction are available but their rates of adoption are slow; efforts are being made to promulgate these construction technologies more quickly to reduce continuing ecological damage. One example is efficient design and construction of earth homes, which make good use of available materials; earth homes are occupied by more than a third of the world's population. Also related to the sustainable use of resources is the attempt of government agencies to develop sustainability metrics for mining companies. One of the chapters discusses how such efforts can promote better safety and health records, as well as a reduction in environmental damage caused by mines.

Small communities in rural areas of developing countries often lag behind urban areas in the same countries in terms of sustainable development. Chapters in this book explore ways to help such communities. For example, off-grid renewable energy can be produced far from cities.

Education is vitally important for enhancing rates of adoption and diffusion of sustainable development methods. One chapter focuses on communicating principles of sustainability to underserved urban communities and the role of community structure in the success of these efforts.

Finally, there are several chapters on effective reporting of sustainability efforts by companies, along with certifications that demonstrate compliance with standards for sustainability. Although these certifications are valuable, efforts are needed to enable small companies to become certified as well as larger companies that can more easily afford it.

Overall, the chapters of this book describe key global problems and solutions leading to sustainable development, along with examples of ways to enhance the adoption of many of these solutions. Every chapter includes one or more case studies that show how people are directly addressing real-world problems.

Ken Thomas and Helen Muga are to be congratulated for putting together an outstanding volume that is loaded with valuable content. This book is a must-read for individuals who want to know what is being done and what can be done to enhance the rate of transition to a more sustainable society. The book is sure to be an important reference as society experiments with ways to accomplish this great transition.

Cliff I. Davidson
Syracuse University, USA
August 17, 2012

Cliff Davidson *is the Thomas and Colleen Wilmot Professor at Syracuse University in Syracuse, NY. He currently holds appointments in the Civil & Environmental Engineering Department and at the Syracuse Center of Excellence in Environmental & Energy Systems. He is the founding Director of the Center for Sustainable Engineering. Davidson received his BS in Electrical Engineering from Carnegie Mellon University and his MS and PhD in Environmental Engineering Science from the California Institute of Technology. He was on the faculty at Carnegie Mellon in the Departments of Civil & Environmental Engineering and Engineering & Public Policy for 33 years before coming to SU. He served as President of the American Association for Aerosol Research and is active in several professional organizations. He has written/edited several books and over 100 journal papers. He has led environmental monitoring campaigns in the Himalaya Mountains of Nepal, the Greenland Ice Sheet, and U.S. National Parks, as well as in rural and urban areas within the U.S. His interests span a variety of topics in air quality, water resources, sustainable development, and engineering education.*

Preface

THE ROLE OF DIFFUSION AND ADOPTION IN SUSTAINABLE DEVELOPMENT

Overview of Sustainable Development and its Diffusion and Adoption into Society

Increased population growth, environmental emissions, water use, energy use, and consumption of various natural resources are some of the drivers that contribute to the current global challenges of rising sea-level, increased frequency and intensity of disasters, increased poverty, and increased health issues – all intricately linked directly and indirectly. Such challenges have been, and continue to be, addressed by society in various ways. For example, the use of alternative energy to reduce environmental emissions, the recycle and reuse of waste materials to reduce society's consumption of natural resources, the recycle of water to reduce the withdrawal dwindling freshwater supplies, and better drug delivery systems to address health. This book explores various innovative sustainable practices inclusive of improved products, processes, services, policies, and organizational and management strategies that have been diffused and integrated into the various facets of society across the globe. The unifying theme of the chapters presented herein is based on various theories, concepts, and practices of diffusion adoption that address sustainable development. This preface presents are brief overview of sustainable development and the theory of diffusion and adoption.

Sustainable development as defined by the World Commission on Environment and Development (WCED) (1987) is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987)." Sustainable development and sustainability have been used interchangeably over the years. While there is no consensus on the definition of sustainability, what is clear is that it strives for the maintenance of economic, environmental, and societal well-being of all individuals, communities, and the environment (Muga & Mihelcic, 2008). Furthermore, it recognizes the need to de-

sign human and industrial systems that ensure the proper use of natural resources to support current and future generations without adverse impacts on social conditions, human health, and the environment (Mihelcic et al., 2003). One of the key aspects of this definition is the need for a balance and/or integration of economic, environmental, and social aspects in decision-making. Take the example of the built environment. The built environment consists of all types of buildings such as houses and shops, together with engineering works such as roads, treatment plants, storm-water management systems, bridges, power generation facilities, and other civil infrastructures that support and enable human activity and urbanization. Water and wastewater treatment facilities and storm-water management systems are designed to protect human lives, other civil infrastructures, and the environment by removing and/or reducing pollutants/contaminants. Power generating facilities enable human activity, industrial processes, and transportation to be possible and also sustain society. Transportation systems including roads and bridges are the "veins" or "conduits" that provide accessibility to goods and services from the natural and built environment and maintain and/or improve human well-being.

Air, land, and water are considered natural systems and are intricately linked to the civil infrastructures/urban system that support human activity and, most importantly, urbanization. These systems are dynamic and complex systems of dependent and independent interactions between humans, the natural environment, the physical infrastructure, and the economy. Human activities such as withdrawal and/or utilization of resources from nature to sustain population growth, urbanization, human well-being, and engineered systems all give rise to environmental, ecological, and socioeconomic consequences that impact these systems. These consequences (e.g. carbon dioxide emissions resulting in increased temperatures and sea level rise and ultimately infrastructure damage due to storms) through positive or negative feedback loops can vary across space, time, geographical, and demographic differences. Given the complexity and the dynamics of the human and natural systems, decision-making that address various impacts should be approached with a holistic, systematic approach that considers economic, environmental, and social constraints. Similarly, research into these complex systems and their impacts should be approached from a multidisciplinary and interdisciplinary perspective that has social scientists, natural scientist, and engineering working together towards a solution. Studying them separately by social scientists, natural scientists and engineers do not reveal the complex patterns, processes and subsequent impacts that may otherwise be evident if the human-natural system were studied from an integrated, holistic, systematic perspective. While this may be difficult to execute, it is possible to reduce the problem into smaller parts (allowing each discipline to evaluate them separately for their environmental, social, and economic impacts), then appropriately reconnecting them within a systems context – a 'sum of all the

parts' approach. A study within the 'smaller parts' approach needs to be able to utilize an integrated method of assessments that allows one to evaluate the social, environmental, and economic dimensions of a solution. As such systematic methods such as an *integrated framework* of Life Cycle Assessment (LCA), Life Cycle Cost Analysis (LCCA), and indicators are valuable tools and have been used in various studies (e.g. Muga & Mihelcic, 2007; Muga & Mukherjee, 2009; Mukherjee and Muga, 2010) to evaluate the environmental, economic, and social impacts. LCA, Economic-Input Output Model (EIO-LCA), and Simapro are tools that can be used to evaluate the environmental impacts of a given product, process, activity/service at various life stages (raw material extraction, manufacturing, distribution, use, and disposal). With LCA/EIO-LCA/Simapro, one can determine the environmental outputs for, for example raw materials that are used to build a commercial property. These tools can also be used to evaluate the outputs from various energy sources used during the life of the facility. LCA/EIO-LCA/Simapro enable researcher and practitioners to identify what stage of a product/process' life significant environment emission occur and where improvements can be made. They are useful tools in aiding decision-making.

Since the advent of sustainability/sustainable development and the development of various assessment tools, a plethora of sustainable practices such as improved products, processes, services, policies, and organizational and management strategies have since been developed, diffused, and integrated into the various facets of society. For example, at the global level, organizations such as the United Nations and the World Bank strive for the improvement of the lives of individuals in struggling economies of the Global South. At the country or national-level, practitioners and policy-makers strive for the use of alternative energy use, alternative building materials, access to clean water, and the use of technologies that reduce or capture carbon dioxide emissions. At the community or household level, especially in the Global South, there is repurposing of items to extend usefulness, teaching of community members to conserve resources and be thrifty while diffusing vital survival skills of sustainable practices to the youth. At the educational institutional-level, educators strive to incorporate the theories, concepts and application of sustainability into their curriculum. Yet how much of these innovative practices have been diffused and adopted into society has remained unexplored, and if it has been, only to a minimal extent. The dissemination of successful sustainable practices across the globe would allow other concerned individuals to assess, modify, and/or integrate these practices into their particular settings. How effectively these sustainable practices diffuse and are adopted into society is critical to addressing global challenges that today's and future society will face.

Innovation coupled with the concepts and theories of sustainability and/or sustainable development present a way of addressing current global challenges. Innovation and sustainability go hand in hand. Innovations and the development of new technol-

ogy provide a way for humans to improve their lives (social progress) through better, smarter ways of conducting their activities. According to Nidumolu, Prahalad, and Rangaswami (2009), sustainability is now the key driver of innovation. Innovation has been defined as "the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (Baregheh, Rowley, and Sambrook 2009). For innovation and sustainability/sustainable development to be an effective mechanism for addressing current and future global challenges, the concept of diffusion and adoption needs to also be considered. Without this, sustainability cannot be fully embedded and integrated into society. Diffusion is "the process in which innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003). In other words, it is the spread of an idea over time. The key factors in enabling spread of innovations and sustainability include: (1) The relative advantage – how much better one idea/ innovation is considered over another, (2) Compatibility with existing values and practices – how this innovation fits in with a person's belief, norms, and practices, (3) Simplicity and ease of use – how easy it is to comprehend and utilize the innovation, (4) Trialability – trying out the innovation before considering adoption, (5) Observable results – if there are visible results of the innovation. Innovations with visible, positive results within a certain time period are more likely to be adopted (Rogers, 2003).

It should also be noted that in addition to the above aspects of diffusion and adoption, social networks through peer-peer conversations and peer networks play a critical factor in whether a sustainable product, process, activity, or policy becomes adopted. The behavior of peers in a social network changes over time due to change in the mental models of individuals. As time progresses, rumors/ knowledge/ information self-organizes and diffuses in a social space in the form of consolidation, clustering, increased correlation, and continuing diversity. This in turn impacts the mental models of individuals. Increased consolidation, clustering and correlation within a group cause individuals to shift their mental models from susceptible to infected, resulting in the adoption/belief of the idea. As a group continues to self-organize over time, the mental models of individuals within a particular network become completely saturated with believers/adopters of the rumor, idea, or knowledge. The change in mental model of an individual has direct impact on whether they adopt or reject the idea. A faster diffusion of an idea leads to faster adoption rates with a network. Slower diffusion of an idea/rumor leads to slower adoption rate. Rogers (2003) categorized these adopters into several distinct categories with respect to their propensity to adoption. Innovators are those individuals who have a very high propensity to adopt a product before the rest of society does. Behind the innovators are the early adopters who join the innovators when the benefits

become apparent. Next are the early majority, who adopt when there is solid proof of the benefits. They are followed by the late majority, who are adverse to risk and uncomfortable with anything new. The last group of adopters is the laggards, who resist till the end because of the high risk that they place with adopting a particular product or behavior. Understanding the diffusion and adoption process, social networks, behavioral change, and the mental models of individuals is important to the spread of sustainability across the globe.

Objectives of the Book

Considering the current global challenges of the 21st century, there is an urgent need for practitioners, policy-makers, educators, and various stakeholders to contribute to the reduction and/or mitigation of these challenges. Innovative sustainable practices such as improved products, processes, services, policies, educational reform, and organizational and management strategies have the potential to reduce carbon dioxide emissions, excess consumption, and improve the quality of lives of individuals. How effectively and rapidly these innovative sustainable practices are diffused and adopted into society is critical to addressing the 21st century's global challenges.

The overarching objective of this book is to provide the target audience with the concepts, theories, and case studies of successful sustainable practices across the globe. The chapters presented herein strive to identify and present key mechanisms and strategies that have enabled the successful diffusion of such practices into communities, region, and nation across the globe.

The book is timely as professionals, researchers, educators, and leaders pursue innovative solutions to climate change, population growth, resource scarcity, water scarcity, food scarcity, poverty reduction, improved health, universal education, sustainable infrastructure, environmental health, and disaster planning and management. Sustainability-related questions addressed in this book include:

- How do we design sustainable engineering systems that address that utilize alternative energy sources?
- How do we design and advance innovative technology that is energy efficient and produces fewer greenhouses gas emissions?
- What policies/strategies are in place are successful in the diffusion of sustainable technologies into society?
- How do success stories of adoption of sustainable practice influence policy reform at the local, national and/or international level?
- What are the cost savings to a corporation, community, state or country after successfully leading a diffusion and adoption campaign to promote a sustainable practice?

- The success of the diffusion and adoption of any sustainable practice depends on social acceptance and 'buy-in' which are both highly dependent on marketing. What are some of the best proven marketing tactics to promote diffusion and adoption of sustainable practices by political, cultural and/or geographical boundary?
- How do we quantitatively measure adoption and diffusion of sustainable practices?
- In the case of diffusion and adoption of sustainable practices in small communities/villages of developing countries that are led by intervention expeditions from the Global North, what measures are put in place to allow for continued adoption after interveners leave? What checks and balances are there that the small community is actually carrying out the practices sustainably after the experts leave?
- How do we evaluate the impacts of sustainable practices given demographic population explosion and extreme hydrologic cycle (droughts and floods) and altered storm patterns due to climate change? What methods are available that quantify the various impacts.

Scholarly Value and Impact of Book

The need to innovate to meet current and future global consumption amongst other global challenges has professionals, decision-makers, scientists, engineers, and other stakeholders turning to sustainable practices as a way of doing business. Businesses are continuously looking for ways to reduce cost, make their products more efficiently, reduce their environmental footprint, and comply with increasingly stringent environmental regulations. In the construction industry, engineers are continuously looking for alternative, environmentally safe, construction materials. This endeavor is more pronounced in developing nations, where there is a push to build infrastructure, e.g. houses, from locally available, indigenous materials such as bamboo. In the energy sector, relevant stakeholders strive for the diffusion and use of alternative energy such as solar panels, wind-turbines, and geothermal as a way of reducing carbon dioxide and reliance on fossil fuel. In academic institutions, educators are striving to incorporate sustainability concepts, theories, and case studies into their curriculum. In essence, sustainable practices are becoming the norm in today's society. But the effective and rapid diffusion and adoption of successful sustainable practices is critical in stabilizing and/or reducing current global trends of excessive, unsustainable consumption that is threatening the fabric of future generations and most importantly contributing to today's ever-increasing climate change disasters. Given today's global challenges, the theme of diffusion and adoption of sustainable practices is an important theme, and one that requires an in-depth discussion from various stakeholders from across the globe.

Because the concepts and theories of sustainability are so broad, it overlaps various disciplines. The materials covered in the book expand on the fields of the social sciences, engineering, sciences, and business. Some of the aspects that the chapters in this book attempt to expand on include:

- The impacts of cultural, political, and societal dimensions on the diffusion and adoption of sustainable practices across the globe. Of importance is the identification of key mechanisms and strategies that worked and those that failed. Do these mechanisms differ from region to region? Are there some similarities or differences in why adoption works in one region and not in others?
- Incorporation of cultural aspects into a design, process, technology, or activity is important if it is to be transferred and implemented/used in a different geographical setting. In terms of cultural impact, authors expand the understanding of cultural barriers to diffusion and adoption of sustainable practices and ways of overcoming them.
- Cultural and political aspects play a tremendous role in the successful adoption and diffusion of sustainable practices, especially in the developing world. Authors shed light into the role of government/government policies in promoting adoption of sustainable practices.
- Diffusion and adoption is a top-down and bottom-up process. Social issues across the globe can and have the potential to either facilitate or impede the diffusion and adoption of sustainable practices. Authors explore the social networks (of key stakeholders) that facilitate diffusion and adoption sustainable practices and evaluate the role of education. All social issues will be delved into in consideration of a society's culture and politics.
- Analyses of the diffusion and adoption of sustainable practices (design, products, processes, technologies, policies) into various businesses and its role in a company's triple-bottom line. Does it pay to incorporate sustainability concepts and principles into a business? Or do the costs of being sustainable outweigh the benefits?

Target Audience

This book is relevant to professionals, researchers, educators, and leaders in various sectors of society interested in the field of sustainable development, sustainability, and diffusion and adoption. The book is timely as professionals, researchers, educators, and leaders pursue innovative solutions to climate change, population growth, resource scarcity, water scarcity, food scarcity, poverty reduction, improved health, universal education, sustainable infrastructure, environmental health, and disaster planning and management. Since sustainability is a multidisciplinary subject,

the information contained in this book is useful to practitioners, researchers, and educators in the various disciplines of the social sciences, sciences, engineering, and business. The book provides insights into the concepts, theories, mechanisms and strategies of case studies that enable the diffusion and adoption of sustainable practices across the globe. The book is a good resource to audiences who are concerned with assessing, modifying, and/or integrating best sustainable practices into their particular setting. From an academic viewpoint, this book is a useful resource to educators and researchers involved with teaching sustainability-related courses.

Book Structure and Chapters Synopsis

The book structure consists of three major sections pertaining to sustainability and sustainable development. These sections are:

Section 1: Social Reform for Sustainable Development.
Section 2: Finances, Economics, and Sustainable Enterprise.
Section 3: Environmentally Responsible Sustainable Development.

In Chapter 1, Farley Simon Nobre and Maria Matilde Zraik Baracat present an exploratory study about the Brazilian program on Human Immunodeficiency Virus (HIV). Their study entitled: "Innovating and Serving the Poor with Antiretroviral Drug Systems: Advances in the HIV Brazilian Program," analyzes the HIV epidemic in Brazil and the contributions of the pharmaceutical industry in Brazil in the diffusion and adoption of antiretroviral drugs. Their results show that the adoption and diffusion of the Brazilian program for HIV, specifically the unrestricted distribution of HIV medicines, has been successful in addressing the epidemic.

In Chapter 2, Abdul Hafeez-Baig and Raj Gurujan explore the study entitled: "Phenomena of Adoption and Wireless Handheld Devices: A Case of Healthcare Setting." Their study centers on the healthcare industry in Australia and the adoption of wireless technology such as handheld devices to improve the efficiency of healthcare. They conducted an extensive literature review into wireless technology adoption. From their literature findings, they developed a framework of key factors that are important in the adoption of wireless technology in the healthcare industry. These included: (1) factors related to previous adoption theories, (2) healthcare-specific factors, (3) organizational-specific factors, (4) user-specific factors, (5) technology-specific factors, and (6) management-specific factors. These adoption factors were then tested on a number of healthcare professionals (including physicians and nurses). They findings showed that organizational readiness (OR), technical readiness (TR), perceived readiness (PR), clinical practices (CP), social context (SC), compatibility (C), perceived usefulness (PU), perceived ease of use (PEU), attitude (A), and intention to use (ITU), were important factors to adoption of wireless technology in the healthcare industry.

In Chapter 3, April Baptiste explores the issue of climate change on an island nation. The study entitled: "Local vs. Expert Perception of Climate Change: An Analysis of Fishers in Trinidad and Tobago," focuses on local communities in Trinidad and Tobago. The study examines the perceptions of three key stakeholders; scientists, policy-makers, and fishers, towards climate change. The key findings of this study indicate that the three stakeholders are aware of, and recognize the consequences of, climate change. Policy-makers and scientists observed a direct link between climate change and consequences, while the fishing community had an indirect link.

In Chapter 4, Md. Mustafa Saroar and Jayant K. Routray explored the potential of adoption of sustainable adaptation strategies against various impacts of climatic disasters in coastal Bangladesh. The main focus of the study entitled: "Desert in Bengal Delta- Changes in Landscape, Changes in Livelihood: Can Diffusion and Adoption of Sustainable Adaptation Make a Difference?" is an adoption of sustainable adaptation strategies to secure livelihood. The findings of the study indicate that severe salinity in soil, groundwater and surface water sources is one of the major consequences of climate change experienced in Bangladesh. Indigenous knowledge and technologies have long in the past enabled the local population to cope with the consequences. However, while these technologies have worked in the past current events of increasing intensity and frequency of flooding, cyclones, and droughts that exacerbate salinity require alternative interventions. Several adaptive measures proposed in the study include structural measures (e.g. construction of safe shelters, construction of new sea-walls/embankments/levees, and re-excavation of occupied canals and construction of new sluice gates), and non-structural measures (e.g. special social safety nets for coastal areas, community food security program for coastal area).

Section 2: Finances, Economics, and Sustainable Enterprise

In Chapter 5, Hamed Niroumand, M.F.M. Zain, and Sanaz Naghavi Alhosseini explore the study entitled: "Earth Building Materials, Production, and Construction Techniques." The urban environment and civil infrastructures are some of the major consumers of resources including water and energy. There is a need to make the urban environment sustainable. This chapter explores earth materials as a sustainable form of material for building walls, floors, and roofs. The different types of construction methods and architectural aspects of buildings built from earth materials are evaluated in this study.

In Chapter 6, Antje Ilberg presents the study entitled: "Project Implementation Constraints with Examples from Affordable Housing and Infrastructure Efforts." The study presents several case studies for low cost, sustainable housing, and civil

infrastructure for urban Sub-Saharan Africa. These studies include low-cost housing in Kigali, Rwanda, low-cost greywater treatment for households in Lilongwe, Malawi, and a sustainable waste management project in Mzuzu, Malawi. The results indicate that while such solutions are available and have the potential to address the problems of urban growth in developing nations, factors of community engagement, understanding the environmental, cultural, and social norms, and political climate are important for their diffusion and adoption.

In Chapter 7, Teresa da Cunha Pinto and Ana Maria Bandeira explore the study entitled: "Sustainability Reporting and Financial Reporting: The Relevance of an Integrated Reporting Approach." Integrated reporting is a way of showing that companies are environmental, socially, and economically responsible in their businesses. In this chapter, the authors evaluate the current state of corporate financial and sustainability reporting. An initial literature review was conducted on several global organizations working on sustainability reporting: Global Reporting Initiative, the International Integrated Reporting Committee, the United Nations Global Compact, and AccountAbility. To enrich their study, the authors selected Novo Nordisk as their case study. Novo Nordisk is a world leader in integrated reporting. Findings from this study show that: (1) there has been an increase in sustainability reporting in the corporate world, (2) stakeholders are demanding that companies disclose more information pertaining to performance, and (3) the increasing demand for companies to show clear linkages between corporate management and social behaviour in their financial reports.

In Chapter 8, Thomas D. Eatmon, Zachary A. Piso, and Elyse Schmitt, explore the study entitled: "Perception is Reality: Factors Influencing the Adoption of Commercial Aquaponics in the Great Lakes Region." In this study, the authors evaluate the utilization of commercial aquaponics in the Great Lakes region for producing local food on a year round basis. The authors' findings indicate that the relative advantage, compatibility, complexity, trialability, and observability are key factors in the diffusion and adoption of the technology.

In Chapter 9, Michelle Jarvie-Eggart explores the study entitled: "Towards Sustainable Mining: Diffusion of Sustainability Concepts into the Mining Industry within Canada." In this study, the author evaluates the Towards Sustainable Mining (TSM) protocols developed by the Mining Association of Canada (MAC). The TSM protocols were developed to address public concerns in the area of environmental and social responsibility of mining actions. The TSM protocols incorporate sustainability indicators that evaluate the social, environmental, and economic impacts of mining. The findings from this study indicate that great progress has been made by mining companies across Canada in adopting the TSM protocols.

Section 3: Environmentally Responsible Sustainable Development

In Chapter 10, Inna Platonova explores the study entitled: "Diffusion of Renewable Energy Technologies in Rural Communities: Exploratory Study of Development Partnerships in Cajamarca Peru." The study evaluates the diffusion and adoption of renewable energy technology by non-governmental organizations (NGOs) to off-grid communities in Peru. The study examines key factors between local communities and non-governmental organizations that enable the adoption of sustainable energy technologies. Findings from this study show that shared values and goals, complementary expertise and capacities, confidences and trust, clear roles and responsibilities, and effective communication were some of the factors in the diffusion and adoption of off-grid technology. Organizational management was also listed as an important factor. The author emphasized that effective partnership between development organizations (e.g. NGOs), community participation and ownership, were also critical in sustaining the off-grid technology well into the future.

In Chapter 11, Denise Margaret S. Matias explores the study entitled: "Electric Public Transport in Puerto Princesa City, Philippines: Enabling Factors for Institutionalizing Low-Carbon Transport," In this study, Denise exams the factors leading to the institutionalization of an electric publication transportation initiative on the island city of Puerto Princesa, Philippines. This initiative led by a non-governmental organization (NGO) aimed at reducing greenhouse gases is consistent with the global frameworks of the United Nations Framework Convention on Climate Change (UNFCCC). The studied identified that the diffusion and adoption of public electric transportation was dependent on the interaction of various stakeholders: local government, local communities, private companies, and the media. Acceptability of such a project was also an important factor.

In Chapter 12, Rasheed A. Charuvilayil investigates the study entitled: "Industrial Pollution and People's Movement: A Case Study of Eloor Island Kerala, India." The case study is centered on the Kerala state in India where environmental pollution, deforestation, and social problems have been experienced. The author investigates the impact of industrialization on society and the environment. Of great importance is the impact of industries on the Periyar River, which is an integral part of the people's livelihood and health and to Kerala's economy. Several solutions identified in the study for addressing pollution include: building sewage treatment plants, setting up slaughter houses, better watershed management strategies, and monitoring systems for saline water intrusion. Of equal importance is the involvement of various stakeholders for example, non-governmental organizations, the media, trade unions, and the public.

In Chapter 13, Christopher Misati Ondieki investigates the study entitled: "Hydrology and Integrated Water Resource Management for Sustainable Watershed Management in Kenya." The main focus of the study is the impact of unsustainable

watershed management on the degradation of watersheds and diminishing quality water resources. Three watershed case study areas were investigated in this study: Lake Turkana Basin, Lake Victoria Basin, and Mount Kenya Basin. Some of the findings show that the quality of the watersheds was largely impacted by runoffs from slaughterhouses, agricultural land, and coffee and tea factories. Some of the recommendations put forth by this study included the integration of a watershed management plan that incorporated all stakeholders, an improved hydro-meteorological network, and conducting awareness campaigns on the benefits of better watershed management. Understanding the impacts of projects and how to reduce and/or minimize the impacts was also recommended in addition to the engagement of various governing water agencies such as Water Resources Management Authority (WRMA), Basin Authorities, and National Environmental Management Authority (NEMA).

In Chapter 14, Cynthia Hall, Regina Easley, Joniqua Howard, and Trina Halfhide, investigate "The Role of Authentic Science Research and Education Outreach in Increasing Community Resilience: Case Studies Using Informal Education to Address Ocean Acidification and Healthy Soils." The study's focus was on evaluating the role of social, racial, and economic demographics in diffusing sustainability principles to underserved communities through informal education. Through the use of case studies such as ocean acidification, healthy living choices, environmental stewardship, and healthy soil to inner-city communities in Tampa, FL, the researchers were able to engage learners from elementary to teenagers in addition to adults. A conclusion from this study is that successful diffusion of sustainability principles and bridging of scientists and the broader community is possible through informal settings.

In Chapter 15, Everson J. Peters investigates "Promoting Rainwater Harvesting (RWH) in Small Island States (SIDs): A Case in the Grenadines." Increasing population coupled with increasing pollution is placing tremendous pressure on water sources around the globe. One of the challenges facing society today is water scarcity and how to address this. The study by Everson focuses on the diffusion and adoption of rainwater harvesting systems for households in the Eastern Caribbean. The findings indicate that quality, design, and the cost of rainwater harvesting systems are key factors in their diffusion and adoption.

In Chapter 16, Diana Chalil investigates the "Assessment of smallholders' Barriers to Adopt Sustainable Practices: Case Study on Oil Palm (*Elaeis Guineensis*) Smallholders' Certification in North Sumatra, Indonesia." Indonesia is the world's largest producer of palm oil. However, from seed to final product, the palm oil requires acres of land and a flowing supply of water to grow. Various environmental problems associated with the production of palm-oil have led to the need for sustainable management practices in the agricultural sector in Indonesia. In this study, the investigator presents the Roundtable Sustainable Palm Oil (RSPO) certificate

for sustainable product which is designed to address the environmental problems in the palm oil industry. To obtain a certificate of sustainable product, a member of the palm oil industry has to have achieved the principles and criteria formulated by the RSPO organization. Key findings indicate that lack of information for smallholders, cost of adoption, incompatibility, and inadequate managerial skills were some of the barriers to the adoption of the certificate for sustainable product.

In Chapter 17, Jacob R. Morris and Ken D. Thomas investigate the "Implementing BioSand Filters in Rural Honduras: A Case Study of His Hands Mission International in Copán, Honduras." In this study, the investigators evaluate the effectiveness of BioSand Filter (BSF) in treating water to a potable level and its diffusion and adoption in several villages in Honduras. Results from this study show that the BSF is capable of removing 96.7% of fecal coliform. Results also show that the adoption level of the BSF system was 85-90%. The key factors to the diffusion and adoption of the BSF system include: simplicity of the system, the ease of use of the system, and its sustainability.

REFERENCES

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision*, *47*(8), 1323–1339. doi:10.1108/00251740910984578

Muga, H., & Mihelcic, J. R. (2008). Sustainability of wastewater treatment technologies. *Journal of Environmental Management*, *88*(3), 437–447. doi:10.1016/j.jenvman.2007.03.008

Muga, H., Mukherjee, A., Mihelcic, J. R., & Kueber, M. (2009). An integrated assessment of continuously reinforced and jointed plane concrete pavements. *Journal of Engineering, Design and Technology . Special Issue on Green Construction*, *7*(1), 81–98.

Mukherjee, A. M., & Muga, H. E. (2010). An integrative framework for studying sustainable practices and its adoption in the AEC industry: A case study. *Journal of Engineering and Technology Management*, *27*(3-4), 197–214. doi:10.1016/j.jengtecman.2010.06.006

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009, September). Why sustainability is now the key driver of innovation. *Harvard Business Review*, 1–10.

Rogers, E. M. (2003). *Diffusion of innovation* (5th ed.). New York, NY: The Press.

World Commission on Environment and Development. (1987). *Our common future*. New York, NY: Oxford University Press.