

Environmental Change and Human Security in Africa and the Middle East

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Editors

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 Springer

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ISBN 978-3-319-45646-1 ISBN 978-3-319-45648-5 (eBook)
DOI 10.1007/978-3-319-45648-5

Library of Congress Control Number: 2016959393

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Cover illustration: Image taken in Morocco by Dr. Olivier Barrière, Researcher at the Institute of Research for Development (IRD), France

Printed on acid-free paper

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

About the Publishing Institution



The Center for Research on Environment, Human Security and Governance (CERES)

The CERES, previously the North-South Center for Social Sciences (NRCS), 2008–2015, is an independent and not-for-profit research institute founded by a group of researchers and experts from Morocco and other countries. The CERES aims to develop research and expertise relevant to environment and human security and their governance from a multidimensional and interdisciplinary perspective. As a think tank, the CERES aspires to serve as a reference point, both locally and globally, through rigorous research and active engagement with policy-making processes. Through its research programme, the CERES aims to investigate the links between environmental/climate change, their implications for human security and the needed shifts to be undertaken in both research and policy. The CERES, led by Dr. Mohamed Behnassi and mobilizing a large international network of researchers and experts, aims to undertake original research, provide expertise and contribute to effective science and policy interactions through its publications, seminars and capacity building.

Preface

The end of the Cold War signalled the beginning of a process that changed and developed our understanding of the concept of security. Security has now evolved beyond the narrow frame of preventing state conflict into a broader notion that concerns the protection of individuals (MacFarlane and Khong 2006). In 1994, the landmark UNDP Human Development Report (HDR) proposed the concept of ‘human security’ in recognition of the need to focus on attaining greater societal resilience and improved environmental conditions, especially for the most vulnerable (UN 2006). This more holistic approach encompassed economic, food, health, environmental, personal and community security that should be ensured to protect individuals from negative impacts. Human security inseparably links humans, their social systems and their environments and strives to achieve freedom from fear, freedom from the impacts of natural hazards and freedom from want by reducing natural and social disruptions (Warner et al. 2008). Nevertheless, it is only now, at the beginning of the twenty-first century, that the effects of environmental and climate change – such as extended droughts and extreme hurricanes, disease, decline of natural resources and resulting migration – are beginning to shape a new and more urgent need for the human security paradigm (Ibid: 48).

The human security paradigm has been – and continues to be – debated and informed by many disciplines, by studies using diverse methods of enquiry and by UN institutions, scholars and advocates in every region of the world. The relevance and growing importance of this emerging imperative has been underlined by the Intergovernmental Panel on Climate Change (IPCC)’s Fifth Assessment Report (AR5), which includes the first systematic assessment across the various dimensions of this concept (Adger et al. 2014). This focus, from a global scientific authority, is evidence that the human security paradigm is increasingly relevant – both in terms of how to define global environmental change and how to address its impacts. The AR5 defines human security, in the context of climate change, as a condition that exists when the vital core of human lives is protected and when people have the freedom and capacity to live with dignity. The AR5 report’s authors find that despite the uncertain interactions between multiple factors, there is robust evidence to suggest that human security will be progressively threatened as the climate changes;

climate change undermines livelihoods, compromises culture and individual identity, increases migration that people would rather have avoided and can undermine the ability of states to provide the conditions necessary for human security (Ibid). Despite these findings, the AR5 also makes clear that there is a need for more comprehensive evidence, collected across multiple locations and over long durations, to build and test theories about relationships between climate change and livelihoods, culture, migration and conflict. It is in response to and in contribution to this need that this volume has been conceived.

In recent years, it has become clear that reaching a consensus on the use and meaning of 'security' and 'human security' is not straightforward, particularly as their meaning is constantly shifting in relation to policy debate, media commentary and academic discussion. However, the need to take environmental change seriously and to find practical approaches and solutions undeniably justifies the need to continue these discussions. This volume aims to contribute to these debates, exploring linkages between environmental change and human security as well as the relevance and need to consider human security as a framework for shaping perceptions and action on environmental change.

Contemporary political discussions on environmental change have focused in particular on the question of our changing climate. Yet climate change is a dynamic process that is interconnected with a much wider range of concurrent environmental transformations. A variety of anthropogenic pressures such as rapid deforestation, decimation of fish populations, urbanization, mining, farming and damming of rivers are also causing dramatic changes to our physical world. Pascual et al. (Chap. 4) show how a range of such pressures combine with climate change to produce a particular set of challenges in the Intercontinental Biosphere Reserve of the Mediterranean (Morocco and Spain). Above all, these changes to our environment signify consequences for people, a point highlighted, for example, in Chaps. 1, 7 and 8. Increased exposure and vulnerability as well as a heightened risk to human populations and their security are among the impacts of environmental change that are of increasing concern to academics, civil society and politicians alike and which form the central focus of the contributions to this volume.

The range of issues encompassed by the human security paradigm is reflected in this volume, for example, with focus on health in Chap. 7 and food in Chap. 16, and Part III is dedicated to the particularly pertinent regional problem of water. Indeed, the concept of security has not only been 'stretched' horizontally to embrace a wide range of topical issues but also has a vertical plasticity that embraces both regional and global structures as well as local and individual identities (McIntoch and Hunter 2010). This appearance of human security at different levels is discussed in detail in Chap. 3 which looks at the use of the human security concept at UN and EU level as well as at national level.

Broadening existing national and international security concepts to encompass a wide range of meanings may seem, on the one hand, a simple question of their inclusion. Yet a truly human security-led approach requires, in its fullest articulation, a conceptual realignment of our understanding of human well-being with a profound impact on the organization of our social, ecological and political priorities.

Similarly, although it is crucial to develop specific strategies to directly mitigate and adapt to environmental change, it is a much broader approach that takes economic and societal strategies into account that is necessary if we are to truly address environmental change and the challenges it presents to human security. While acknowledging that full protection of human security may rely on our capacity to rethink conventional governance frameworks, we are not operating with a tabula rasa nor in a vacuum from competing approaches and concerns. Thus, without consideration of the complexity of the existing paradigms and dynamics that govern our socio-ecological systems and decision-making processes, it is unlikely that attempts to promote human security approaches can be sustainable. This is particularly apparent in the discussion in Chap. 3 which demonstrates that while human security can provide a useful conceptual framework, its practical application and connection to other policy areas directly influences its acceptability and adoption.

Based on this background, the approach adopted in this contributed volume is structured as follows:

The contributions to Part I examine the human security dimensions of global environmental change and how these intersect with other strands of action on environmental change such as climate change adaptation, socio-ecological strategies and development policy. In Chap. 1, coeditor Mohamed Behnassi investigates the links between climate change and security by highlighting key biophysical, human, economic and geopolitical impacts of climate change and their security implications, examining the extent to which these implications are currently well-managed and assessing the usefulness of 'climate security' as a framework for boosting climate change policy and governance. The analysis draws the conclusion that if climate security concerns are underestimated, we must expect and find ways to manage future security challenges. In this way, he suggests that a climate security framework helps to adopt preventive and security-sensitive responses to climate risks, with the potential to generate new dynamics within climate policy and governance. In a second chapter, El Fella and Behnassi discuss the relationship between environmental change and dominant development pathways and demonstrate how the current discourse often disregards the interlinkages between growing social injustice and the ever-increasing environmental crisis. The authors conclude that fighting social vulnerabilities must be at the heart of policy responses to the global environmental change in order to prevent threats to human security. In Chap. 3, McGlade et al. analyse the relevance and usefulness of the concept of human security in the context of climate adaptation policy-making. They find that, while the concept can help frame initiatives and act as a rallying call to action, it is not a prerequisite for effectively ensuring human security. One element of ensuring human security is the physical protection of people from environmental changes, ensuring their health, safety and well-being.

In Part II, a variety of case studies provide empirical examples of how environmental change is impacting human security in the Middle East and African regions, divided into two sections: (1) physical impacts and (2) socio-economic impacts. In Chap. 4, Pascual et al. carry out a multidisciplinary assessment of the potential water vulnerability in the Intercontinental Biosphere Reserve of the Mediterranean

(IBRM) that lies in both Spanish and Moroccan territories. Their assessment of vulnerability includes the use of climate change scenarios, a hydro-ecological model and the participation of stakeholders and local experts. In Chap. 5, an impact assessment carried out by Deafalla et al. uses qualitative and quantitative techniques to map and assess the impact of environmental change on demographical dynamics and land use/land cover (LU/LC) change in the Nuba Mountains of Sudan. Chapter 6 looks at the situation in Nigeria, the most populous country in Africa. Suleiman Iguda Ladan finds that human security is seriously threatened by global environmental change, a situation aggravated by the lack of economic development and institutional capacity to mitigate and adapt to the changes. In Chap. 7, Kahime et al. assess the impacts of environmental change on human health and security in pre-Saharan North Africa. Their focus is on the dynamics and impacts of zoonotic cutaneous leishmaniasis (ZCL), a vector-borne disease widespread in most countries of the Mediterranean Basin including Morocco where it causes a public health problem that is worsening with changes in climate and unsustainable population activities. In Chap. 8, Niklas Baumert and Julia Kloos investigate a hypothetical vulnerability scenario for preventive resettlement as a response to sea level rise (SLR) in low-lying coastal zones (LLCZ). Taking the city of Alexandria in Egypt as an example, the authors argue that SLR-induced preventive resettlement can lead to the severe disruption of the livelihoods of certain social groups who then become vulnerable to displacement, unemployment and homelessness. Baumert and Kloos thus present a conceptual framework to anticipate the need for preventive resettlement and raise awareness of potential vulnerabilities and threats to human security.

In the second section, the broader socio-economic impacts of global environmental change form the focus of chapters by Madhumati Dutta and Nabil Sultan. In Chap. 9, Dutta takes us to India, looking at the rise of consumption in the population and the impacts of consumer behaviour on environmental change and accordingly for human security. Chapter 10 brings us to the Arab Gulf region where the population is heavily reliant on the revenues generated by oil and gas. Here, Sultan examines the emerging interest in shale gas and the social, economic and environmental implications of a changing energy supply.

Part III focuses on water security, a particular problem caused by environmental change and anthropogenic activity in the Middle East and Africa. It looks at differing regional manifestations of this question and provides evidence that many locations at the subregional level face imminent threats to water and food security, declines in agricultural production and potential socio-economic crises. Chapters in this section examine impacts at both local and global scales and highlight the interplay between policies for water security at both scales of observation. We begin with Antonelli et al. who examine water resources, food security and the role of virtual water trade in the Middle East and North Africa (MENA) region in Chap. 11. The study is the first comprehensive analysis of the virtual water trade phenomenon in the MENA. The authors find that the region is highly dependent on virtual water imports to ensure its water and food security. In Chap. 12, we travel to eastern Algeria, where Abdelhafid Aimar discusses how water scarcity, pollution and

water supply problems are obstructing the region's development, creating social tensions and affecting the quality of life and availability of drinking water. In Chap. 13, Özden Zeynep Oktav surveys Turkey's water policy and relations with its neighbours Iraq and Syria in terms of water scarcity in the Euphrates-Tigris Basin. Oktav finds that shared water resources can act as a source of cooperation as well as of conflict depending on the changing political, economic and security circumstances.

Finally, in Part IV, we present some critical perspectives and approaches for addressing the impacts of environmental change on human security. These chapters outline the need for a shift from both theoretical and practical standpoints and point to areas to be developed in future research. We begin with Chap. 14 by Olivier Barrière where the author investigates the human relationship to the land from a legal perspective and considers it as a human and environmental security challenge. In a context of global change, the human relationship to the land and its natural resources increasingly defines a key challenge to human and environmental security. From this relationship materializes an ecological dimension on which the humanity depends for its existence, well-being, health and development. However, current pressures on land, including the land grabbing phenomenon, that are growing worldwide and particularly in Africa place the land issue at the heart of the human and environmental security (through many problems such as food insecurity and climate change-induced displacements or 'climate refugees'). This issue is even considered as one of the main drivers of many current and potential violent conflicts. The author assumes that the human relationship to the land and its resources, and the resulting consequences, depends on how they are supported by relevant laws. The reason is that land-related laws are not subject to a unique thought since they are plural and diversified worldwide. In Chap. 15, Matsa et al. provide a detailed study of traditional and cultural approaches to food security and features of environmental change in the rural district of Beitbridge, Zimbabwe. They establish that impacts of environmental change on food security are gendered and that indigenous knowledge systems are an essential pillar of ensuring food security.

This volume provides insights from recent research on global environmental change and human security in the Middle East and Africa. These regions face particular challenges in relation to environmental degradation, the decline of natural resources and the security implications that existing and future trends in these areas may present. It touches on the scientific and policy features of the discourse with a focus on the particular regional challenge of climate change impacts on water resources and water security. Through the insights shared in this publication, the editors aim to contribute to the growing academic literature pertained to environmental change and human security while enhancing political discussions and policy agendas on how to address current and future challenges.

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References

- Adger, W. N., Pulhin, J. M., Barnett, J., Dabelko, G. D., Hovelsrud, G. K., Levy, M., Oswald Spring, Ú., & Vogel, C. H. (2014). Human security. In: C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea & L. L. White (Eds.), *Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 755–791). Cambridge, UK/New York: Cambridge University Press.
- Dalby, S. (2009). *Security and environmental change*. Cambridge: Polity Press.
- MacFarlane, N. S., & Khong Yuen Foong. (2006). *Human security and the UN: A critical history*. Bloomington: Indiana University Press.
- McIntoch, M., & Hunter, A. (2010). *New perspectives on human security*. Sheffield: GreenLeaf Publishing Limited.
- Warner, K., Afifi, T., Dun, O., Stal, M., Schmidl, S., & Bogardi, J. (2008). Human security, climate change, and environmentally induced migration. In *Climate change: Addressing the impact on human security*. Hellenic Foundation for European and Foreign Policy (ELIAMEP) and Hellenic Ministry of Foreign Affairs, 2007–2008. Greek chairmanship of the Human Security Network, Athens.

Acknowledgements

This contributed volume is based on the best papers presented during the International Conference on Global Environmental Change and Human Security: The Need for a New Vision for Science, Policy and Leadership (GECS2012), organized on November 22–24, 2012, in Marrakesh by the North–south Center for Social Sciences, Morocco (now the Center for Research on Environment, Human Security and Governance (CERES)) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany, in collaboration with the International Center for Biosaline Agriculture (ICBA), United Arab Emirates, and the Moroccan Ministry of Environment.

I have been honoured to chair the GECS2012 and to share the editorship of this volume with my colleague Katriona McGlade, a fellow from Ecologic Institute, Germany, whose professionalism, expertise and intellectual capacity made the editing process an exciting and instructive experience and undeniably contributed to the quality of this publication.

The chapters in this volume are also the result of the invaluable contributions made by our peer-reviewers, who generously gave up their time to provide insight and expertise to the selection and editing process. On behalf of my coeditor Katriona McGlade, I would thus like to acknowledge, with sincere and deepest thanks, the following colleagues: Dr. Dania Abdul-Malak (senior environmental researcher, European Topic Centre for Spatial Information and Analysis, University of Malaga, Spain), Christiane Gerstetter (senior fellow, Ecologic Institute, Berlin, Germany), Rodrigo Vidaurre (fellow, Ecologic Institute, Berlin, Germany), Dr. Mohamed Aly Ramady (visiting associate professor, Department of Finance and Economics, College of Industrial Management, King Fahd University of Petroleum and Minerals, Saudi Arabia), Dr. Ian Alcock (research fellow, European Centre for Environment and Human Health, University of Exeter, UK), Dr. Ethemcan Turhan (Mercator-IPC fellow, Istanbul Policy Center at Sabanci University, Turkey), Dr. Prof. Jan Van Heerden (retired head of economics at Pretoria University, South Africa and former president of the African Econometric Society and deputy director of Economic Research Southern Africa) and Dr. Prof. Mohamed Tawfic Ahmed

(Environmental Impact Assessment Unit, Faculty of Agriculture, Suez Canal University, Egypt).

We also wish to take this opportunity to express our sincere appreciation to the institutions who made this book project an achievable objective. In particular, we thank the funding institutions of the GECS2012 Conference which, in addition to NRCS, include the GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) and International Center for Biosaline Agriculture (ICBA). Special thanks are due to all chapters' authors and co-authors without whom this valuable and original publication could not have been produced.

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List of Abbreviations and Acronyms

AEA	ASEAN Energy Awards
AET	Actual evapotranspiration
ANOVA	Analysis of variance
AR	Assessment report
BWTC	Bahrain World Trade Center
CAPMAS	Central Agency for Public Mobilization and Statistic
CCI	Climate Change Initiative
CDM	Clean Development Mechanism
CERES	Center for Research on Environment, Human Security and Governance
CFSP	Common Foreign and Security Policy
CGIAR	Consultative Group for International Agricultural Research
CLICO	Climate Change, Hydro-conflicts and Human Security
CNG	Compressed natural gas
COP	Conference of the Parties
CRED	Centre for Research on the Epidemiology of Disasters
CSDP	Common Security and Defence Policy
CSP	Concentrated solar power
CVD	Cardiovascular disease
DEAP	District Environmental Action Planning Programme
DFDR	Development-forced displacement and resettlement
EHSP	Environment and Human Security Program
EMA	Environmental Management Agency
ENEC	Emirates Nuclear Energy Corporation
ENVSEC	Environment and Security Initiative
EPHD	Errachidia Provincial Health Delegation
ERDAS	Earth Resources Data Analysis System
ESA	European Space Agency
ESS	European Security Strategy
EU	European Union
FANR	Federal Authority for Nuclear Regulation
FAO	Food and Agriculture Organization

GAP	Great Anatolian Project
GCC	Gulf Cooperation Council
GCMs	Global Circulation Models
GDP	Gross national product
GEC	Global Environmental Change
GECHS	Global Environmental Change and Human Security
GECS	Global Environmental Change and Human Security Conference
GED	Gender, Environment and Development
GHG	Greenhouse gases
GIS	Geographical information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GMES	Global Monitoring for Environment and Security
GNEII	Gulf Nuclear Energy Infrastructure Institute
GOLD	General Organization for Land Development
GOPP	General Organization for Physical Planning
HDR	Human Development Report
HEPP	Hydro-electric power plants
HSU	Human Security Unit
HVAC	Ventilation and air conditioning
IAEA	International Atomic Energy Agency
IBRM	Intercontinental Biosphere Reserve of the Mediterranean
ICBA	International Center for Biosaline Agriculture
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
INDH	National Initiative for Human Development
IPCC	Intergovernmental Panel on Climate Change
IRD	Institute of Research for Development
KACARE	King Abdullah City for Atomic and Renewable Energy
LAGOS	Research Laboratory on Territorial Governance, Human Security and Sustainability
LLCZ	Low-lying coastal zones
LPG	Liquid petroleum gas
LU/LC	Land use/land cover
MAB	Man and the Biosphere Programme
MDG	Millennium Development Goals
MENA	Middle East and North Africa
ML	Maximum likelihood
MMES	Middle East and Sahel
MPCE	Monthly per capita expenditure
NAPA	National Adaptation Programmes of Action to climate change
NASA	National Aeronautics and Space Administration Agency
NATO	North Atlantic Treaty Organization
NCD	Noncommunicable diseases

NDVI	Normalized difference vegetation index
NESTA	National Earth Science Teachers Association
NOAA	National Oceanic and Atmospheric Administration
NRCS	North–south Center for Social Sciences
OCHA	UN’s Office for the Coordination of Human Affairs
OECD	Organisation for Economic Co-operation and Development
PACJA	Pan African Climate Justice Alliance
PCA	Post-classification analysis
PCD	Post-change detection
PET	Potential evapotranspiration
QEWCO	Qatar’s Electricity and Water Company
QST	Qatar Solar Technologies
ROI	Return on investment
SDG	Sustainable development goals
SLR	Sea level rise
SOER	State of Environment Reporting
SWAT	Soil and Water Assessment Tool
TERRA	Spaceborne Thermal Emission and Reflection Radiometer
TM	Landsat Thematic Mapper
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNTFHS	United Nations Trust Fund for Human Security
UNU-EHS	United Nations University, Institute for Environment and Human Security
USAID	United States Agency for International Development
USGS	United States Geological Survey
VOCs	Volatile organic chemicals
WCED	United Nations World Commission on Environment and Development
WDI	Water deficit index
WFP	World Food Programme
WGBU	German Advisory Council on Global Change
WHO	World Health Organization
WMO	World Meteorological Organization
ZCL	Zoonotic cutaneous leishmaniasis

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