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Exploring the interconnections between climate change-gender in adaptation and mitigation contexts

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Marina Kovaleva

aus Bischkek, Kirgisistan

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Referent: Prof. Dr. (mult.) Dr. h.c. (mult.) Walter Leal

Korreferent: Prof. Dr. Christian Borgemeister

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Abstract

Global human-driven climate change and its consequences are continuously transforming natural and socio-economic systems by altering the environment and posing threats to people's health, well-being and livelihood stability. The population's characteristics including geographical distribution, education, poverty and gender predefine to varying degrees individuals' capacity and ability to overcome climate change challenges. In the light of the recent developments at the international arena, gender has been mentioned more often in the climate change-related context, compared to other characteristics. Interconnections between climate change and gender are characterized by complex synergies and dynamics, continuous development, and ongoing mutual impacts. The integration of these interconnections is among the factors that are expected to influence the development and implementation of effective global-scale adaptation and mitigation solutions.

This PhD work explores some key aspects of the climate change-gender interconnections and sheds light on their interactions in a variety of contexts in different geographical regions including Central Asia (CA), Africa, and the Pacific.

The work is structured around three main domains of climate change-gender interconnections: vulnerability, leadership/empowerment, and benefits, which are subject to thematic and geographical contexts, as well as level of application: regional, national or local.

Chapter 1 provides an introduction to the topic including the objectives and scope of this work and discusses gaps in the climate change-gender interconnections landscape. Chapter 2 explores the overall developments of inclusion of gender/women's issues in scientific contributions in climate change research. It also outlines the main themes that can be referred to the vulnerability, leadership/empowerment, and/or benefits domain(s) of climate change-gender interconnections. Chapter 3 examines the leadership/empowerment domain by analysing advances made towards attaining gender-balanced leadership/empowerment in climate change adaptation and mitigation in 12 African countries. Chapter 4 investigates the progress in addressing gender/women considerations by climate change-related areas in CA countries. Chapter 5 discusses climate change-gender interconnections by reviewing a feminisation process, its drivers, positive and negative outcomes, and associated challenges within the broader agricultural context in different geographical regions including Latin America and CA. Chapters 6, 7 and 8 explore the domains of climate change-gender interconnections, in the context of additional issue areas such as the partly successful implementation of the Sustainable Development Goals (SDGs), extreme events and mental health, and climate change-induced migration.

The findings obtained during this PhD study reflect a new perspective under a unified umbrella of climate change-gender interconnections framework. The work provides innovative insights on the progress made towards taking into consideration men's and women's differences in handling climate change issues, and the potential added value that an improved understanding of these interconnections may bring from a climate change perspective, at meta level.

Zusammenfassung

Der globale, vom Menschen verursachte Klimawandel und seine Folgen verändern kontinuierlich die natürlichen und sozioökonomischen Systeme, indem sie die Umwelt verändern und die Gesundheit, das Wohlergehen und die Stabilität der Lebensgrundlage der Menschen gefährden. Die Merkmale der Bevölkerung wie geografische Verteilung, Bildung, Armut und Geschlecht bestimmen in unterschiedlichem Maße die Fähigkeit der Menschen, die Herausforderungen des Klimawandels zu bewältigen. Angesichts der jüngsten Entwicklungen auf internationaler Ebene wird ‚Geschlecht' im Zusammenhang mit dem Klimawandel im Vergleich zu anderen Merkmalen häufiger erwähnt. Die Verflechtungen zwischen Klimawandel und ‚Geschlecht' sind durch komplexe Synergien und Dynamiken, eine kontinuierliche Entwicklung und anhaltende gegenseitige Auswirkungen gekennzeichnet. Die Integration dieser Verflechtungen gehört zu den Faktoren, von denen erwartet wird, dass sie die Entwicklung und Umsetzung wirksamer globaler Lösungen zur Anpassung an und Eindämmung des Klimawandels beeinflussen werden.

Diese Studie untersucht einige Schlüsselaspekte der Klimawandel-Geschlecht Verflechtungen und beleuchtet deren Wechselwirkungen in einer Vielzahl von Kontexten in unterschiedlichen geografischen Regionen, einschließlich Zentralasien, Afrika und den Pazifikraum. Die Forschungsarbeit wurde um drei zentrale Themenbereiche dieser Verflechtungen herum strukturiert: i) Anfälligkeit, ii) Führung/Ermächtigung und iii) Vorteile, die dem thematischen und geografischen Kontext, sowie der Anwendungsebene: regional, national oder lokal unterliegen.

Eine Einführung in das Thema, einschließlich der Ziele und des Umfangs dieser Arbeit, sowie der Forschungstand im Themenbereich Klimawandel und Geschlecht, wird in Kapitel 1 gegeben. In Kapitel 2 werden die allgemeinen Entwicklungen bei der Einbeziehung der Geschlechter/Frauenaspekten in wissenschaftliche Beiträge zur Klimawandelforschung untersucht. Außerdem werden die Hauptthemen skizziert, die sich auf Anfälligkeit, Führung/Ermächtigung und/oder Vorteile Bereiche der Klimawandel-Geschlecht Verflechtungen beziehen lassen. Kapitel 3 analysiert die Fortschritte, die auf dem Weg zu einer geschlechtergerechten Führung/ Ermächtigung bei der Anpassung an den Klimawandel und seiner Eindämmung in 12 afrikanischen Ländern erzielt wurden. In Kapitel 4 wird untersucht, wie Gender- bzw. Frauenaspekte in den mit dem Klimawandel verbundenen Bereichen in den Ländern Zentralasiens bereits berücksichtigt wurden. In Kapitel 5 werden die Klimawandel-Geschlecht Verflechtungen erörtert. Es untersucht ein Feminisierungsprozess, seine Triebkräfte, positive und negative Ergebnisse und die damit verbundenen Herausforderungen im breiteren landwirtschaftlichen Kontext die in verschiedenen geografischen Regionen, einschließlich Zentralasien und Lateinamerika, untersucht werden. In den Kapiteln 6, 7 und 8 werden verschiedene weitere Thementeilbereiche der Klimawandel-Geschlecht Verflechtungen untersucht, und zwar im Zusammenhang mit der teilweise erfolgreichen Umsetzung der Ziele für nachhaltige Entwicklung (SDGs), mit extremen Wetterereignissen und psychischer Gesundheit sowie mit klimawandelbedingter Migration.

Die im Rahmen dieser Doktorandenstudie erzielten Ergebnisse reflektieren eine neue Perspektive eines einheitlichen Rahmens für die Klimawandel-Geschlecht Verflechtungen. Die Arbeit bietet innovative Einblicke in die Fortschritte bei der Berücksichtigung der Unterschiede zwischen Männern und Frauen im Umgang mit Fragen des Klimawandels. Es zeigt auch den potenziellen Mehrwert auf, den ein

besseres Verständnis dieser Zusammenhänge aus der Perspektive des Klimawandels auf Metaebene bringen kann.

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[1] The following chapters and subchapters are not available for republication due to closed access in the published journals

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The shorter version of the dissertation has been approved for publication by the dissertation supervisors:

Prof. Dr. (mult.) Dr. h.c. (mult.) Walter Leal

Prof. Dr. Christian Borgemeister

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List of Abbreviations

AAP	Africa Adaptation Programme
AC	Adaptation Committee
ADB	Asian Development Bank
ASAL	Arid and Semi-Arid Land
AWGGCC	African Working Group on Gender and Climate Change
CA	Central Asia
CAP	Central Asia Program
CAREC	The Regional Environmental Centre for Central Asia
CBD	Convention on Biological Diversity
CC	Compliance Committee
CDM	Clean Development Mechanism
CEE/CIS	Central and Eastern Europe and the Commonwealth of Independent States
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CEO	Chief Executive Officer
CGE	Consultative Group of Experts
COP	Conference of the Parties
COVID-19	Coronavirus disease 2019
CRC-PEG	Courant Research Centre - Poverty, Equity and Growth
CRM/TASP	Climate Risk Management Technical Assistance Project
CTCN	Climate Technology Centre and Network
DRR	Disaster Risk Reduction
DIAUD	Disability Inclusive and Accessible Urban Development
ECLAC	Economic Commission for Latin America and the Caribbean
EEA	European Environment Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
ESD	Education for Sustainable Development
EU	European Union
EWEs	Extreme Weather and Climate Events
FAO	Food and Agriculture Organisation
FSM	Federated States of Micronesia
FWG	Facilitative Working Group
GAP	Gender Action Plan
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse gas
GS	Google Scholar
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
IDM	Individual Deprivation Measure
IDMC	International Displacement Monitoring Centre
IFPRI	International Food Policy Research Institute
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
JISC	Joint Implementation Supervisory Committee
JRC	Joint Research Centre
KCI	Katowice Committee of Experts on the Impacts of the Implementation of Response Measure
LAC	Latin America and Caribbean

LEG	Least Developed Countries Expert Group
MDD	Major Depressive Disorder
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NDMO	National Disaster Management Office
NWO	Dutch Research Council
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OHCHR	Office of the United Nations High Commissioner for Human Rights
OSJI	Open Society Justice Initiative
PAIC	Paris Agreement Implementation and Compliance Committee
PCCB	Paris Committee on Capacity-Building
PICs	Pacific Island Countries
PTSD	Post-traumatic distress syndrome
QWIDS	Query Wizard for International Development Statistics
SCF	Standing Committee on Finance
SCP	Sustainable consumption and production
SD	Sustainable development
SDGs	Sustainable Development Goals
Sida	Swedish International Development Co-operation Agency
SLR	Sea level rise
STEM	Science, Technology, Engineering, and Mathematics
TEC	Technology Executive Committee
TROSA	Trans-boundary Rivers of South Asia
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNEP-FI	United Nations Environment Programme Finance Initiative
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organisation
UNIFEM	United Nations Development Fund for Women
UNODC	United Nations Office on Drugs and Crime
UNSDG	United Nations Sustainable Development group
WB	World Bank
WDS	World Development Sources
WEDO	Women's Environment and Development Organization
WHO	World Health Organization
WMO	World Meteorological Organization
WoS	Web of Science
WUAs	Water User Associations

1. Introduction

1.1 Background

1.1.1 Climate change impacts

Human-driven climate change has become an undeniable reality and is one of the greatest challenges faced by humanity. This global phenomenon continuously transforms natural and socio-economic systems by altering the environment and threatening the populations' health, well-being and livelihood stability. On the other hand, the projected growth of the global population that is expected to reach 9.7 billion in 2050 (UN Department of Economic and Social Affairs, 2022), fossil fuel-based economic and production activities, land and energy use patterns not only amplify existing multiple climate threats, but also will incrementally create more complex and cascading risks increasing related losses and damages (IPCC, 2021; IPCC, 2023). In 2023, various regions of the world experienced numerous catastrophes from tornados, destructive wildfires to wide-ranging impacts of cyclones with were followed by floods that caused preliminarily around USD 200 billion in damages (Aon plc, 2023). Over the last two decades, climate change-related meteorological, hydrological and climatological extremes have led to total global economic losses exceeding USD 2 trillion (Eckstein et al., 2021; WMO, 2021a; 2021b). Furthermore, climate change increases the volatility of the global economy by reducing its output at between 11% and 14% by 2050 compared to the 'without climate change' scenario (i.e., 0°C temperature change) (Swiss Re Institute, 2021). No industry or economic sector have zero contribution to climate change or remains 'immune' to its impacts, though some are significantly more sensitive to them compared to others. For instance, agriculture is responsible for 15–29% of global greenhouse gas (GHG) emissions (Magazzino et al., 2023; Ivanovich et al., 2023), but it also experiences reduction in crop yields mainly in mid- and low latitude regions (IPCC, 2023). Furthermore, the sector faces an increasing risk, particularly of food, water- and vector-borne diseases, as well as decreasing availability of water supply for irrigation needs, and an acceleration of biodiversity loss (Abbass et al., 2022). Studies estimate that the total economic climate change-related losses in agriculture could reach 0.3% of the global gross domestic product (GDP) per annum by the end of the century (Stevanović et al., 2016).

The energy sector, another major contributor to climate change, experiences disruptions in fuel supply and energy production at an unprecedented pace and scale. Massive power outages as a result of weather extremes affect millions of people worldwide (e.g., Xi, 2016; WMO, 2022). Heatwaves, droughts and water stress are undermining the resilience of current and future energy infrastructure and jeopardizing supplies of renewable energy (WMO, 2022). Economic losses due to natural hazards (e.g., floods, droughts, heatwaves) reach approximately USD 0.6 billion per year in the European energy sector only. They are projected to rise by 394% and 860% by the 2020s and 2050s, respectively (Forzieri et al., 2018).

The health sector contributes significantly less to climate change compared to agriculture and energy. It is accounting for about 5% of global GHG emissions (Watts et al., 2019) but is also significantly affected by the climate change impacts. The sector's capacity and infrastructure are under constant pressure due to the growing and amplified health risks associated with climate change including mental health issues, morbidity and mortality rates (Rocque et al., 2021). It is estimated that

climate change will lead to an additional 250,000 deaths annually between 2030 and 2050 due to malnutrition, malaria, diarrhea and heat stress (WHO, 2023). Over two decades, about 9 000 natural disasters affected more than 4 billion people and were responsible for more than 730 000 fatalities (EM-DAT, CRED, 2023). Furthermore, affected populations can experience heat exhaustion, physiological heat strain, heat-related and respiratory illnesses, longer-term impacts on mental health including psychological distress and anxiety about the future and severe illnesses requiring hospital care (Flouris et al., 2018; Palinkas and Wong, 2020; Ebi et al., 2021).
Climate change also influences economies by triggering people's displacement. Extreme weather events, decreasing water resources, loss of arable agricultural land, droughts and other critical changes in environmental conditions force individuals to migrate in an attempt to reduce vulnerability and risks to their livelihoods (McLeman, 2017). Additional driver for displacement is a 'threat multiplier' (Goodman and Baudu, 2023) that amplifies other factors that threaten security, such as poverty, tensions and conflicts over depleting natural resources, loss of income source, etc. According to the projections, in the worst-case scenario, over 1 billion people could be forcibly displaced by 2050 due to climate change and natural disaster events (Institute for Economics and Peace, 2020).

1.1.2 Responding to climate change

Mitigation and adaptation are the efforts to address the unprecedented rates of global climate change and its associated risks that pose a direct threat to human health and well-being. The global scale of the problem calls for increased international cooperation and nations' commitment to advance these efforts, including adequate and sustained funding, enhancement of the scientific basis and technological development (Ford and King, 2015; Midgley and Methner, 2016; IPCC, 2023). According to estimates, achieving a low-carbon transition by 2050 requires about USD 2.4 trillion of annual average energy investments, which represent around 2.5% of the global GDP (IPCC, 2018). Adaptation costs are rising due to the growing level of associated climate change risks. Recent projections indicate that adaptation finance for developing countries will require between USD 215 billion and 387 billion per annum by 2030, which is equivalent to between 0.6% and 1.0% of their combined GDP (United Nations Environment Programme, 2023). It is worth mentioning that there is no single amount reflecting the adaptation finance needed across developed countries. Several studies conducted in Europe showed that the required investments for the 1.5°C scenario, are estimated at approximately USD 44 billion per annum, while for the 2°C scenario are at USD 88-132 billion, and for the 3-4°C scenario are at USD 192-220 billion (Feyen et al., 2020; Watkiss et al., 2018).
Mitigation and adaptation actions stimulate technological innovations. Companies are introducing new materials (e.g., carbon fibre), climate-smart appliances, non-carbon and carbon capture and storage technologies as well as innovations that allow farmers to adopt alternative types of farming, and new stress-tolerant plant and animal breeds (Wilson et al., 2018; Sovacool et al., 2019; Loboguerrero et al., 2019; Özatağan, and Ayalp, 2021). In addition to intensive financing and technological development, effective long-term planning and implementation of mitigation and adaptation require a flexible, multi-sectoral and inclusive approach. Failure to develop this type of approaches, without including individual (e.g., age, gender, education and disabilities, personal past experience), group (e.g., religion, ethnicity), or livelihood (e.g., capabilities, material and social resources) differences may worsen the conditions that mitigation and adaptation strategies were initially

addressing (Schipper, 2020; Meijer et al., 2019). The importance of inclusiveness of climate action has been captured in a broad range of reports, policies and initiatives including the United Nations Sustainable Development Goals (UN SDGs) (Gupta and Vegelin, 2016).

1.1.3 Climate change and sustainable development interconnection

The Sustainable Development Goals (SDGs) initiative along with the Paris Agreement represent major global multilateral efforts to mitigate and adapt to climate change impacts and promote sustainable development (Dagnachew et al., 2021). A growing body of evidence demonstrates that climate change impacts can hinder the achievement of most of the SDGs (e.g., Fleurbaey et al., 2014; von Stechow et al., 2016; IPCC, 2018; Fuso Nerini et al., 2019). This may become a constraint for simultaneous transition to a low-carbon society (IPCC, 2018; Gomez-Echeverri, 2018; Moreno et al., 2023). The strong interlinkage between climate change and SDGs creates both synergies and trade-offs that may either maximise or impede successful associated decision-making and co-benefits across multiple targets (Thornton and Comberti, 2017; Fuso Nerini et al., 2019; Dagnachew et al., 2021; Moreno et al. 2023). One of the examples is climate change-induced migration that was addressed by the Paris Agreement only in the context of migrants' vulnerability, while the SDGs recognize migration as one of the powerful drivers of sustainable development without mentioning how it might be altered by climate change (United Nations, 2015c). Nevertheless, climate action and vulnerability reduction are among the key factors in achieving a progress on SDGs, particularly in improving access to health services, ensuring food and water security, and reducing poverty and inequality. This, in turn, will increase population resilience against the climate change impacts (Pelling and Garschagen, 2019; Schipper, 2020; Fuso Nerini et al., 2019; Dzebo and Shawoo, 2023). However, none of these activities will be fully effective without consideration of population characteristics.

1.2 Filing the research gap: Climate change and gender landscape

The successful development and implementation of adaptation and mitigation strategies require, among others, a deeper understanding of the roles played by population's socio-economic and demographic characteristics in the climate change contexts and consequently, their inclusion in the respective processes. All these characteristics, including population age structure, size, spatial distribution, mortality and natality rates, education, poverty, life expectancy, and gender, predefine, to various degrees, a persons' capacity and ability to overcome climate change impacts.

Compared to other characteristics, gender is discussed more frequently in the climate change-related context, especially after the international recognition of gender non-neutrality of climate change impacts (UN Secretary-General, 2008; Pham and Saner, 2021). The term 'gender' is defined as relationships between men and women, boys and girls, with the determined behaviour, roles, expectations, rules, and practices (FAO, 1997; March et al., 1999; UNESCO, 2014). It is widely perceived as a core principle that "often governs the processes of production and reproduction, consumption and distribution" (FAO, 1997) shaping access to power, control over natural and financial resources, vulnerability, resilience and engagement in decision-making processes (UN Women, 2001; Sida, 2015). Understanding and addressing the disproportionate climate change effects experienced by women and men has

become one of the central points for vulnerability reduction and building resilience. The late 1990s were marked as a pivotal point, when gender/women issues began to be actively included into the climate change agenda. Among the notable milestones are:

- 1995 – the Beijing Declaration and Platform for Action that outlined a greater impact women face from environmental degradation, pollution, and resource depletion (United Nations, 1995).
- 2002 – the call of the Commission on the Status of Women to "mainstream a gender perspective into ongoing research and encourage the application of the research results in policies and programmes on the impacts and causes of climate change" (UN Commission on the Status of Women, 2002).
- 2008 – the acknowledgement of climate change as a non-gender-neutral phenomenon by the United Nations Secretary-General (UN Secretary-General, 2008).
- 2017 – the United Nations Framework Convention on Climate Change (UNFCCC) Gender Action Plan that set out objectives and activities to "advance knowledge and understanding of gender-responsive climate action and its coherent mainstreaming in the implementation of the UNFCCC … as well as women's full, equal and meaningful participation in its process" (UNFCCC, 2017).

Previous research works have discussed the linkages between gender differences in environmental attitudes and support for environmental policies (e.g., Greenbaum, 1995; Davidson and Freudenburg, 1996; Mohai, 1997) and women roles and their vulnerability in natural disasters in comparison to men (Enarson and Morrow 1998; Fothergill, 1999). In the early 2000s, the thematic focus shifted to climate change, ranging from its impacts on exacerbating gender inequalities and gender-based violence (e.g., Brody et al., 2008; Adzawla et al., 2019; Desai and Mandal, 2021), to the recent studies on the effects of the COVID-19 pandemic on already vulnerable to climate change gender groups (e.g., Belsey-Priebe et al., 2021; Nyahunda et al., 2021; Sifa et al., 2021). However, despite an apparent interconnection between these studies, it often remains difficult to draw a holistic perspective on climate change-gender interconnections due to thematic, geographical, and scaled scattering of the obtained findings. The works mainly focus on an interlinkage between gender/women and a specific activity, process or sector affected by climate change in a particular geographical region. For instance, Lama et al. (2021) discuss the complexity and nonlinearity of the interrelation between gender, migration, and climate change. The authors defined gender as an organising principle, and climate change as a risk modifier rather than an additional risk. Rahman and Khatun (2019) investigated the linkages between men's and women's vulnerability and water quality, salinity intrusion, land, socio-economic and demographic conditions that are affected by extreme weather events (e.g., cyclonic storms) in Bangladesh. Kironde et al. (2022) examined the insights and outcomes of gender inclusion in climate change and water policies, demonstrating existing gaps and challenges for the implementation in Tanzania. Gartaula et al. (2020) highlighted the interrelation between emissions reduction, female labour participation in the agricultural sector, and adoption of more effective rice production technologies in India. The study noticed that the potential benefits vary depending on the extent of women's engagement in the production and the agro-climatic conditions of the regions.

The climate change-gender interconnections contribute to a better understanding of their common ground, identification of critical points, trade-offs, and failures to

develop effective adaptation and mitigation solutions. The global nature of the climate change problem requires solutions that can have an effect on a similar scale. Consequently, being considered as one of the key elements of adaptation and mitigation, climate change-gender interconnections are needed to be explored by taking into account a holistic perspective.

1.3 Scope of the dissertation

1.3.1 Aim and objectives

Interconnections between climate change and gender are characterized by complex synergies and dynamics, continuous development, and ongoing mutual impacts. This PhD work aimed to investigate some key aspects of the climate change-gender interconnections and shed some light on their interactions in a variety of contexts in different geographical regions. The work was built around three main domains of climate change-gender interconnections: *vulnerability*, *empowerment*, and *benefits*, which are subject to thematic and geographical, regional, national or local level context (Figure 1.1). **Vulnerability** here is considered as a factor that has been amplified by gender imbalances in decision-making power, land ownership rights, access to natural and financial resources, information and knowledge, and gender-blindness/neutrality of climate change policies and action. **Leadership/Empowerment** is characterised by male domination, women's underrepresentation and their limited decision-making power from local to international levels. Empowerment provides women with opportunities to increase their social, economic, and political capacities and contribute to adaptation and mitigation strategies and related decision-making processes. **Benefits** are reflected in improved effectiveness of adaptation and mitigation solutions as result of gender/women considerations integration.

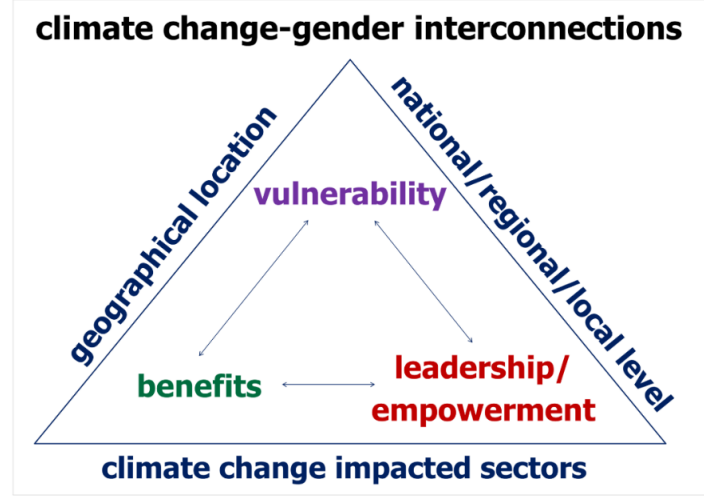


Figure 1.1 Domains of climate change-gender interconnections framework at meta level. Source: author.

To attain the main aim, this work focused on the following specific objectives that explored:

- how climate change research addresses gender and women issues;

- how changes concerning/progress on disbalances in gender empowerment and leadership are reflected in climate change adaptation and mitigation in African countries;
- how gender and women considerations and needs are perceived in the climate change context in the Central Asian countries.

Additionally, the work looked at

- how changes in gender balance of those who have been engaged in agriculture affected the sector;
- where stands gender in the climate change-induced extreme events and mental health context in the Pacific region;
- how gender as a cross-cutting issue interact with the SDGs towards their implementation and attainment of SDGs; and
- how gender issues are perceived within the context of climate change-induced migration in Kenya and Ethiopia.

These are the aspects that could be considered as one or more sub-domains of the climate change-gender interconnections. Figure 1.2 shows the research implementation roadmap for this PhD research. The work deploys a variety of methods, which include literature reviews, content analysis, bibliometric analysis and on-line surveys. For the purposes of this research, in some cases the terms 'gender' and 'women' terms were used interchangeably, and 'gender groups' were referred to men and women groups. The following approach could be influenced by the specific social and cultural environments in the investigated countries, as well as by the size and scope of the impacts that women and men groups make in the climate change adaptation and mitigation context at the global level.

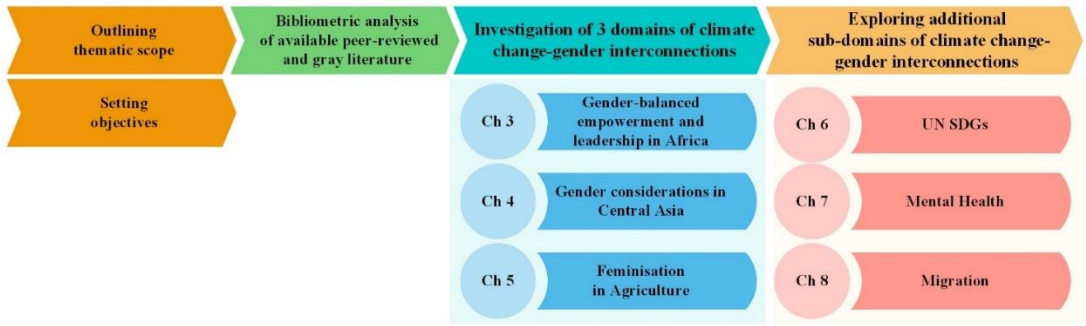


Figure 1.2 Research implementation roadmap. Source: author.

1.3.2 Structure of the dissertation

The structure of this dissertation follows the objectives set out above. Chapter 2 explores the overall developments of inclusion of gender/women issues in scientific contributions in climate change research and the main themes that can be referred to the vulnerability, leadership/empowerment, and/or benefits domain(s) of climate change-gender interconnections. Chapter 3 discusses the leadership/empowerment domain based on analysis of the advances made towards attaining gender-balanced leadership/empowerment in climate change adaptation and mitigation in 12 African countries. Chapter 4 investigates the progress made on including gender/women considerations by climate change-related in CA countries. Chapter 5 reviews climate change-gender interconnections in terms of feminization, its drivers, positive and negative outcomes, and associated challenges within the broader agricultural context

in different geographical regions including Latin America and CA. Chapters 6, 7 and 8 explore several additional domains of climate change-gender interconnections in the context of additional issue areas such as the successful SDGs implementation, extreme events and mental health, and climate change-induced migration. The last chapters synthesize the obtained findings, discuss their implications and provide an outlook for future research.

2. Gender issues within climate change research: a bibliometric analysis

This chapter was published as Kovaleva, M. et al. (2021) *Climate and Development*, DOI: 10.1080/17565529.2021.1980365

2.1 Abstract

The last decades are recognized as a period when a gender-sensitive perspective being broadly acknowledged by the majority of actors involved in the field of climate change. Existing gender inequalities exacerbated by climate change urge the inclusion of a differentiated female-male approach into research, decision-making processes, adaptation, and mitigation. This paper quantitatively reviews scientific contributions in the gender subfield within climate change research published between 1996-2020 by adapting a bibliometric analysis approach. The literature was extracted from Web of Science, Google Scholar, and World Bank's repositories. The results of the co-occurrence, bibliographic coupling, co-citation, and co-authorship analyses were mapped by using the VOS viewer software. The selection criteria were developed to maximize the thematic coverage of the publications that could be referred to the gender subfield within climate change research. The findings help better understand the overall developments in the gender subfield in terms of discussed topics, authors and institutional collaborations, contributions of international organizations in the capacity of authors, and an amount of grey literature. The review might represent an interest for further studies in consideration of new research topics, geographical focus, compositions of co-authors teams, and be communicated in debates on gender within the climate change context.

3. Understanding Needs and Potentials for Gender-Balanced Empowerment and Leadership in Climate Change Adaptation and Mitigation in Africa

This chapter was published as Kovaleva, M. et al. (2022) *Sustainability,* DOI: 10.3390/su14159410

3.1 Abstract

The past years were marked by the COVID-19 pandemic, economic downfall, the 5th anniversary of the Paris Climate Agreement, and the end of the African Women's Decade. According to the latest projections, African countries will continue to face increasing inequalities, as well as risks to human health, water and food security, due to climate change. African countries are also struggling to reduce gender-related power imbalances in adaptation and mitigation that magnify existing vulnerabilities, particularly those of women. Therefore, any advances made in this narrative are significant. This paper investigates the needs and potential for gender-balanced leadership/empowerment in adaptation and mitigation based on climate change experts' views on the advances made in Africa. This is complemented by a bibliometric analysis of the literature published on the topic between the years 2015 and 2022. The study suggests that although women's influence on climate change related decisions is growing, a series of barriers need to be overcome, among which are lack of knowledge and political will. The COVID-19 pandemic is seen as having both positive and negative potentials for gender-balanced leadership/empowerment. The findings provide a premise for identifying possible directions of further actions towards gender-balanced leadership/empowerment in climate change in African countries.

3.2 Introduction: Climate Change–Gender Interconnections

The continuous climate crisis poses a threat to the already fragile ecosystems, livelihoods, health, food and water security, increasing poverty and marginalization. Climate change and *its* related issues have been investigated in various contexts in relation to a wide range of factors. One such factor is the inclusion of a gender variable. The United Nations acknowledged climate change as a non-gender-neutral phenomenon (UN Secretary-General, 2008) and the United Nations Framework Convention on Climate Change (UNFCCC) called " . . . to advance knowledge and understanding of gender-responsive climate actions . . . as well as women's full, equal and meaningful participation in its process . . . " (UNFCCC, 2017). Inequalities between gender groups have economic, political and social implications regarding how and whether individuals are affected by and respond to climate change (Björnberg and Hansson, 2013; Rohr, 2007; IPCC, 2014b). Therefore, it is vital to understand climate change–gender interconnections, which are characterised by their complex synergies and dynamics, continuous development, and ongoing mutual impacts across all levels and dimensions. The majority of the studies are very often evidence-based and focus on the interconnection within a specific thematic and geographical context, at the regional, national, or community level. For instance, Mensah et al. (2022) investigated gender differences in adaptation strategies and climate change perception among smallholder farmers in a semi-arid region of Africa. Bunce and Ford (2015) discussed the connections between gender and adaptation, resilience, and vulnerability research. The authors pointed out that the

investigations are strongly focused on women's experiences (Bunce and Ford, 2015). von Lander Svendsen et al. (2022) investigated the mutual impact of gender and climate policies, including equality in respective decision-making processes, in the Nordic countries.

Pearse (2016) analysed gender and climate change relations in a broader context. The study was focused on five dimensions: (i) vulnerability and climate change impacts; (ii) adaptations in various contexts; (iii) responsibility for greenhouse gas emissions; (iv) inequalities in climate governance; (v) knowledge and social action on climate change. The author also indicated a key role of gender in social transformation in connection to climate change (Pearse, 2016). Brody et al. (2008) extended the scope by linking the climate change–gender interconnections to (i) health; (ii) agriculture; (iii) water; (iv) wage labour; (v) disasters and their aftermath; (vi) migration; (vii) conflict (Brody et al., 2008). In 2016, Global Gender and Climate Alliance (GGCA) report illustrated how gender differences shape vulnerability to climate change and decisions on its adaptation, including policy issues and health impacts (Sellers, 2016).

In the broader scope, i.e., at the meta-level, climate change–gender interconnections can be clustered into three thematic domains: vulnerability, benefits and leadership/empowerment.

Climate change **vulnerability** is subject to gender differences. Women face climate change threats and struggle to overcome its challenges to a greater extent, as they have fewer means and adaptive capacities than men (e.g., Lambrou and Piana, 2006; Alston, 2013; Reggers, 2019; FAO and ARC, 2021; Eskenazi et al., 2020). Moreover, their vulnerabilities are amplified by gender imbalances in decision-making power, land ownership rights, and access to natural and financial resources, information and knowledge (Khandekar et al., 2019; Habtezion, 2013; Yadav and Lal, 2018; Kabir et al., 2016). Very often, governments delay in introducing the gender variable to adaptation and mitigation processes and national climate policies (Khandekar et al., 2019; Nhamo, 2014; Least Developed Countries Expert Group, 2015; Ford et al., 2015). Gender-blind or gender-neutral measures and policies create additional barriers to reducing and easing women's vulnerability (e.g., Habtezion, 2016; Davis et al., 2015).

On the other hand, attaining a gender balance might provide a range of climate change-related **benefits**. The effectiveness of adaptation and mitigation solutions can be significantly improved as a result of gender inclusion and the more active involvement of women, who are perceived as powerful agents of change to address climate change at scale (Glemarec et al., 2016; Dankelman, 2010; Glazebrook, 2011; Osman-Elasha, 2013; Aguilar et al., 2015; IUCN, 2015; Cook et al., 2019). Furthermore, more gender-balanced representation in decision-making positively affects the integration of climate-smart agricultural technologies, the ratification of climate treaties, the building-up of community resilience and improvements in adaptive capacities (e.g., Habtezion, 2016; Andrijevic et al., 2020; FAO, 2011; Carvajal-Escobar et al., 2008; FAO and CARE, 2019; Dar et al., 2020; Oyawole et al., 2020; Glazebrook et al., 2020). According to estimations, the 20–30% increase in productivity achieved by women farmers would reduce the number of undernourished people by 100–150 million worldwide (FAO, 2011).

Leadership, empowerment, and their associated processes are crucial in confronting and overcoming global challenges such as climate change and its impacts (Parker et al., 2015; United Nations, 2015a). Similar to other processes, leadership/empowerment in climate change is characterised by male domination, and

women have limited decision-making power from local to international levels (FAO, 2020d). Empowerment aims to reduce power imbalances and provides women with opportunities to increase their social, economic and political capacities and make strategic choices that, in turn, contribute to adaptation strategies and related decision-making processes (UNDP, 2007; Chen and Tanaka, 2014; Mekonnen, 2022; Habib et al., 2022).

Table 3.1 provides examples of specific climate change–gender interconnections for each domain: vulnerability, benefits or leadership/empowerment. Given the enormity and diversity of the works, particularly at the local level, the list of included studies is far from being exhaustive.

Table 3.1 Climate change–gender interconnections. Source: author.

Domains	Interconnections (Selected)	Description	Reference
Vulnerability	Natural disasters and extreme weather events	Natural disasters: extreme weather events and their subsequent impacts might disproportionately affect different gender groups, increasing existing inequalities, and undermining their water and food security. The events also narrow the gender gap in life expectancy.	IPCC (2014b), Neumayer and Plümper (2007), Soroptimist International of the Americas (2011), Racioppi and Rajagopalan (2016), FAO (2017a), Patel et al. (2020)
	Climate change-induced displacement/ migration	Climate-induced displacement is caused by an individual's inability to adapt to the environmental and the socio-economic consequences of climate change as a result of inequalities or a lack of resources. It is triggered by direct physical harm from extreme weather events or slow-onset impacts, indirect consequences on food insecurity and conflict over natural resources and land rights. Women represent more than half of displaced people. Very often, they face an increased risk of domestic or sexual violence and deterioration in their physical, emotional and mental health, and have less access to relief resources.	CARE (2020), Sams (2019), Rigaud et al. (2018)
	Unequal adaptive capacities	Gender groups have unequal adaptive capacities due to a lack of or limited decision-making powers, assigned roles and tasks, labour division, gender-biased legislation, limited access to and availability of technology, economic capital and productive resources, and gaps in literacy level, health and nutritional status.	IPCC (2014b), Khandekar et al. (2019), FAO (2017a), Patel et al. (2020)
	Limited or no access to information, education, knowledge	Gender inequalities in access to education and information are among the key causes of vulnerability to climate change that decrease an individual's ability to build up resilience to its impacts.	Habtezion (2013), Yadav and Lal (2018), Kabir et al. (2016)

	Limited or no access to resources (e.g., natural, financial, etc.), ownership rights	Socio-cultural gender roles and norms that determine access to resources and (land) ownership rights influence and shape an individual's vulnerability. Very often, women have limited or no access/rights.	Khandekar et al. (2019), Habtezion (2013), Sen Roy (2018a), Mnimbo et al. (2016)
	Gender-blind climate finance/policies/interventions	Gender-blind climate finance might reinforce climate change vulnerabilities. Very often, funding institutions lack a gender perspective in their policy frameworks. Prior to 2015, projects that address climate change and women's rights received 0.01% of worldwide funding support. The efficacy and effectiveness of mitigation and adaptation interventions might be significantly reduced due to the exclusion of gender issues from climate-related projects and policies, although, in recent years, the situation has been changing.	Habtezion (2016), Davis et al. (2015), GEF Independent Evaluation Office (2017), Schalatek (2018)
Benefits	Agents of change	Women are powerful agents of change to address climate change at scale.	Habtezion (2016), Glemarec et al. (2016)
	Gendered-balanced participation and engagement	Women's increased participation in decision-making processes at various levels of governance makes considerable contributions to natural resource management, biodiversity conservation efforts, ratification of international environmental treaties, building community resilience and responding to climate-related disasters. Their expertise and experience contribute to the reduction in adverse impacts and accelerate the development of technological innovations to address climate change.	Yadav and Lal (2018), Habtezion (2016), Leisher et al. (2016), Loarne-Lemaire et al. (2021)
	Climate resilience and adaptive capacity	A reduction of gender imbalances is one of the most effective mechanisms in the development of climate resilience and adaptive capacity, which, in turn, improves food security.	Glemarec et al. (2016), Andrijevic et al. (2020), Doss (2018)

	Paris Agreement	Support of gender equality and women's rights is one of the most powerful ways to implement the Paris Agreement.	Glemarec et al. (2016)
Leadership/ Empowerment	Equal representation on boards/ administrative and political bodies	Equal gender representation in administrative and political bodies engaged in climate change contributes to effective climate change policies. However, sometimes, having a critical number of women on these bodies does not directly lead to the development of gender-sensitive climate change policies and/or the inclusion of gender differences in climate issues.	Loarne-Lemaire et al. (2021), Magnusdottir and Kronsel (2015)
	Underrepresentation	There is a gender gap in representation (women are underrepresented) in climate-change-related decision-making processes in climate governance, including in international delegations on UNFCCC bodies.	FAO (2020d), UNFCCC (2021)
	Adaptation strategies and decision-making	Adaptation capacities to climate change are positively influenced by women's empowerment and decision-making power.	Mekonnen (2022), Habib et al. (2022)

The current work focuses only on climate change–gender interconnections in the leadership/empowerment domain in a specific geographical region. More precisely, the paper investigates the needs and potentials for gender-balanced leadership/empowerment in climate change adaptation and mitigation, based on the views and perspectives of climate change experts regarding the advances made in a number of African countries over the last five years. The study is complemented by a bibliometric analysis (i.e. keywords and terms co-occurrence analysis) of the literature on women's leadership and empowerment in climate change in the region published between the years 2015 and 2022.

The continuously increasing role of African nations in the global climate change negotiations, a growing action on the national level, and the transformation of women's role as an agent of change lead to the need to ensure that gender imbalances in leadership and empowerment will be thoroughly addressed and not neglected along the way. Therefore, it is essential to demonstrate the implications of the steps that have been already taken towards attaining equality, to outline additional potential benefits and reductions in risk, in addition to simple improvements in gender-disaggregated statistical data.

The work contributes to the current literature by providing initial insights on the outcomes of the advances made in recent years. The findings can form a basis to show the importance of the measures that could be taken towards more gender-balanced leadership and empowerment in the climate change adaptation and mitigation context.

The following two sections discuss the aspects of climate change–gender leadership/empowerment interconnections and the characteristics of gender leadership/ empowerment in climate change in Africa. The fourth section describes the methods used. The penultimate section presents the obtained findings and their implications for gender-balanced leadership and empowerment in climate change. The paper concludes with a summary of the findings and the study limitations.

3.3 Climate Change-Gender Interconnections in Leadership/Empowerment

Climate change leadership and empowerment with reference to gender issues at international, national or sectoral levels vary depending on a range of factors, among which are economic development, political will, strong social rules, and beliefs. Gender imbalances in this context are perceived as one of the hindrances to more effectively addressing climate change stressors and impacts. Therefore, recent decades have been marked by initiatives to attain gender parity in climate leadership roles in governance bodies and boards across countries, sectors and levels of implementation.

The intermediate analysis of the progress made by the United Nations Framework Convention on Climate Change (UNFCCC) demonstrated that equal or female-dominated representation was only reached in the Adaptation Committee (AC) in 2018–2020, Consultative Group of Experts (CGE) in 2013 and 2016, and Paris Committee on Capacity-Building (PCCB) in 2017–2020. Figure 3.1 shows the female/male ratio of the representatives on UNFCCC boards and bodies during the period 2013–2020. Values below 1 signify the prevalence of male representatives on a board or body in a particular year. Figure 3.2 presents the share of women who occupied the leadership position of Chair, Co-Chair or Vice Chair on these boards and bodies from 2013 to 2020. The percentage value is calculated based on the total number of female representatives on a board or body in that year. The results indicate that even the bodies/boards with a prevalence of female representatives are often

male-chaired, such as the Consultative Group of Experts (CGE) in 2013 and 2016 (Figures 3.1 and 3.2). Both figures exemplify the challenging nature and complexity of the processes to achieve a significant reduction of gender gaps and attain gender parity in leadership positions in climate change related bodies. Thus, it can be assumed that similar processes at lower (e.g., regional, national and community) levels might be characterised by even larger barriers, hindrances, and complexity.

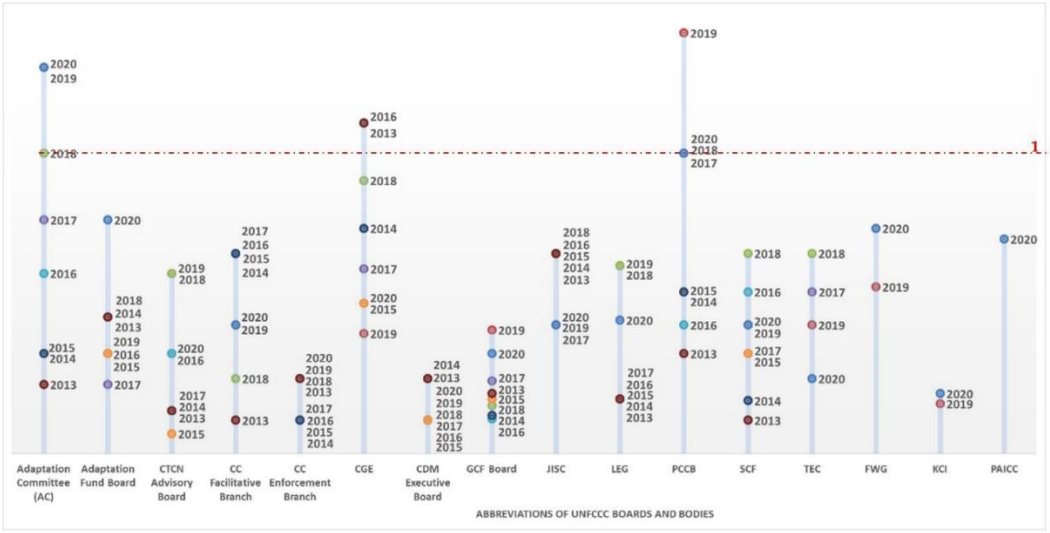


Figure 3.1 Female/male ratio of the number of the representatives on UNFCCC boards and bodies between the years 2013 and 2020, except TEC; the data have been available since 2017, FWG and KCI—since 2019, PAICC—since 2020 (based on Gender Climate Tracker); full body names are listed in Appendix I. Source: author.

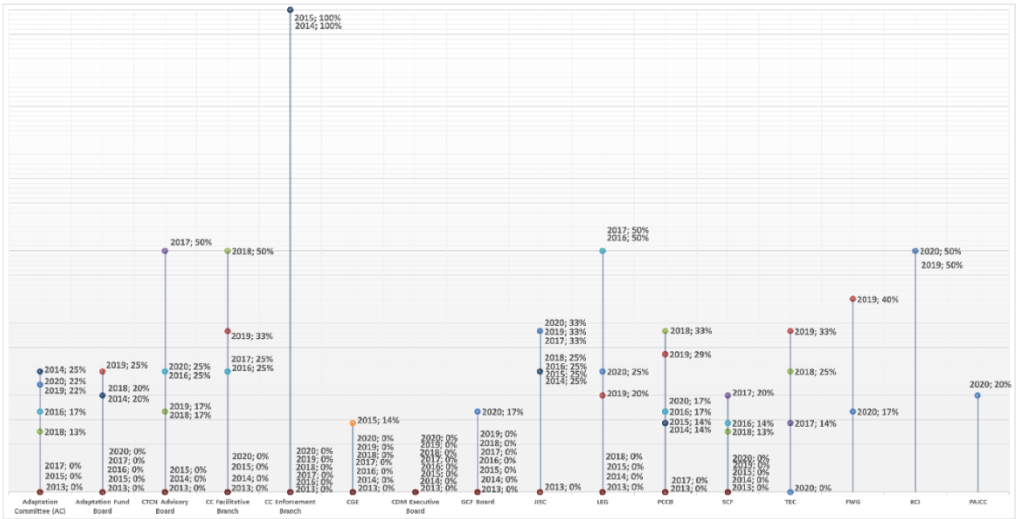


Figure 3.2 Percentage of Female Chair, Co-Chair or Vice Chair out of the total number of female representatives on UNFCCC boards/bodies between the years 2013 and 2020, except TEC; the data have been available since 2017, FWG and KCI—since 2019, PAICC—since 2020 (based on Gender Climate Tracker); full body names are listed in Appendix I. Source: author.

At the national level, according to the National Adaptation Plan (NAP) Global Network Synthesis Report, only a few nations place women as stakeholders or as agents of change rather than victims and indicate their empowerment as a priority in

adaptation measures (Dazé and Dekens, 2018). Holvoet and Inberg (2014) suggested that having a woman lead the governmental agency responsible for drafting a National Adaptation Programme of Action (NAPA) does not always actively contribute to gender inclusion, women's participation, or expertise on gender in the programme or its related decision-making processes and evaluation. However, Mavisakalyan and Tarverdi (2019) suggested that women's representation in national parliaments significantly contributes to the acceptance of more rigorous climate change policies across countries. Such contrary findings might exemplify not only the topic's complexity but also the still low number of studies, and inconsistencies in research methodology or estimation approaches. Nevertheless, these factors do not oppose the need to reduce gender imbalances in climate change leadership and empowerment. Similarly to the situation at the international level, these processes are hindered by a range of economic, political, and cultural aspects, among which are societal resistance, lack of education, insufficient knowledge, lack of motivation or confidence, mainly among women (Wen et al., 2013; Pham and Brockhaus, 2015). Numerous case studies demonstrate diverse solutions and approaches to overcoming some of these barriers. For instance, in India, local women leaders created their own groups to adapt to the effects of climate change, increase resilience, and receive access to international sources of income and capacity-building (Christoff et al., 2019). The BSR's Business Action for Women offered the cluster "Empowering Women to Lead through Climate Resilience", which supports women's empowerment in climate-resilient agriculture in the private sector by promoting gender-sensitive climate resilience methods and strategies (Harris and Abbott, 2018).

In the business sector, the gender discrepancies in leadership are about two times larger than they are in labour-force participation (Woetzel et al., 2015). As of January 2022, only 6.6% of CEO positions in the companies listed in the SandP 500 list are occupied by women (Catalyst, 2022). In 2021, 31% of senior leadership roles were held by women globally and 90% of firms had at least one woman in senior management (Grant Thornton, 2021).

In the United States, the energy sector is mainly characterised by the overrepresentation of male leaders (Pearl-Martinez and Stephens, 2016), although female leadership plays a significant role in advancing energy system transformations (Allen et al., 2019). Increasing investments in renewable energy, and companies' more effective commitment to climate change management, including the implementation of climate policies and carbon performance, have been linked with gender diversity in companies' leadership (Pearl-Martinez and Stephens, 2016; Allen et al., 2019; Jizi et al., 2021) and particularly with having a critical number of women in top management teams (Nuber and Velte, 2021; Caby et al., 2022).

3.4 Gender Leadership/Empowerment in Climate Change in the African Context

Characteristics of gender leadership/empowerment in climate change in the region have been continuously changing as a result of the efforts to reduce the imbalances and transform of women's position. Nevertheless, the role of women in African countries remains dependent on geographical location and their belonging to a specific religious or ethnic group (Punnett and Clarke, 2017). These factors create further challenges and complexities in terms of gender dynamics when shaping leadership/empowerment in climate change at every level. According to the Global Gender Gap Index, the gender-based gap that needs to be closed in the Political

Empowerment dimension in African countries ranges between 44.7% (Rwanda), 50.7% (Mozambique), 95.3% (Nigeria), and 99.9% (Yemen) (World Economic Forum, 2021). The studies also demonstrate men's overrepresentation in decision-making processes in the sectors sensitive to climate change (Dekens and Dazé, 2019).

Addressing gender gaps in leadership and empowerment significantly contributes to reducing vulnerability and building resilience while the continent faces high exposure to climate change and its impacts, with low adaptive capacities (Niang et al., 2014). National governments, with the support of international organisations, introduced and implemented a set of programs (e.g., Africa Adaptation Programme (AAP)) aimed at women's empowerment, more active engagement in decision-making processes and capacity-building. The ratification of key international documents, such as the Convention on the Elimination of All Forms of Discrimination Against Women and the African Union's Protocol on the Rights of Women in Africa, paves the road for more women to enter the labour market and be promoted to managers and leaders (Punnett and Clarke, 2017). The McKinsey Global Institute study found that if North Africa, the Middle East and sub-Saharan African countries reached their fastest-moving neighbour gender parity performance, they would contribute about USD 0.9 trillion to the global gross domestic product (GDP) in 2025 (McKinsey, 2015).

In 2013–2014, the African Working Group on Gender and Climate Change (AWGGCC) and Women and Gender Programme on Climate Change were established to support the engagement of African countries in global and regional climate change-gender processes, as well as the participation of women negotiators in climate action (AWGGCC, 2017). At the national level, 85% of the submitted Nationally Determined Contribution (NDC) reports referenced gender (Remteng et al., 2021). Furthermore, countries supported by the international community introduced a range of initiatives with the inclusion of the gender variable. For instance, in Niger, the gender dimension was included in the Climate Risk Management Technical Assistance Project (CRM/TASP). A gender intervention approach, "Transformative Adaptation Prioritizing the Adaptation Needs of Women in the AAP", focused on climate change adaptation, was presented in Nigeria. In Kenya, steps were taken to mainstream gender into the country's climate change response strategy and to improve women's ability to adapt to climate change impacts through their empowerment (Least Developed Countries Expert Group, 2015).

Despite the growing trend of this type of action, the majority of studies at present focus on or refer to one of these two issues: (i) gender imbalance, its causes, and associated impacts, (e.g., Holvoet and Inberg, 2014; Makinaa and Moyob, 2016; Angula et al., 2021; Patnaik, 2021); (ii) actions taken to reduce these, (e.g., Babugura, 2010; Wagner et al., 2015; Grillos, 2018; Nyahunda, 2021).

3.5 Materials and Methods

The study used two methods: a bibliometric analysis and an online questionnaire.

3.5.1 Bibliometric Analysis

Bibliometric analysis has attracted growing attention among scholars as a tool to evaluate the relevant scientific literature and identify publication trends and research elements. This analysis was performed to outline prominent themes in the climate change–gender domain in leadership/empowerment in selected African countries. The datasets used included peer-reviewed and grey literature, retrieved from the Web

of Science (WoS) core collection, Scopus, and Google Scholar (GS) databases. These three databases represent the largest collections of scientific and scholarly publications published worldwide. The downloaded datasets included such variables as publication title, keywords, abstract, authors' name, year of publication, and journal name. However, only the first three variables were used for analysis and the rest were used for cross-checking and the elimination of duplicates.

Table 3.2 the search data range was limited to the years 2015–2022 and specific geographical locations. The datasets were retrieved in February 2022. Only publications in English were selected.

Table 3.2 Selection criteria. Source: author.

Criteria	Description
Data range	2015–2022
Language	English
Type of publication	All types available in the collections
Databases	Scopus, Web of Science, Google Scholar
Geographical focus	Selected African countries

The search query returned publications where the defined key terms appeared in titles and abstracts or as keywords. The main key terms were 'climate change', terms associated with 'leadership' and 'empowerment', and names of the online questionnaire respondents' countries. It is worth mentioning that, in this article, the terms 'gender' and 'women' were used as synonyms.

The set of the Google Scholar publications was retrieved using the Publish or Perish software program (Harzing, 2007) based on the appearance of indicated keywords similar to those used for the Scopus and WoS search. The full search strings included the following key terms, attributes, and Boolean operators:

Web of Science:

TS = ((wom*n OR gender) AND ("climat* chang*" OR "climat* adapt*" OR "climat* mitigat*") AND (leader* OR empower* OR "decision-making" OR negotiat*) AND (afric* OR tanzan* OR niger* OR kenya OR cameroon OR gambia OR eswatini OR congo OR uganda OR ethiopia OR tunis*)) Data range: 1 January 2015 to 26 January 2022.

Scopus:

TITLE-ABS-KEY ((wom*n OR gender) AND ("climat* chang*" OR "climat* adapt*" OR "climat* mitigat*") AND (leader* OR empower* OR "decision-making" OR negotiat*) AND (afric* OR tanzan* OR niger* OR kenya OR cameroon OR gambia OR eswatini OR congo OR uganda OR ethiopia OR tunis*)) AND (PUBYEAR > 2014)

Google Scholar:

Keywords: (women OR gender) AND ("climate change" OR "climat* adaptation" OR "climate mitigation") AND (leader OR empowerment OR "decision-making" OR negotiation) AND (africa OR tanzania OR niger* OR kenya OR cameroon OR gambia OR eswatini OR congo OR uganda OR ethiopia OR tunisia) Years: 2015 to 2022; Other options: exclude citations; exclude patents.

Both the joined Scopus/WoS and Google Scholar (GS) datasets were used as the input data for co-occurrence analysis. This was based on keywords and terms that appeared in the titles and abstracts of the publications included in each dataset (van Eck and Waltman, 2014). Titles, keywords, and abstracts were considered to effectively describe and reflect papers' contents (Springer, 2020). This type of

analysis is a favourable tool to identify prominent topic clusters. The VOSviewer software (van Eck and Waltman, 2010) was used to conduct the analysis and visualise its results in the form of network maps. Each node in a network represents a term or keyword. The size of the node indicates the occurrence of the term/keyword; the larger the node, the higher the occurrence of the term/keyword. All nodes are divided into thematic clusters, which are differentiated by colours.

3.5.2 Online Questionnaire

The online questionnaire was developed to collect the opinions of experts who are engaged in climate-change-related field(s) in African countries on the advances made to attain gender-balanced leadership/empowerment in climate change adaptation and mitigation.

The set of 40 questions was characterised by several different types of question, including closed and open-ended questions. The Likert scale was used to assess respondents' agreement/disagreement with a particular situation, state, or achievement. A relatively large number of open questions was included to provide respondents with more opportunities to share their experiences and comments, rather than limiting their responses to already provided specific answers. This questionnaire structure was chosen to reduce authors' biases, which might affect the range and direction of close answers. Consequently, it was expected that this may result in a lower-than-usual number of questionnaire respondents. The responses were collected anonymously, and respondents were asked for their consent. The questions referred to the period of the last five years.

Thematically, the questions were divided into several blocks: (i) questions on respondents' characteristics (e.g., country, experience and engagement in climate change related field(s), etc.), (ii) questions focused on women's/men's situation regarding climate change in their country, (iii) questions focused on advances made in the field over the last five years, and (iv) questions asking the respondents to share their comments on possible solutions.

The initial set of questions was reviewed by external experts from related fields. The latest version of the questionnaire was adjusted based on their comments and recommendations. The MS Excel software was used to conduct the statistical analysis and visualise the obtained findings. The invitation to participate in the questionnaire was distributed via a number of thematic expert networks and mailing lists. The voluntary nature of participation reduced the number of respondents to those who expressed their interest in sharing their opinion and views on the matter based on their experience. The participants were not necessarily gender experts, nor did they all participate in gender mainstreaming activities. The type of expertise and geographical diversity of the respondents were not predefined, and the instrument was open to experts engaged in climate change related fields from any African country.

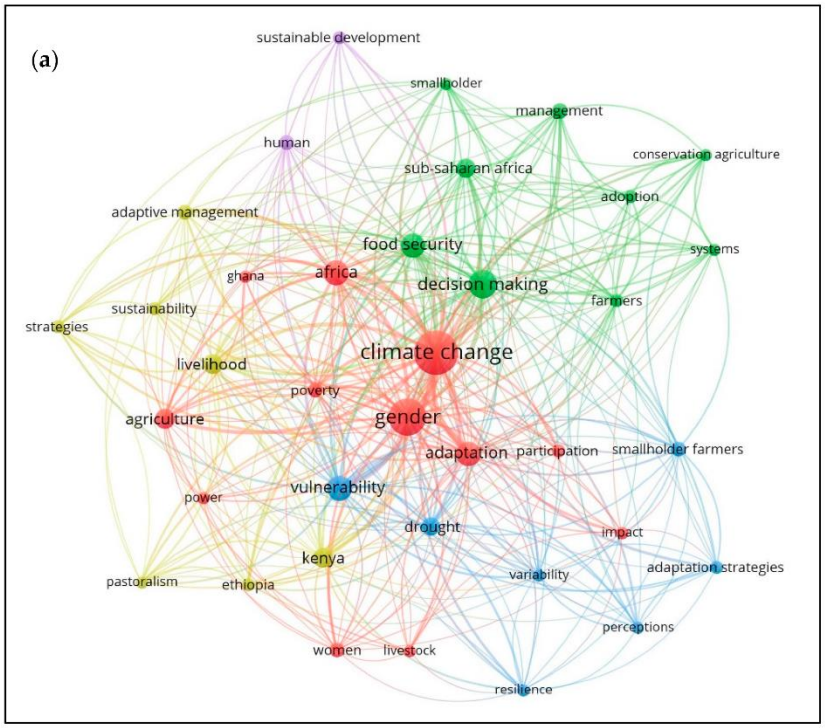
3.6 Results and Discussion

3.6.1 Bibliometric Analysis

The results of the bibliometric analysis based on the joined (Scopus/WoS) dataset of 137 publications and the GS dataset of 995 publications outlined the following characteristics of the overall thematic structure of the climate change–gender domain in leadership/empowerment in the selected African countries. The large difference in

the number of retrieved publications demonstrated a significant prevalence of the grey literature. This leads to the conclusion that topics relevant to this domain are of more interest among civil society and international development organisations compared to the scientific community. It might also imply that the respective literature mainly discusses the applied rather than the theoretical aspects.

The co-occurrence analysis demonstrated that, thematically, the domain is divided into five major clusters based on keywords (Figure 3.3(a,b)), and into four (Scopus/WoS dataset) and six (GS dataset) clusters based on terms (Figure 3.3(c,d)). The maps of terms are more comprehensive and complement the co-occurrence maps of keywords. By analysing all clusters, the thematic structure of the domain could be outlined as follows. The key topics discussed that pertained to climate change–gender in leadership/empowerment were those related to agriculture, food security, vulnerability, adaptation mechanisms, resilience, gender gaps and differences. The prominence of 'agriculture' and related issues is apparent, due to the multiple threats that climate change poses to the sector, including threats to wellbeing, livelihood and food security (Campbell et al., 2016; Mbow et al., 2019; Zakari et al., 2022; Pickson and Boateng, 2022). Furthermore, the rural population, which comprises, on average, about 52% of the total population in Africa (TheGlobalEconomy.com, 2022) and mainly relies on agricultural activities, is becoming more vulnerable, particularly women who are poorer and have less access to, e.g., financial and natural resources, knowledge and information, limited or no land ownership rights, and lower adaptive and coping capacities (Mekonnen, 2022; Adzawla et al., 2020; Afriyie et al., 2018). On the other hand, the effectiveness of adaptation mechanisms depends not only on their gender sensitivity but also on women's inclusion in decision-making processes and their presence in leadership positions on relevant boards and bodies, due to the significant positive contributions that women make to climate change solutions (e.g., Least Developed Countries Expert Group, 2015; Cook et al., 2019; Mavisakalyan and Tarverdi, 2016; Grillos, 2018; Huyer, 2016).


(a)
sustainable development
smallholder
management
human
conservation agriculture
sub-saharan africa
adoption
adaptive management
food security
systems
ghana
africa
decision making
farmers
sustainability
strategies
climate change
livelihood
poverty
agriculture
gender
adaptation
participation
smallholder farmers
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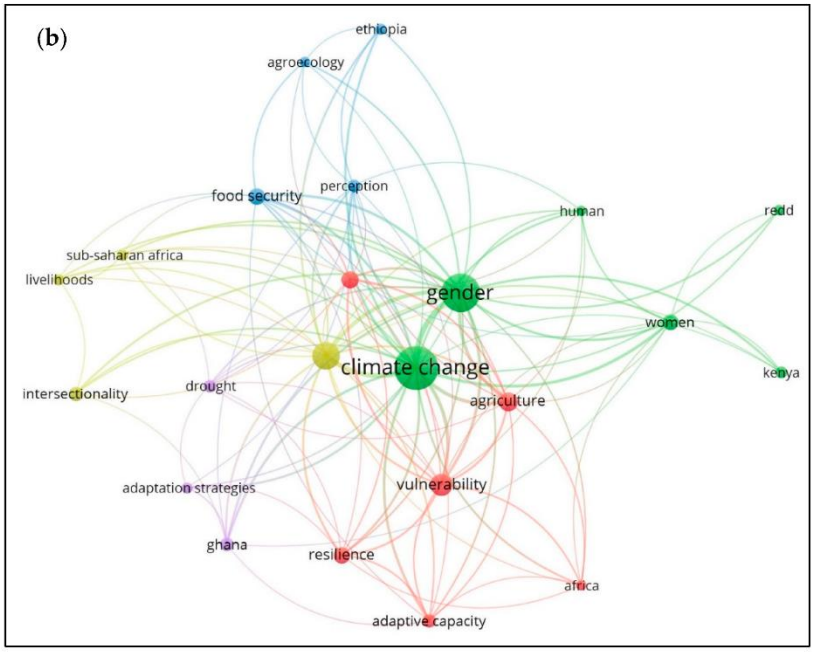
(b)
ethiopia
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sub-saharan africa
livelihoods
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drought
agriculture
adaptation strategies
vulnerability
ghana
resilience
africa
adaptive capacity

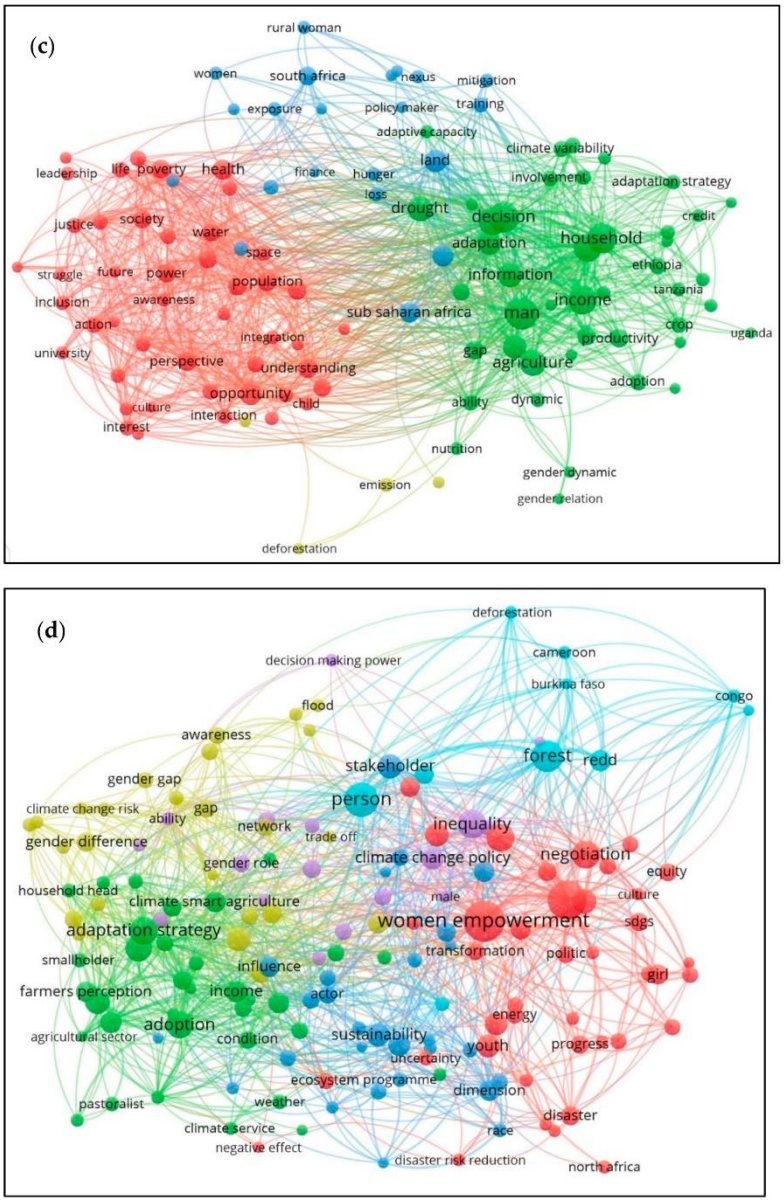


Figure 3.3 (a) Co-occurrence map of keywords (Scopus/WoS dataset); (b) Co-occurrence map of keywords (GS dataset); (c) Co-occurrence map of terms (Scopus/WoS dataset); (d) Co-occurrence map of terms (GS dataset). Created with VOSviewer. Source: author.

In terms of geographical locations, only certain countries (e.g., Ethiopia, Kenya, Cameroon) were included in the clusters. These results might imply that the climate change–gender in leadership/empowerment theme received unequal attention among researchers across different countries in the African region. Furthermore, it could also be assumed that the number of relevant development programs and initiatives implemented by civil society and international organizations varies geographically, since these activities are usually accompanied by a set of publications (e.g., reports, briefs, letters, etc.) and are added at least to the GS database.

It is worth mentioning that ‘COVID-19′ and the associated terms/keywords were not included in any cluster, meaning that the number of works in this domain with a connection to the COVID-19 pandemic is still significantly low, even though there

are works on climate change–gender without connection to leadership/empowerment (e.g., Akrofi et al., 2021; Nyahunda et al., 2021; Belsey-Priebe et al., 2021).

3.6.2 Online Questionnaire

3.6.2.1 Respondents' Characteristics

Thirty experts from South Africa, Tunisia, Uganda, Nigeria, Niger, Cameroon, DR Congo, Kenya, Gambia, Tanzania, Ethiopia, and Swaziland participated in the online questionnaire (Figure 3.4).

Figure 3.4 Countries of the respondents participated in the online questionnaire (created with Datawrapper). Source: author.

The respondents were representatives of academia, business, international, governmental, and non-profit organisations, working in one or more of the following fields: climate change assessment, climate change impacts, climate projections, climate change and conservation, climate change mitigation, climate change adaptation and resilience, climate education and climate change governance. Their international, regional, national or community working experience in the field(s) ranged from less than five years (7% of the respondents) to more than five (50% of the respondents), ten, and more (43% of the respondents) years.

3.6.2.2 Women's Leadership/Empowerment in Climate Change

The dynamics between the economic sectors and climate change is characterised, among others, by the gendered support received by individuals engaged in the sector. The respondents were asked to compare and indicate sectors in which women are better-supported than men and vice versa. Based on their assessment, women are supported best in agriculture, followed by water and waste management (Figure 3.5). The attention paid to the agricultural sector is explained by its large share in total employment, i.e., 43.8% as of 2020 (OECD, 2021). Being on the frontline of the sector, women's participation in the labour force varies, on average, between 40 and 43% depending on the country, crop, and type of activity (Doss, 2014; Palacios-Lopez et al., 2017). Agriculture is characterised by gender imbalances in decision-making power and leadership, as well as by gaps in adaptive capacities to climate change (Mnimbo et al., 2016).

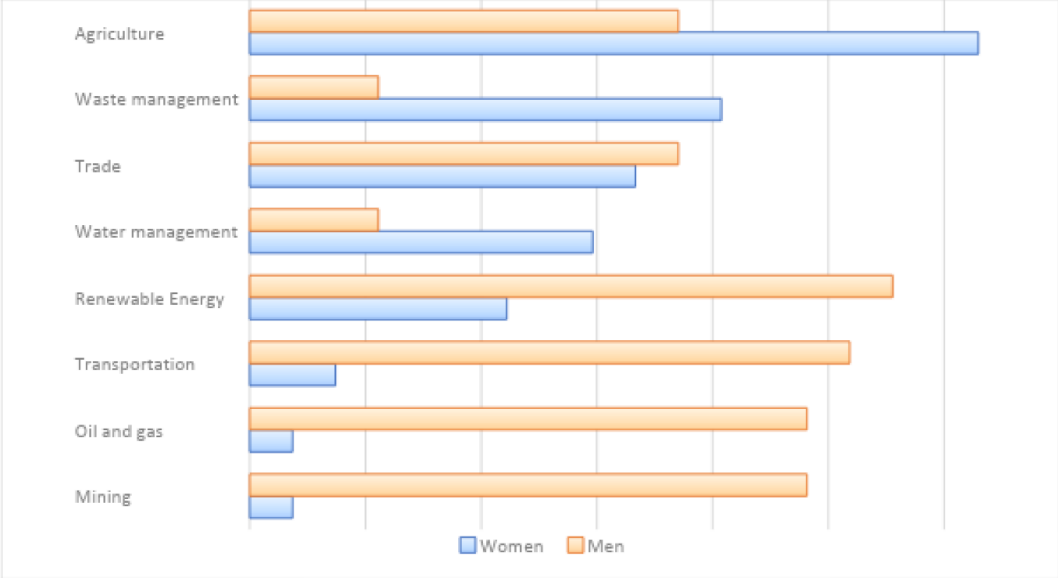


Figure 3.5 Sectors with better support. Source: author.

It is worth mentioning that the respondents named renewable energy, transportation, oil, gas, and mining as the sectors in which men receive better support than women (Figure 3.5). This opinion might be expected regarding oil, gas and mining, since these are often considered male-dominated industries (Catalyst, 2016; Kansake et al., 2021). However, renewable energy has often been positioned as an industry that provides a substantial opportunity for women's empowerment through their inclusion in decision-making processes and the energy-value chain because the continent has significant potential for clean energy (UN Women et al., 2015). Since the countries are challenging to design and implement gender-sensitive climate programmes and policies with reference to the energy sector (UN Women et al., 2015), it might be assumed that the support provided for women in renewables has low visibility or is still not sufficient enough to be noted by the outer audience.

When defining the characteristics of women's leadership in climate change, the majority of respondents indicated factors such as willingness to reduce climate change impact and the vulnerability of different gender groups, the effective, practical implementation of gender-related climate decisions, sustainable economic growth and development (Figure 3.6). These responses come along with studies that posture women leaders as contributors to more rigorous climate action and resilience, successful adaptation and mitigation strategies, and innovative and sustainable solutions (Women4ClimateAction, 2019; Ndiritu et al., 2014; Bob and Babugura, 2014). They also take the lead in advocating for behavioral changes to reduce climate change impacts and improve the wellbeing of disadvantaged and marginalized groups (Women4ClimateAction, 2019; Ndiritu et al., 2014; Bob and Babugura, 2014).

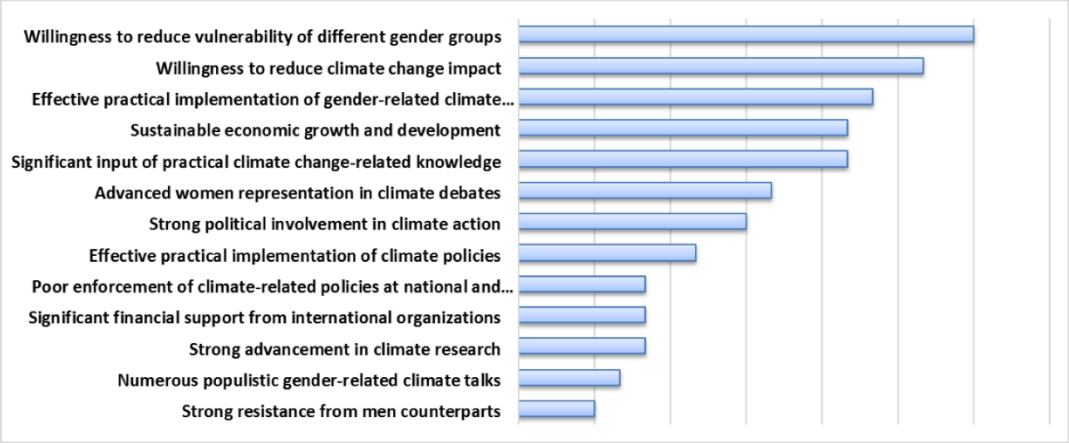


Figure 3.6 Characteristics of women's leadership in climate change. Source: author.

It is worth mentioning that, despite the widespread notion of male domination in decision-making power and their overrepresentation in leadership positions (FAO and ARC, 2021; UNFCCC, 2019; 2021), only a few respondents saw strong resistance from male counterparts as a characteristic of women's leadership. Several assumptions could be made based on these results. Firstly, if this type of resistance does exist, it is hardly identified or is not visible, particularly to those whose climate-change-related working area is not directly interconnected with 'gender/women' issues. Secondly, the significance of other factors affecting women's leadership in climate change is so large that it eliminates even the need for such resistance to develop. Among these factors are the economic and social gender inequalities that exist in societies that lock women's leadership potential away. The majority of these inequalities refer to legal rights, access to education, resources, power, opportunities to build social capital, etc. (e.g., Women4ClimateAction, 2019; UNDP, 2021).

When assessing the change in women's and men's roles in climate action over the investigated period (Figure 3.7), the respondents indicated a range from no degree at all to a very significant degree for both roles. Women's roles have changed to a certain degree, while men's roles have changed to small, significant and very significant degrees. These changes might reflect the measures taken regarding the countries' international and national gender-related obligations in climate change. It is worth mentioning that even if the assessment based on the respondents' experience and observations is subjective, in some cases, this might paint a better picture of the actual and visible outcomes of the progress that has been made on this matter than available, statistical, gender-disaggregated data.

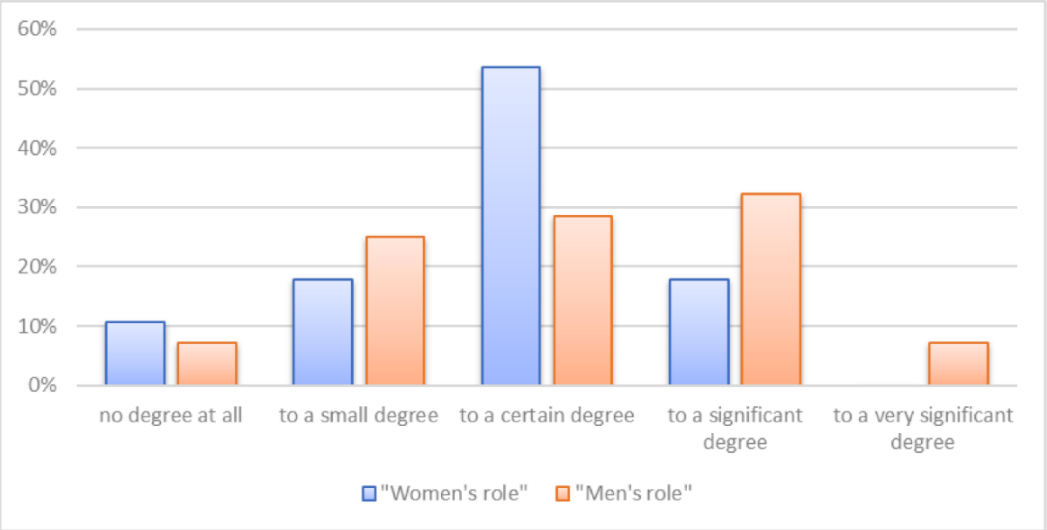


Figure 3.7 Change in women's and men's roles in climate action. Source: author.

The change in women's roles is associated among others with advances in their empowerment and engagement in climate change related processes.

When identifying the areas in which women have become more empowered, the majority of respondents named climate change adaptation, resilience, mitigation, impacts, and conservation (Figure 3.8). Considering the extent of African women's vulnerability to climate change stressors (Awiti, 2022), the named areas represent key targets for relevant measures to be applied. The obtained results are not only expected to significantly reduce vulnerability and improve livelihood, but also to have positive impacts on other climate change and gender-related areas.

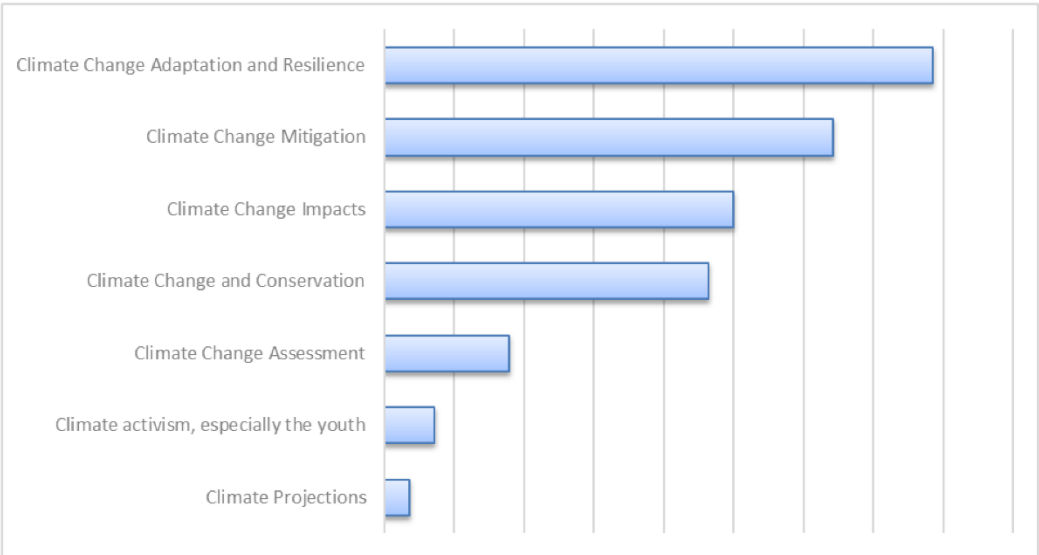


Figure 3.8 Areas where women's empowerment has most increased. Source: author.

During the past five years, the advances in women's engagement in climate change related processes have been associated with their larger involvement in gender-based analysis, decision-making, solutions and policy development and research (Figure 3.9). The predominance of the first two processes reflects the greater attention given to, and effectiveness of, measures to include the gender variable in climate change. The gender-based analysis helps to identify inequalities, provides

information on women's and men's different roles, and considers policies and legislation in terms of gender outcomes or potential differential impacts (International Training Centre of the International Labour Organisation, 2009). Respondents listed adaptation, mitigation, emission and disaster risk reduction, as well as financial resources and education, as areas that require further intervention due to the still-significant unequal gender representation in leadership positions and poor levels of women's empowerment.

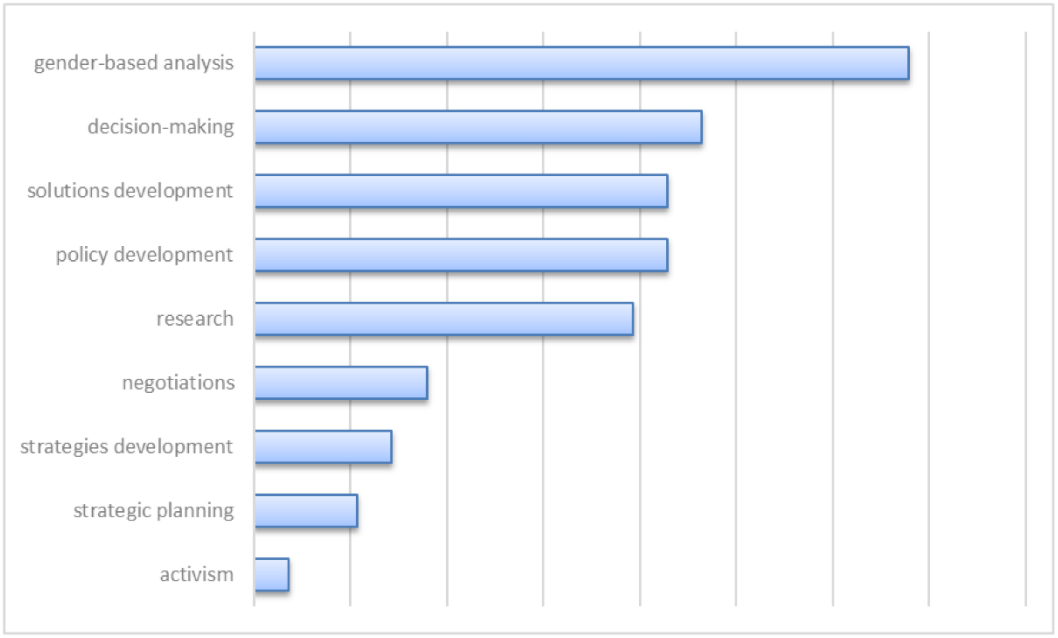


Figure 3.9 The extent of women's engagement in climate-change-related processes. Source: author.

However, the increase in women's participation in climate change related processes does not always directly correlate with their influence on decision-making. Often, women's engagement signifies only their presence, without their opinions being taken into account by male colleagues. The respondents assessed the progress in women's influence, and rating it from no degree at all to a very significant degree, with the majority of responses referring to a small or certain degree (Figure 3.10). They also noted the change in women's ability to overcome the impacts of climate change, which is unequivocally interconnected with their growing influence (Figure 3.10). To ensure that women's inclusion in decision-making attains its objectives, it is necessary to assign the smallest weight to quantitative indicators of their presence when assessing the effectiveness of the respective measures. Undoubtedly, this will significantly increase the complexity of the process, but diminish the formal nature of the 'gender' requirement.

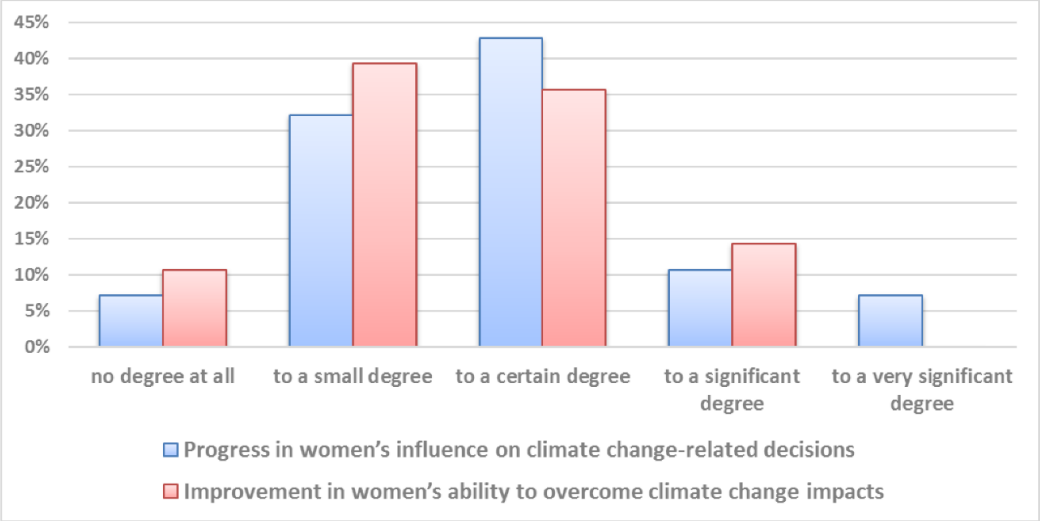
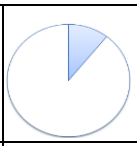
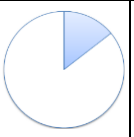
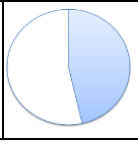


Figure 3.10 Progress in women's influence on climate-change-related decisions and improvements in their ability to overcome the impacts of climate change. Source: author.

Indicating potential hindrances to women's representation in climate-related leadership positions, the majority of respondents agreed on the lack of factors such as women's confidence in their ability to participate, social and professional experience, accumulated career capital, networks and contacts, as well as referencing women's low socio-economic status (Table 3.3). These factors are not specific to the climate change domain. Some of these barriers are also indicated in studies on women's potential and abilities to attain leadership positions in other areas, for instance, academia, business sectors, health care, and public sectors (Kalaitzi et al., 2017; Newman et al., 2017; Begashaw Abate and Terefe Woldie, 2022). However, the respondents do not consider the women's lack of leadership ambitions or a negative attitude towards this type of activity as being among these barriers (Table 3.3).

Table 3.3 Barriers to women's representation in climate-related leadership positions. Source: author.

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Lack of women's leadership ambitions					
Lack of women's confidence in their ability to participate					
Lack of knowledge and expertise					

Lack of social and professional experience					
Lack of accumulated career capital					
Lack of qualities and skills					
Lack of political will in the country despite international gender equality commitments					
Women's negative attitude towards leadership activities					
Low socio-economic status of women					
Lack of role models of women leaders					
Lack of the networks and contacts					

Assessing the overall outcomes of changes in women's and men's roles in climate action, the majority of respondents indicated their positive rather than negative character (Table 3.4). More than half of respondents also suggested a positive correlation between the number of women in climate-related leadership positions and the number of national gender-responsive climate policies, plans and programmes. These results follow earlier studies on the link between the number of women in leadership positions and the introduction of climate-related measures (Mavisakalyan and Tarverdi, 2019; Norgaard and York, 2005), supported by the works that indicate women's essential contribution to climate action (Mekonnen, 2022; Habib et al., 2022; Loarne-Lemaire et al., 2021). However, there are no works focusing solely on the change in men's role in climate action and its outcomes. Therefore, the specific characteristics of the 'new' roles of both women and men, and scale and effectiveness assessments of their positive and negative outcomes, require further, more rigorous investigation that lies beyond the scope of this work.

Table 3.4 Outcomes of the change in women's and men's roles in climate action. Source: author.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A change in women's role in climate action over the last five years, if any, has led to positive outcomes					
A change in men's role in climate action over the last five years, if any, has led to positive outcomes					
A change in women's role in climate action over the last five years, if any, has led to negative outcomes					
A change in men's role in climate action over the last five years, if any, has led to negative outcomes					

To consolidate and strengthen the positive results that have already been achieved in the reduction of gender imbalances in climate-related leadership positions, the factors perceived as hindrances should continue to be addressed. Among the possible measures, the respondents suggested improving climate change knowledge-sharing, additional training and the development of capacity-building, the introduction of a gender quota system and a reduction in corruption in recruitment processes. However, they expressed concern that the prioritisation of gender-based over merit-based opportunities might lead to negative consequences, including the amplification of stereotypes in case of women's failure.

Other issues that were raised included the need to guide particularly male leaders on ways to include women in climate action and demonstrate how their behaviour could affect women's engagement. Often, climate change–gender studies are women-centric (Bunce and Ford, 2015), discussing their vulnerabilities, empowerment and leadership, adaptation and mitigation. There is a very little investigation on men's attitudes, perceptions and opinions with respect to female leadership, empowerment and their roles as potential agents of change for climate change solutions.

It is worth mentioning that, even after overcoming the barriers to leadership positions, women continue to face a range of challenges. In this respect, the respondents outlined factors including insufficient education, training, skills, expertise, or experience, lack of political will and governmental support, and weak institutional linkages. It is important to note that some of these challenges are similar

to the aforementioned causes of women's under-representation in leadership positions. Other factors include cultural and societal barriers and stereotypes, lack of or insufficient financial resources, and the corruption and non-transparency of selection processes.

The development, introduction and implementation of measures to overcome these challenges require the active involvement of different actors. The respondents outlined the role of national governments and experienced civil servants in encouraging women's advancement to leadership positions. However, the international, national and community efforts that have been taken to advance gender-equal participation in climate action and representation in climate-related positions in recent years were mainly assessed as being moderate (Figure 3.11). These results are in line with the global concern over the slow pace of progress towards reductions of gender imbalances in leadership and empowerment in climate change (UNFCCC, 2021).

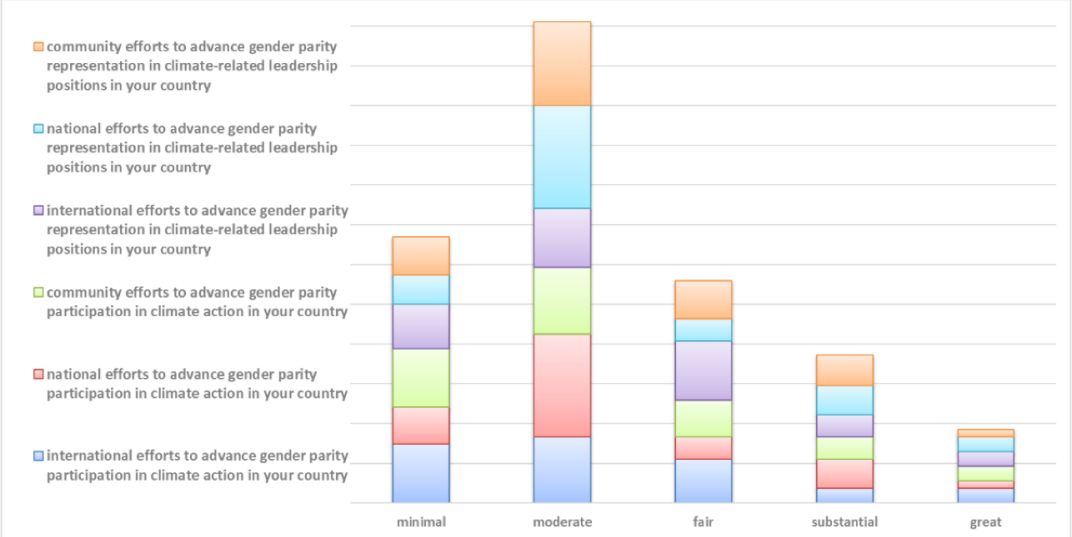


Figure 3.11 Efforts to advance gender-equal participation and representation in climate action and leadership positions. Source: author.

Assessing the potential timeframe to achieve gender-equal participation and representation in climate leadership in their countries, the respondents' opinions varied between less than 5 years and more than 10 years, with the latter slightly prevailing. Several respondents were even more pessimistic, indicating that gender-equal representation will never be achieved (Figure 3.12). At international level, the UNFCCC estimated that the gender-balanced representation of delegates will be achieved in 24 years and of COP Heads of Delegation in 46 years following the current rate of change (UNFCCC WEDO, 2020). At national level, considering the recent global emergencies and the state of the global economy, it is very difficult to project the amount of time that will be required by the countries to achieve gender-balanced participation and leadership in their climate action.

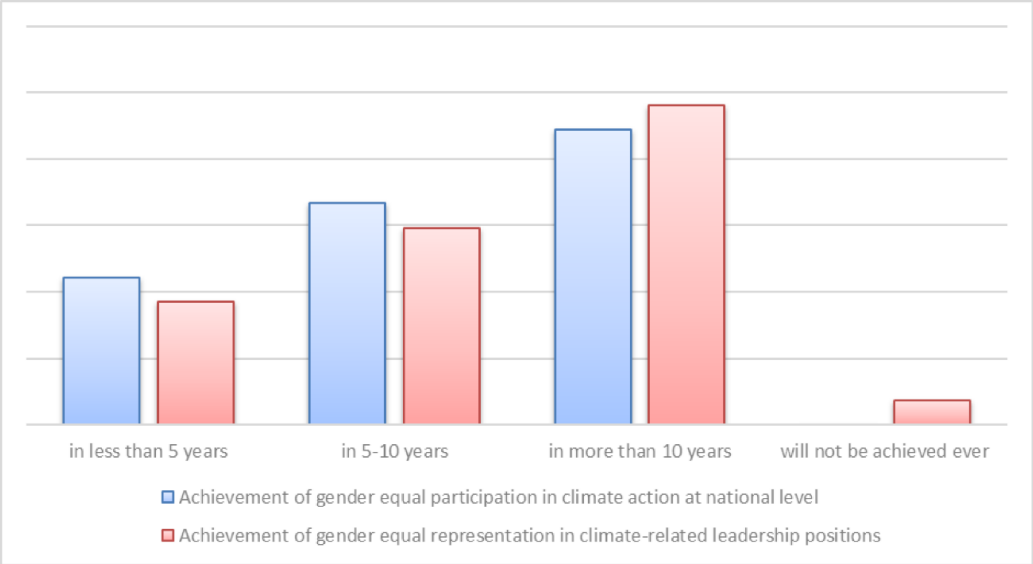


Figure 3.12 Time needed to achieve gender-equal participation and representation in leadership positions in climate action at the national level. Source: author.

One such global emergency is COVID-19 and its impacts. The pandemic unveiled and further amplified existing climate change vulnerabilities, including those related to gender inequalities (Nyahunda et al., 2021; Ingutia, 2021; Patrick et al., 2021). Furthermore, there has been a concern that the pandemic might undermine actions taken towards climate change mitigation and reduction of gender imbalances (OECD, 2020a; Women for Climate-Resilient Societies, 2020; Reilly et al., 2021). However, some works claim that the recovery plans could be seen as a strategic opportunity to use the lessons learned and additionally stimulate the climate agenda and its objectives (Newell and Dale, 2020; Nguyen et al., 2021). The gender-related measures taken in response to COVID-19 could also be applied to address the gender-related impacts of climate change (Akrofi et al., 2021; Women for Climate-Resilient Societies, 2020). The respondents did not come to an agreement on whether the pandemic's impacts on advancing gender-equal representation in climate-related leadership positions and women's empowerment in climate action were positive or negative. Their opinion ranged from a minor negative to a very substantial positive impact (Figure 3.13).

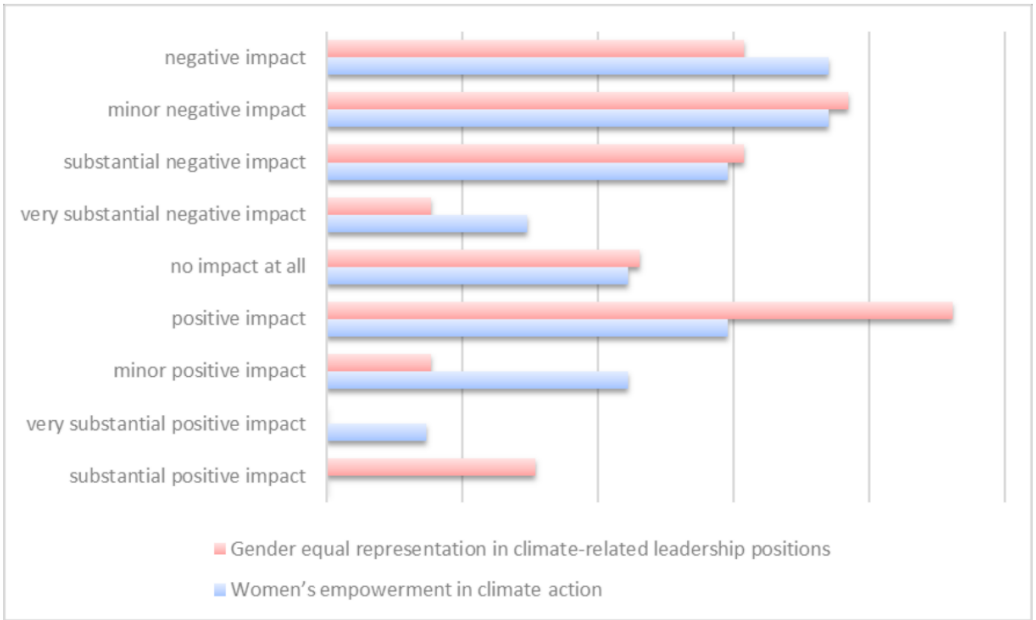


Figure 3.13 Impact of the COVID-19 pandemic. Source: author.

Considering the time required to develop, introduce and implement COVID-adjusted measures regarding gender-balanced leadership and women's empowerment in climate action, it is challenging to predict their actual outcome, particularly at this stage. In addition to time, the outcome will be shaped by the gender sensitivity of the planned recovery schemes, established interconnections between the pandemic and climate change, defined priority areas, and implementation strategies.

3.6.3 Final Remarks

Although the results of the bibliometric analysis and the online questionnaire are not fully comparable, the following can be inferred. In addition to the issues that received attention from researchers and respondents, some points were indicated by the latter that were not prominent on the co-occurrence maps. This might demonstrate that these topics have received limited attention from scholars or development organizations to date. Although the raised points were based on the respondents' experience and often subjective opinion, they might reflect another perspective on the climate change–gender domain in leadership/empowerment, from those facing the outcomes of these measures. In addition, there were 'not included' topics, such as, for instance, 'COVID-19 pandemic', 'role models' or 'quota systems', which have already been discussed with reference to climate change, gender, and leadership as standalone topics (OECD, 2020a; Women for Climate-Resilient Societies, 2020; Reilly et al., 2021; Dimitrova-Grajzl and Obasanjo, 2019; Bosha, 2014). Their lack of prominence on the maps demonstrates the need for more rigorous investigation with connection to climate change-gender in leadership/empowerment in African countries.

Even though the obtained findings are not directly connected to enterprises, several assumptions can be made. It could be implied that companies of any background will have to comply with stronger climate-change-related binding policies and regulations due to a positive trend in advances in women's leadership and empowerment regarding climate change. In addition, the gender gap will decrease on more executive boards and the number of women executives will reach

the minimum number indicated by some studies as being necessary to integrate more climate-friendly activities and improve climate/environmental performance (Nuber and Velte, 2021; Caby et al., 2022).

Overall, the results of this study outline the thematic structure of the climate change–gender research domain, provide insights into the outcomes of the advances made towards reduction of gender imbalances in climate change leadership in African countries, and elucidate the areas and directions that might need to be addressed in more depth.

3.7 Conclusions

Gender-balanced representation is perceived as one of the integral characteristics of effective leadership and empowerment, which are required to overcome and tackle complex challenges such as climate change and its impacts. Being recognized as one of the most vulnerable global areas (IPCC, 2023), the African continent will continue to face climate change impacts that affect its socio-economic development, increase inequalities, and exacerbate threats to human health, food and water security. On the other hand, African countries are increasingly contributing to the global climate change agenda, for example by taking on commitments in the frame of the Paris Agreement. In this context, it is essential to ensure that the countries will also continue to amplify their efforts to reduce gender imbalances in leadership and empowerment. Therefore, the visibility of the already-attained outcomes, in terms of both gender and climate change experts, demonstrates their effectiveness, the potential benefits and risk reductions, which are key factors supporting the importance of, and need for, further measures.

The paper investigates the need and potential for gender-balanced leadership/empowerment in climate change adaptation and mitigation based on the views and perspectives of climate change experts regarding the advances made in African countries over the last five years. The study is complemented by a bibliometric analysis (i.e., co-occurrence analysis) of the literature published on the topic between the years 2015 and 2022, which demonstrates the considerable prevalence of grey literature compared to peer-reviewed works.

Although the results from the online questionnaire and the bibliometric analysis are not fully comparable, some of the points raised by the respondents are reflected on the maps. For instance, the questionnaire findings revealed agriculture, the topic with the high number of co-occurrences on the maps, as one of the sectors where women are better supported. This type of support is also accompanied by a high number of studies (publications), development projects and initiatives on vulnerability, adaptation, climate-smart agriculture, etc. However the co-occurrence maps do not demonstrate the prominence of such topics as ‘COVID-19 pandemic’, ‘role models’ or ‘quota systems’, although the respondents saw the latter as being among the potential solutions, and perceived that the pandemic has both positive and negative impacts on reducing gender imbalances in leadership/empowerment.

Additionally, the questionnaire findings indicated renewable energy, transportation, oil and gas, and mining as sectors where men are better supported. The study suggests that women’s influence on climate change related decisions, as well as their ability to overcome its impacts, have changed, but mainly to a small or certain degree. The lack of knowledge, expertise, skills and qualities, political will and female leader role models were indicated as being among the hindrances to women’s representation in climate-related leadership positions. Overcoming these barriers was linked to better climate change knowledge-sharing, additional training

and capacity building, skills development, the introduction of a gender quota system and a reduction in corruption in recruitment processes. The importance of providing merit-based and not only gender-based opportunities was highlighted, as the latter might amplify some stereotypes regarding women if they failed to succeed. Assessing the potential timeframe needed to achieve gender-equal representation in climate change leadership in their home countries, the respondents' opinions ranged from very optimistic (less than five years) to very pessimistic (never).

The current study has several limitations. The Google Scholar (GS) dataset used for the bibliometric analysis was limited to a maximum of one thousand records due to software features. Only English-language publications were retrieved and analysed, which might alter some of the obtained results. The structure of the questionnaire and the types of questions affected the number of respondents and countries' representation.

Nevertheless, despite the aforementioned limitations, the findings demonstrate the visibility of the measures that have already been taken to those who are not directly engaged in the gender/women field but undoubtedly experience its outcomes. Their opinion provides a better understanding of the actual progress and its implications, particularly those that are not quantifiable. This study can be used as a premise when identifying possible directions of further actions towards gender-balanced leadership/empowerment in climate change, supporting their development, types and areas to be applied in the adaptation and mitigation context in African countries.

4. Central Asia: Exploring Insights on Gender Considerations in Climate Change

This chapter was published as Kovaleva, M. et al. (2023) *Sustainability*, DOI:10.3390/su151612667

4.1 Abstract

More than three decades of independence of Central Asia (CA) countries have been marked by socio-economic, political, and legal reforms. Growing climate change impacts threaten the wellbeing and livelihood of the already vulnerable local population, more than half of which comprises women. In this context, it is essential to adequately include both women's and men's needs in multiple efforts taken by national governments to overcome climate change challenges. This paper explores how gender/women considerations have been already addressed in climate change in CA using bibliometric analysis, an expert-driven assessment approach, and a comprehensive analysis of thematically relevant development projects. The findings demonstrated a significant prevalence of grey literature implying much lower interest from academia. The experts outlined the importance of women's participation and consideration of their experiences, which were different from men's, in climate change decision making. The comprehensive analysis of the selected development projects revealed the leadership/empowerment domain of climate change–gender interconnections as being mostly addressed. The implications of this paper regarding the current knowledge on the topic related to the CA region are threefold. Firstly, it highlights a strong need for further scientific research that could be implemented through international research initiatives and national institutional programs. Secondly, it calls for increased input from women representation in climate action at all levels. Thirdly, it outlines areas that require stronger cooperation with international donors to mainstream gender/women considerations among a wide range of stakeholders engaged in climate change and its related fields. Overall, the paper lays a basis for further steps towards advancing gender-sensitive and -responsive approaches in CA, particularly in those climate-change-related areas that are often perceived as being gender-neutral.

4.2 Introduction: Gender in the Climate Change Context

The importance of considering gender in all facets of climate action has been continuously growing, along with the acknowledgment of disproportional vulnerability, unequal empowerment and leadership, and potential benefits from a reduction of these types of imbalances. Vulnerability, leadership/empowerment, and benefits represent key domains of climate change–gender interconnections (Kovaleva et al., 2022). The vulnerability to climate change of different gender groups is shaped by numerous socio-economic, political, and cultural factors existing in every community. Very often, women, compared to men, are less resilient, with less capacity to overcome challenges of food, energy, and water insecurity, as well as to cope with disaster events and their aftermath. Empirical findings from various geographical locations provide evidence of differential gender vulnerabilities due to unequal or lack of access to natural, financial, and information resources, decision-making power, and limited property (e.g., land) ownership rights and paid employment opportunities (Collantes et al., 2018; Yadav and Lal, 2018; Jerin et al., 2023; Botreau and Cohen, 2020; Assaduzzaman et al., 2023). On the other hand, men

experience stronger climate change impacts on their mental health and physical health, and on their abilities to perform "traditional" roles such as providing income and securing the livelihood of their family (Alston and Kent, 2008; Babugura, 2010; WHO, 2014). Studies report that men farmers, for instance, are found to be more vulnerable to higher temperatures and changes in rainfall patterns (Bessah et al., 2021). Therefore, neglecting men's and women's differences in adaptation needs can not only exacerbate inequalities but also diminish women's potential as agents of change in the economic sectors that are sensitive to climate change, such as agriculture, energy, and water, as well as disaster risk reduction (Botreau and Cohen, 2020; Lau et al., 2021; Ampaire et al., 2020; Tobi et al., 2023).

Unbalanced empowerment between men and women, their representation in leadership positions, and participation in decision-making processes reduce the effectiveness of adaptation and mitigation measures and amplify existing vulnerabilities (Asongu et al., 2021; Glazebrook et al., 2020). Recent estimates demonstrate that men still dominate in various sectors despite wider acknowledgment of women's positive role in contributing to climate action and calls to broaden their integration in climate policy and decision making (UNFCCC Secretariat, 2020; 2022; Mavisakalyan and Tarverdi, 2019; Huyer et al., 2020). For instance, in 2022, in the EU-28 region, women, on average, occupied 44% of the senior administration positions in national ministries and 27% as members of the upper decision-making bodies in European agencies dealing with the environment and climate change (European Institute for Gender Equality, 2023). In the same year, the overall men/women ratio in UNFCCC boards and bodies varied between 0.2 and 9. The number of women members was greater in only 3 out of 17 divisions. The share of men in the national Party delegations at the Conference of Parties COP 27 exceeded that of women by almost two times, implying the lack of significant progress in achieving gender-balanced representation (WEDO, 2023). Globally, climate-sensitive economic sectors have been also characterized by under-representation of women in leadership positions, particularly in energy and agriculture, where they occupy 20% and 23%, respectively (World Economic Forum, 2022).

However, numerous steps have been taken to promote a wider inclusion of gender considerations in the climate change context worldwide across different sectors (e.g., Ampaire et al., 2020; Howland et al., 2019; UNDP, 2022), consequently creating additional benefits for adaptation and mitigation measures, poverty reduction, resilience, and capacity building (Patel et al., 2020; UN Women, 2016). For instance, highly qualified women, members of board committees, who are actively involved in companies' governance, undoubtedly affect their voluntary climate change disclosure (Ararat and Sayedy, 2019). There is also a positive correlation between the percentage of women occupying managerial positions and the reduction of carbon emissions in a company (Altunbas et al., 2022). Furthermore, more gender-balanced access to agricultural land and ownership rights decreases land degradation, increases land productivity, and triggers sustainable land use practices and efficient water technologies (Collantes et al., 2018; UNDP, 2018).

This study examines how gender/women considerations in the climate change context in Central Asia are reflected in the published literature, viewed by experts engaged in climate action, and supported by international donors through the implementation of thematically relevant development projects. The subject is of particular importance in the light of (i) continuously growing pressure from a changing climate on the livelihoods and wellbeing of the CA population; (ii) national

efforts towards broader inclusion of gender considerations in adaptation and mitigation processes; and (iii) strengthening of the role of women as agents of change. Therefore, it is necessary to understand developments that have been already attained to lay a basis for further steps towards advancing gender-sensitive and -responsive approaches, particularly in those climate-change-related areas that are often perceived as being gender-neutral.

The paper is organized in the following way. The next section discusses the narrative of climate change and gender/women in the Central Asian countries, as well as international donors' assistance. It is followed by the Methods section, which describes instruments used to collect and analyze the data. The Results and Discussion section describes and discusses the obtained findings. The paper concludes by presenting some implications, recommendations, and limitations of the study.

4.3 Central Asia: Climate Change, Gender/Women, and International Donors

4.3.1 Climate change

Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, five countries that comprise the Central Asia region, have been facing a large variety of challenges, reforms, and transformations in political and socio-economic life during their more than three decades of independence. Furthermore, the region, where between 42% and 72% of the population resides in rural areas (The World Bank, 2021a), heavily relies on natural resources and is mainly engaged in agricultural activities (Linn, 2012; Pradhan, 2022), and constantly experiences growing climate change impacts, including alterations in precipitation patterns, increasing aridity, and seasonal climatic shifts (Lioubimtseva, 2015; Stucker et al., 2012; IPCC, 2022; Hu et al., 2014; Reyer et al., 2017b; Hu and Han, 2022). Recent studies report increasing temperature trends across the region that lead to a rapid rate of shrinking of glacier areas and temporary alterations in groundwater and lake water levels (Haag et al., 2019; De Beurs et al., 2018). These changes amplify the magnitude and frequency of most types of natural disasters that CA is exposed to, including floods, landslides, extreme temperatures, and droughts (IPCC, 2022; De Beurs et al., 2018; GFDRR, 2020).

Additionally, the vulnerability of the local communities is aggravated by poverty, intensive outmigration, and relatively low levels of coping capacity (Xenarios et al., 2019; The World Bank Group and The Asian Development Bank, 2021a; 2021b; 2021c; 2021d; 2021e). The countries rank between 39th (Kazakhstan) and 132nd (Turkmenistan) among the 182 countries on the 2022 ND-GAIN (Notre Dame Global Adaptation Initiative) Index, which assesses their vulnerability to climate change and other global threats, together with their ability to increase resilience (University of Notre Dame, 2022). A changing climate also affects key economic sectors that already face consequences of ineffective environmental management implemented during the Soviet Union period (e.g., Howland et al., 2019; Qushimov et al., 2007; The World Bank, 2019). For instance, the agriculture sector is projected to absorb between USD 1.6 million (Tajikistan) and USD 50 million (Kazakhstan) of climate-change-induced economic losses by 2040 (Kunwar, 2020). Currently, it contributes between 5% and 25% to the national GDPs (Agency for Strategic Planning and Reforms of the Republic of Kazakhstan Bureau of National Statistics, 2023; The State Committee of the Republic of Uzbekistan on Statistics, 2023) and

employs between 15% and 45% of the total labor force, of which between 13% and 60% are women (The World Bank, 2021a).

Overall, the national governments' efforts regarding climate change include the implementation of obligations and commitments in the frame of the ratified international climate initiatives and agreements, including the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement (United Nations Treaty Collection, 2021a; 2021b; 2021c), and the introduction of numerous short- and long-term development and climate strategies, e.g., the Strategy Kazakhstan-2050, the National Climate Change Strategy of Turkmenistan, the National Strategy for Climate Adaptation until 2030 of Tajikistan, the National development strategy of the Kyrgyz Republic for 2018–2040, and the "Concept of Environmental Protection of the Republic of Uzbekistan until 2030" ("Strategy Kazakhstan-2050", 2014; National Climate Change Strategy of Turkmenistan, 2012; Government of Tajikistan, 2019; Government of the Kyrgyz Republic, 2018; Decree by the President of the Republic of Uzbekistan on Approval of the "Concept of Environmental Protection of the Republic of Uzbekistan until 2030", 2019). However, the effective implementation of climate-change-related measures is hampered by various factors, including countries' economic situations, weak governance, insufficient regional integration, and external stressors (e.g., COVID-19, military conflicts). Furthermore, it remains challenging to include adaptation and mitigation steps in long-term sectoral development programs and strategies (Liu W. et al., 2020).

4.3.2 Gender/Women

In Central Asia, women comprise a larger share of the population (Table 4.1). Between 36% (Kazakhstan) and 70% (Tajikistan) of women reside in rural areas (Agency for Strategic Planning and Reforms of the Republic of Kazakhstan Bureau of National Statistics, 2023; Agency on Statistics under the President of the Republic of Tajikistan, 2021). Women are mainly employed in health care, service and accommodation, education, and real estate sectors, which often are considered as women-dominated sectors, while men are overrepresented in mining and quarrying, transportation, construction, and public administration (National Statistical Committee of the Kyrgyz Republic, 2021; Agency for Strategic Planning and Reforms of the Republic of Kazakhstan Bureau of National Statistics, 2022a; The State Committee of the Republic of Uzbekistan on Statistics, 2022; Agency on Statistics under President of the Republic of Tajikistan, 2020). The agriculture sector, previously the main employer in most of the CA countries, currently employs between 13% (Kazakhstan) and 60% (Tajikistan) of women out of the total labor force (The World Bank, 2021a; Mogilevskii, 2020; The World Bank, 2021b).

Table 4.1 Central Asia countries' characteristics. Source: Authors compilation based on data from the World Bank, UNDP, national official websites, and statistical offices.

Countries	Share of Women Population	Labor Force Participation Rate, Women out of the Total Employed Population	Share of Seats in Parliament Held by Women	Gender Gap Index Ranking out of 146 Countries, 2022 *
Kazakhstan	51.4% (2021)	55.2%	27.4% (Mazhilis) (2021)	65
Kyrgyzstan	50.4% (2022)	38%	17% (2021)	86

Tajikistan	50.8% (2021)	46.1%	23.8% (2021)	114
Turkmenistan	50.8% (2021)	45%	25% (2019)	
Uzbekistan	49.7% (2022)	41.3%	32% (Oliy Majlis) 25% (Senate) (2019)	

* Turkmenistan and Uzbekistan were not included in the ranking.

At the institutional level, women's and men's equal rights, freedoms, and opportunities are guaranteed and protected by national legislations, including the constitutions, specific laws, and countries' international obligations on the elimination of discrimination (The Constitution of the Kyrgyz Republic as Last Amended of 5 May 2021. Article 24; The Constitution of the Republic of Kazakhstan as Last Amended of 08.06.2022. Article 13; The Constitution of the Republic of Uzbekistan as Amended of 9 February 2021. Article 46; The Constitution of the Republic of Tajikistan as Last Amended of 22.05.2016. Article 17; The Constitution of Turkmenistan as Last Amended of 25 September 2020; The Law of the Republic of Kazakhstan on State Guarantees of Equal Rights and Equal Opportunities of Men and Women Dated 8 December 2009; The Law of Turkmenistan about the State Guarantees of Providing the Equal Rights and Equal Opportunities of Women and Men as Amended of the Law of Turkmenistan of 25 November 2017; The Law of the Republic of Uzbekistan "On Guarantees of Equal Rights and Opportunities for Women and Men" No. ZRU-562 as of 2 September 2019; The Law of the Republic of Tajikistan "On State Guarantees of Equality between Men and Women and Equal Opportunities for Their Implementation", Adopted on 11 February 2005; The Law of the Kyrgyz Republic on State Guarantees of Equal Rights and Opportunities for Men and Women as Amended of 14 July 2011; OHCHR, 2023). Furthermore, to support women's political empowerment and leadership, the governments introduced a national legislated quota system that regulates a minimal share of women candidates to be included in political party lists and as members of national parliaments. The current quota is set at 30% (Constitutional Law of the Kyrgyz Republic "On Elections of the President of the Kyrgyz Republic and Deputies of the Jogorku Kenesh of the Kyrgyz Republic". No 68 of 2 July 2011; Constitutional Law of the Republic of Kazakhstan "On Elections in the Republic of Kazakhstan". No 2464 of 28 September 1995; Election Code of the Republic of Uzbekistan of 26 June 2019). However, today, women occupy between 17% and 32% of the seats in national parliaments (Table 4.1). Studies also outline other socio-economic and cultural factors that shape gender gaps in various spheres. For instance, men are more often registered as agricultural landowners despite the lack of apparent gender-related differences during the privatization period (The World Bank, 2009; Asian Development Bank, 2016a; Lastarria-Cornhiel and Garcia-Frias, 2005a). Differences in employment of women and men and their wage levels across sectors are linked to the outmigration of men or their leaving to better-paying sectors (Mogilevskii, 2020). The latest assessment of gender gaps, which passive in areas such as economic participation, educational attainment, health and survival, and political empowerment, ranked Kazakhstan 65th, Kyrgyzstan 86th, and Tajikistan 114th out of 146 countries, whereas Turkmenistan and Uzbekistan were not included in the list (World Economic Forum, 2022).

In the climate change context, women have been acknowledged as one of the most vulnerable groups whose needs are required to be given specific attention along

with the importance of their empowerment and inclusion in decision-making processes (e.g., Government of Tajikistan, 2019; Ministry of Water Resources of the Republic of Uzbekistan, 2020; Government of the Kyrgyz Republic, 2013). Furthermore, by being responsible for most food choices and related decisions in their homes, women could contribute to a reduction of carbon emissions and communities' resilience to climate change impacts (CAREC, 2020). They also could significantly contribute to the management of water resources, which are highly sensitive to a changing climate, by participating in the water user associations (WUAs). However, currently, these organizations are characterized by overrepresentation of men (Asian Development Bank, 2020). At the international level, women participate at UNFCCC meetings, where their share in national Party delegations has varied between 0% and 100% across different years and across the CA countries. For instance, in 2009, women accounted for, on average, 56% of delegates representing Kazakhstan, compared to 72% from Kyrgyzstan, 26% from Tajikistan, 77% from Turkmenistan, and 90% from Uzbekistan. On the other hand, in 2016, these values were 65%, 84%, 0%, 0%, and 75%, respectively (WEDO, 2023).

4.3.3 Donors

More than three decades of independence of the CA countries have been also characterized by the establishment of multilateral relations with numerous principal international organizations and institutions, including the United Nations (UN), Organization of Security and Co-operation in Europe (OSCE), European Union (EU), World Bank Group, and Asian Development Bank (ADB) etc. In the frame of this cooperation, the countries receive financial and expert assistance, in a wide spectrum of areas including but not limited to water resource management, agriculture, energy, environment protection, climate change, gender, and women (Dukhovny et al., 2015; Sehring et al., 2019; Rakhimov, 2010). Table 4.2 summarizes the official development assistance (ODA) received by the five countries between the years 2016 and 2020 to support environment protection, energy, agriculture, water supply and sanitation, women's rights organizations and movements, and government institutions. It is worth noting that the size of the latter is considerably smaller compared to others.

Table 4.2 Total net ODA disbursements received by the CA countries over the period 2016–2020, USD million. Source: The authors' calculations based on the Query Wizard for International Development Statistics (QWIDS).

Countries	**Environment Protection**	**Energy**	**Agriculture**	**Water supply and Sanitation**	**Women's Rights Organizations and Movements, and Government Institutions**
Kazakhstan	30.7	38.6	11.9	2.1	0.23
Kyrgyzstan	24.4	159.9	38.6	75.2	3.7
Tajikistan	28.9	405.8	131.4	123.5	2.4
Turkmenistan	5.5	7.3	0.4	----	0.1
Uzbekistan	191.3	1129.5	659.3	386.2	1.1

To date, the ADB and the World Bank have committed to over a thousand commitments and projects having a total value of over USD 46 billion and focusing on, among other aspects, climate change, energy, water resources, agriculture, rural development, and environmental policies (Table 4.3) (Asian Development Bank, 2023; The World Bank, 2023). It is worth mentioning that the subsequent initiatives implemented within the frame of this financial assistance are subject to multiple factors, including national strategic priorities, socio-economic and political situations, and donors' requirements stipulated in respective bilateral/multilateral agreements.

Table 4.3 Number and size of the ADB and World Bank commitments by country; USD billions. Source: The authors, based on data from the Asian Development Bank and the World Bank 2023.

		Kazakhstan	**Kyrgyzstan**	**Tajikistan**	**Turkmenistan**	**Uzbekistan**
World Bank	No. of projects*	60	131	118	7	75
	Total project cost	10.76	3.87	2.24	0.12	8.67
ADB	No. of Commitments**	196	127	146	13	228
	Total size	2.4	6.0	2.2	0.632	10.4

* Includes active and closed projects only.
** Commitments include public sector loans, grants, and technical assistance.

4.4 Methods

The study deployed three methods to explore how gender/women considerations in the climate change context in the Central Asia countries are reflected in published peer-reviewed and grey literature, viewed by experts, and supported by international donors. The methods were (i) bibliometric analysis, (ii) an expert-driven assessment approach, and (iii) comprehensive analysis of climate-change-related development projects with reference to gender and/or women issues implemented in the region.

4.4.1 Bibliometric Analysis

In recent years, bibliometric analysis has been used by researchers as a tool for the evaluation of published scientific works and their trends. In this study, a term co-occurrence analysis was conducted to identify subjects with a connection to gender or women considerations in the climate change context in Central Asia, that are discussed in peer-reviewed and grey literature available in Scopus and Google Scholar (GS). The benefit of this method is in identifying relevant patterns in text data as well as getting insights on the interconnections between various concepts and terms (Radhakrishnan, 2017). Both Scopus and GS databases represent the largest collection of scientific and scholarly works published globally. Table 4.4 lists the selection criteria used to form the datasets. The search data range was limited to five CA countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, and the period between the years 2000 and 2023. Only works in English were selected. The full search strings included the following elements:

Scopus: TITLE-ABS-KEY ((“clim* chang*” OR “clim* vulnerab*”) AND (“gender” OR “wom*n”) AND (“central asia*” OR “kyrgyz*” OR “kazakh*” OR “tajik*” OR “uzbek” OR “turkmen*”)) AND (EXCLUDE (PUBYEAR, 1990)).

Google Scholar: Keywords: (gender OR women) AND ("climate change") AND ("central asia" OR kyrgyzstan OR kazakhstan OR uzbekistan OR tajikistan OR Turkmenistan); Publication year 2000–2022.

Table 4.4 Selection criteria. Source: author.

Criteria	Description
Data range	2000–2023
Language	English
Type of publication	All types available in the collections
Databases	Scopus, Google Scholar
Geographical focus	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

The search and selection of literature from GS were undertaken using the Publish or Perish software program (Harzing, 2007). Both datasets were retrieved in February 2023 and included 13 (Scopus) and 982 (GS) publications characterized by such variables as "title" and "keywords" that effectively describe every publication (Springer, 2020).

The exclusion of duplicated and irrelevant works reduced the merged (Scopus/GS) dataset to 892 items, which served as input data for the term co-occurrence analysis. The results were visualized as a network map using the VOSviewer software (Van Eck and Waltman, 2010). Nodes on the map that represented terms or keywords were split into different thematic clusters, differentiated by color. The larger size of a node correlated with a higher co-occurrence of a term or keyword.

4.4.2 Expert-Driven Assessment Approach

The expert-driven assessment approach was used to reflect the opinions of those who are engaged in climate action and, consequently, in the measures taken towards the inclusion of gender/women considerations in climate change. The chosen approach is beneficial for this study because it provides an opportunity to gather and synthesize diverse views, particularly in the fields where data are limited or even not available, which may lead to severe challenges (Hemming et al., 2018). The approach is among the key elements used across various fields, including women roles and climate change adaptation and projections (Grainger et al., 2022; Oppenheimer et al., 2016; Agu et al., 2021).

In this work, an on-line survey instrument was used to elicit experts' opinion. The instrument comprised 45 open- and close-ended questions that were grouped into two categories: general and thematic, where the latter focused on three domains of climate change–gender interconnections: (i) vulnerability, (ii) benefits, and (iii) leadership/empowerment. The survey design, which was characterized by the prevalence of open-ended questions, was chosen due to a low number of similar studies investigating gender/women considerations in the climate change context in Central Asia. Open-ended questions provided respondents with more opportunities to share their own experiences and comments. However, it is worth mentioning that this type of survey design, as expected, resulted in a relatively low response rate. The initial set of questions was reviewed by a group of international experts working in thematically related fields. The final version of the survey was modified based on reviewers' comments and recommendations. The instrument was disseminated via

professional networks and emails. Participation was voluntary, and responses were collected in an anonymous mode.

4.4.3 Development Projects Analysis

The study was complemented by a comprehensive analysis of climate-change-related development projects with reference to gender/women. This method was one of the ways used to synthesize available information to uncover and demonstrate evidence on a meta- (Central Asia) level. The projects were and have been implemented in the CA countries between the years 2000 and 2023 in the frame of international assistance. These types of initiatives reflect, among other factors, donors' interest and willingness to support the integration of gender/women issues in the region. The projects were selected based on several criteria, including availability and accessibility of the relevant information to the general public, participation of a donor (e.g., international organization, governmental agency, or institution), and a reference of project objective(s) or outcome(s) to gender/women in climate change. The information was collected by means of extensive desktop research and summarized against a set of the following variables:

- project title;
- donor organization;
- country(-ies) of implementation;
- duration;
- short description;
- source of information.

Results of the comprehensive analysis of project characteristics including objectives, target audience, and outcomes were categorized according to three domains of climate change–gender interconnections: vulnerability, leadership/empowerment, and benefits (Kovaleva et al., 2022).

4.5 Results

4.5.1 Bibliometric Analysis

The analysis showed that 98% of the retrieved publications that comprised the merged dataset could be classified as grey literature. This mainly included reports, briefs, project findings, and guidelines. Thirteen peer-reviewed publications focused on a specific topic such as health, social factors, education, and energy and water resources with reference to climate change and gender. For instance, several studies investigated the impacts of weather shocks on child health (Freudenreich et al., 2022), extreme heat on the risk of preterm birth and stillbirth (McElroy, 2022), seasonality on anemia and eclampsia (Hlimi, 2015), and desertification in the Aral Sea Basin on the local communities' health (Orlovsky et al., 2001; Hill et al., 2013), and explored sexual and reproductive health and rights in the light of the post-2015 development goals, and the impact of climate change on the microelement status of the adult population (Batyrova, 2021). Another two publications discussed the relationship between social movements and the global carbon budget (Thiri et al., 2022) and the effects of the socioecological transformations such as climate change on local populations (Kassam, 2009). Kumar et al., 2021 focused on gender diversity in enrolment in Geo-Spatial Technology and Applications programs (Kumar et al., 2021). In the energy context, the authors investigated various factors, including the gender-shaped perception that affected energy security (Knox-Hayes

et al., 2013; Sovacool et al., 2012). Water-related studies discussed the impacts of climate change on water resources and their effects on women and girls (Sen Roy, 2018b), and adaptation to climate-change-exacerbated water scarcity, droughts, and flash floods (Stucker et al., 2014). Only four publications focused solely on one or more CA countries, while the rest investigated within a much broader geographical scope.

The results of the term co-occurrence analysis are presented in the network map consisting of 62 terms divided into four clusters (Figure 4.1). The clusters describe energy, sustainability, and adaptive capacity (red cluster); biodiversity, global climate change, and each CA country (green cluster); empowerment, gender equality, disaster risk reduction, science, and knowledge (blue cluster); and health, women, children, and conflict (yellow cluster). It is worth mentioning the relatively high co-occurrence rate of geographical locations other than CA, e.g., China, the Middle East, and Europe. The domains of climate change–gender interconnections (Kovaleva et al., 2022) are not clearly distinct on the map. Furthermore, the terms "vulnerability", "benefit", "leadership" are not included in any of the clusters. Overall, all terms could be explored under every domain with a reference to the aforementioned geographical locations.

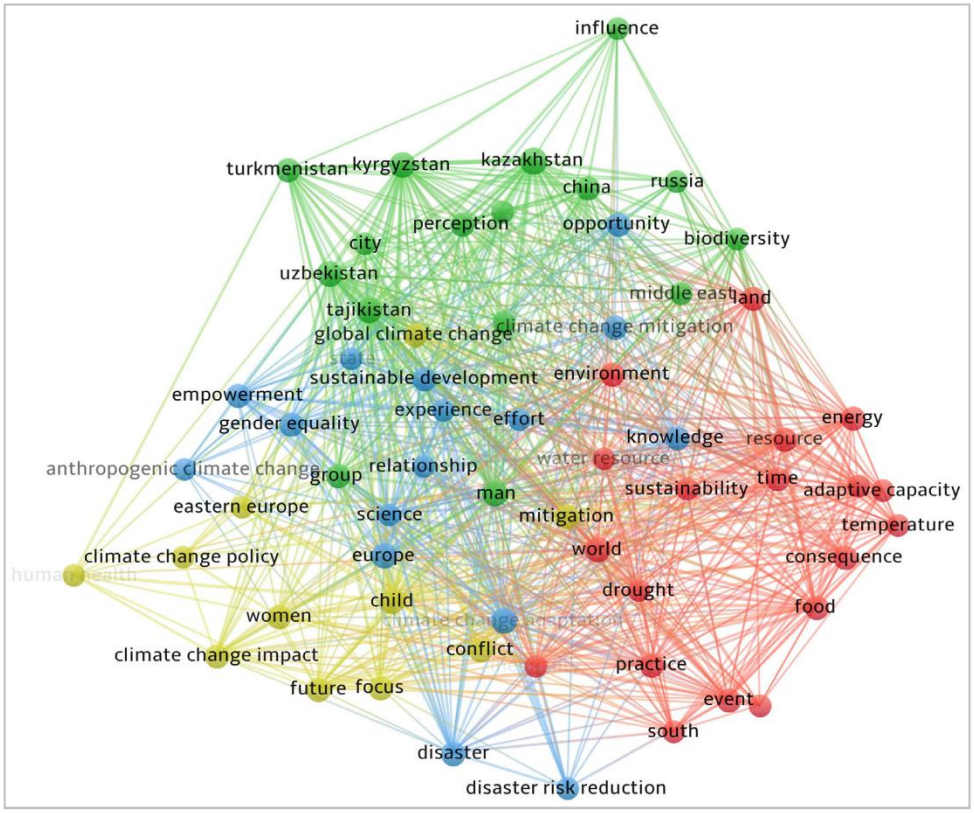


Figure 4.1 Co-occurrence map of terms (merged Scopus/GS dataset). Created with VOSviewer. Source: author.

4.5.2 On-Line Survey

4.5.2.1 Respondents' Characteristics

Experts from all five CA countries participated in the on-line survey and shared their comments and opinions on gender, women, and men considerations in the climate

change context. Forty respondents, more than 50% of which were women, were representatives of international, governmental, and civil organizations, and the private sector working in such fields as climate change, disaster risk reduction (DRR), gender, environment protection, water, agriculture, and energy. It should be also noted that some of the respondents have expertise in more than one field due to the nexus character of respective issues. Table 4.5 summarizes the respondents' characteristics.

Table 4.5 Socio-demographic characteristics of the on-line survey respondents. Source: author.

Characteristic	**Percentage of Respondents**	**Characteristic**	**Percentage of Respondents**
Country:		Type of organization:	
Kazakhstan	39.13%	international	32.61%
Kyrgyzstan	23.91%	governmental	8.70%
Tajikistan	21.74%	private	4.35%
Turkmenistan	4.35%	civil society	54.35%
Uzbekistan	10.87%		
Gender:		Working Experience:	
female	58.70%	1–5 years	64%
male	41.30%	6–11 years	20%
		15–30 years	16%
Area of your expertise:		Degree of engagement with local communities:	
water	38.33%	not at all	10.87%
energy	10.00%	only a little	15.22%
climate/climate change	20.00%	to some extent	30.43%
food/agriculture	11.67%	rather much	15.22%
gender	15.00%	very much	28.26%
environment protection	3.33%		
DRR	1.67%		

4.5.2.2 Gender/Women in the Climate Change Context

Climate change affects CA local populations to various extents. More than 55% of the survey participants assessed its impacts as high, 25% as very high, and 20% as moderate. The respondents also indicated that rural men and women are more vulnerable to climate change compared to those who are residing in urban areas. The rural population faces impacts of climate change such as, among others, insect outbreaks, low water levels, disruption in irrigation services, and higher health risks (Figure 4.2).

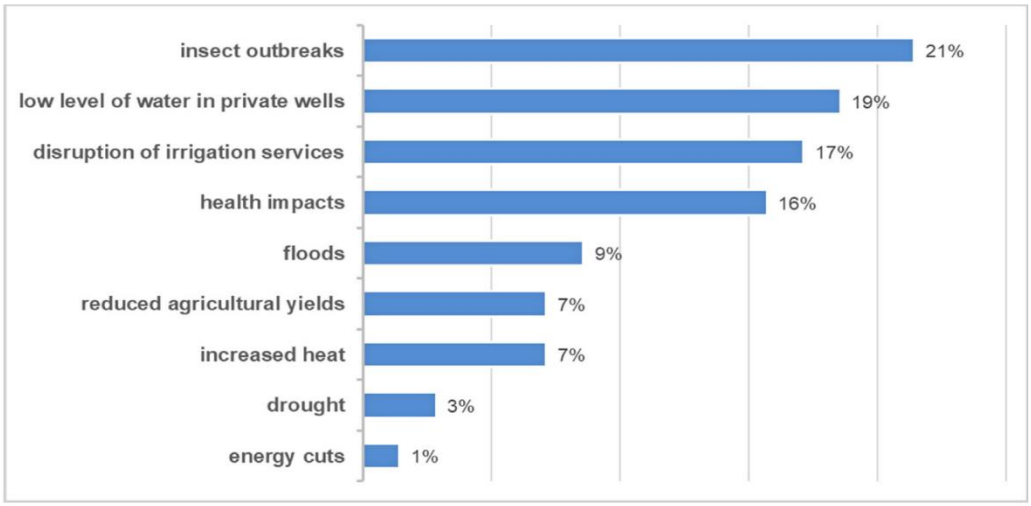


Figure 4.2 Main impacts of climate change on the rural population. Source: author.

The majority of the respondents were inclined to agree that in the agriculture, water, and energy sectors, men and women have been affected by the same problems and to a similar extent, regardless of their socio-economic status (Figure 4.3).

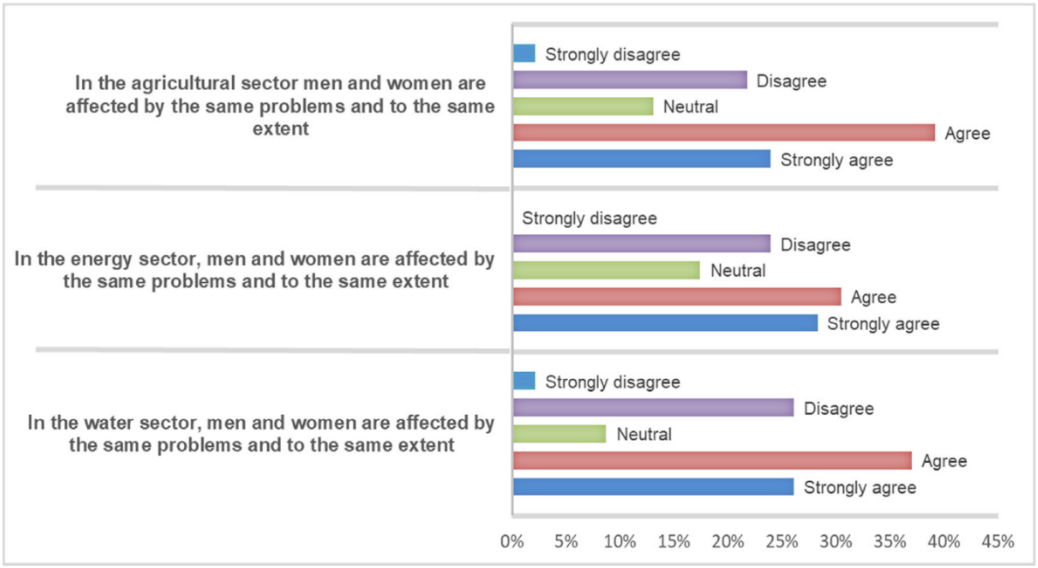


Figure 4.3 How men and women are affected in the key sectors. Source: author.

Specifying the main causes of rural men's and women's vulnerability to climate change, the respondents were inclined to categorize limited access to loans and financial resources as men-related, whereas unemployment and less capacity with "water providers" and household activities were categorized as women-related. Water scarcity and its low quality, interruptions in electricity supply, low level of education and medical services, and economic and financial issues were named as of both men's and women's. The comprehensive list of the main causes of rural men's and women's vulnerability to climate change indicated by the respondents is presented in Appendix II Table 12.2. The majority of the respondents agreed that women's experiences differ from those of men's and, therefore, should be also considered in discussions on climate change and its related issues. Furthermore, they acknowledged the need to address women's and men's differences in governments'

initiatives and to formulate and develop gender-sensitive climate change adaptation and mitigation measures (Figure 4.4).

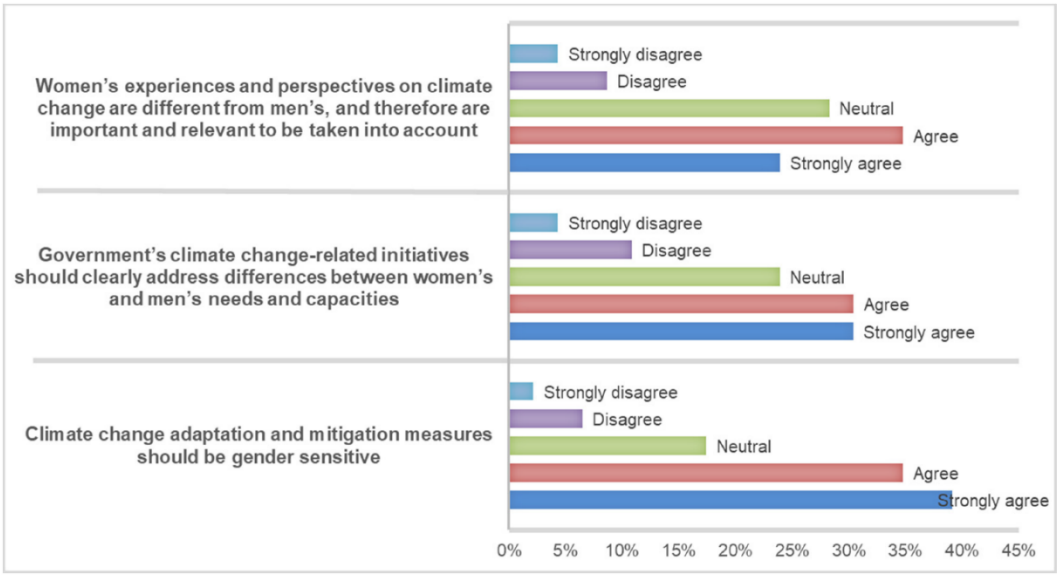


Figure 4.4 Inclusion of women's and men's differences. Source: author.

Additionally, the survey participants outlined the importance of increasing rural women's participation in decision-making processes, particularly at the town/village level (Figure 4.5), despite them having a still small input into decisions on water distribution, use of renewables, and water efficient and adaptation practices (Figure 4.6).

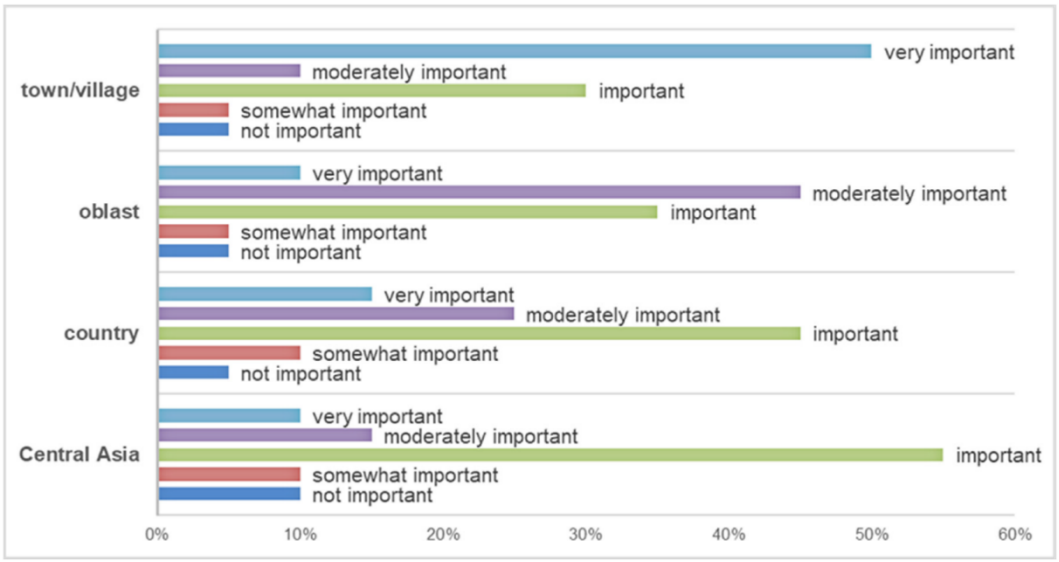


Figure 4.5 Importance of including more rural women in decision-making processes on climate-change-related issues across all levels. Source: author.

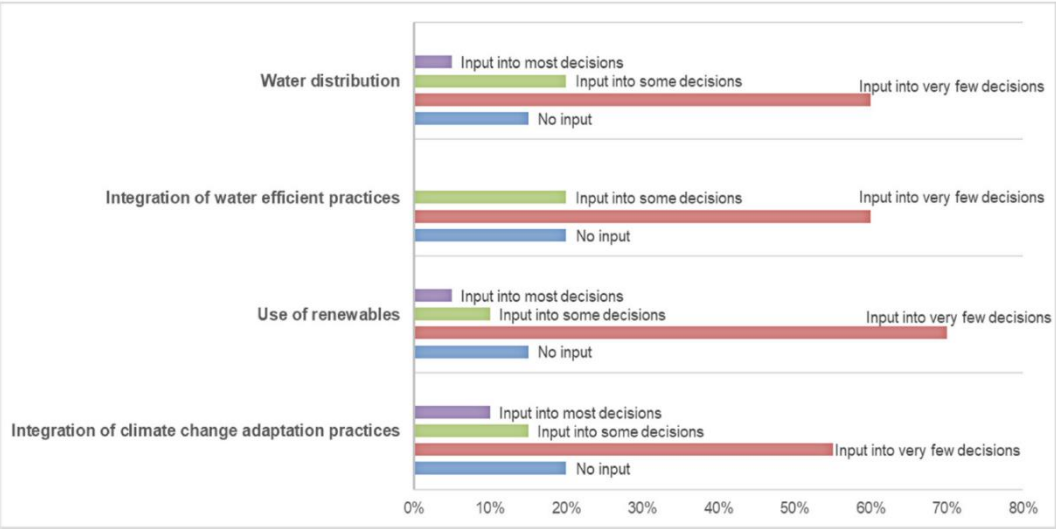


Figure 4.6 Rural women's input in decision-making processes at the town/village level. Source: author.

The respondents also agreed that the role of women in climate change mitigation and adaptation over the last five years has stayed the same or improved insignificantly (Figure 4.7).

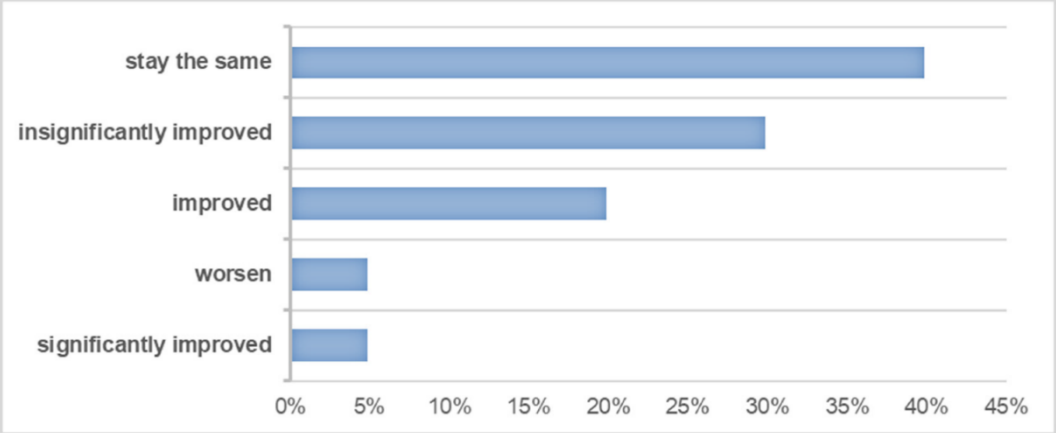


Figure 4.7 Change in women's role in climate change adaptation and mitigation (over the last five years). Source: author.

4.5.2 Development Projects Analysis

The study analyzed 17 climate-change-related development projects implemented in the region between the years 2003 and 2023. The list and their short description are presented in Appendix II Table 12.3. The projects, which vary in their scope, scale, geographical coverage, and duration, include gender/women considerations as one of the (sub-) components, objectives, or outcomes. Nine can be classified as standalone gender/women projects, i.e., gender or women considerations are the core focus. In the context of climate change–gender interconnections, most of the projects refer to more than one domain. It is worth mentioning that leadership/empowerment is addressed more often than other domains. For instance, the projects "Land Rights and Economic Security of Rural Women and Improved Food Security" and "Enhanced Livelihoods through Institutional and Gender Sensitive Land Reform" in Tajikistan were implemented as part of the national government's efforts to

mainstream gender into climate change policy between the years 2003 and 2008. Led by the United Nations Development Fund for Women (UNIFEM), the projects contributed to the development of more gender-sensitive land and policy legislation, the introduction of gender statistics, and the improvement in women's land rights and sustainable livelihoods (Mirzoeva, 2009). The project "Women and Water in South and Central Asia" by the Central Asia Program (CAP) (George Washington University) and Women4Climate Mentorship Program (Nur-Sultan) by the C40 Cities focused solely on leadership/empowerment supporting young women leaders to exchange the knowledge and experience of innovative conflict resolution, water management, and climate change issues, and to increase their networking opportunities (Central Asia Program, 2022; Women4Climate, 2021). In 2019, the International Organization for Migration (IOM) launched the "Tajikistan: Understanding the Nexus of Migration, Gender, Climate Change and Agriculture" initiative, which can be assigned to the vulnerability domain. It focuses on the migration, gender, climate change, and agriculture nexus to address women's needs in climate change adaptation in one of the regions of Tajikistan. It also aims to mainstream migration in climate change policy and programming (IOM, 2019). The benefit domain is reflected by the CLIMADAPT project through, for instance, better access to climate technologies and practices that support efficient use of energy, and more effective collaboration of financial institutions with men and women separately (Climate Investment Funds, 2018).

The large-scale projects, where gender/women considerations are one of the (sub-) components, objectives, or outcomes, can also be classified under more than one domain. The Water Resource Management Project in Uzbekistan, which aimed at rehabilitation and upgrading of irrigation systems and inter-farm canals, created favorable conditions for women to become farmers and provided additional opportunities for seasonal jobs. Furthermore, the project activities contributed towards vulnerability reduction by improving women's economic situation, increasing their participation in water consumer associations, enhancing the environment, and reducing allergies (Asian Development Bank, 2017). There are projects that included a gender action plan (GAP) with specific targets and reporting requirements, instead of indicating gender/women considerations as an activity, objective, or pillar. For instance, the GAP of the Water Resource Management Project in Uzbekistan addressed equal participation of men and women. It also defined a set of indicators and goals, including identification of women's roles through information campaigns, gender sensitization of key stakeholders, and collection of gender-disaggregated information (Asian Development Bank, 2017).

4.6 Discussion

4.6.1 Bibliometric Analysis

Output in the form of scientific publications reflects research interest in an investigated field among the academic community, experts, and practitioners. The prevalence of grey literature in the retrieved and analyzed dataset is consistent with the findings of (Vakulchuk et al., 2022), and showed an overall low number of peer-reviewed publications on climate change or related topics in the region, particularly compared with the scope of the problem. It also implies significantly greater attention to gender/women considerations in the climate change context by international donor institutions. Taking into account a very small number of the connected peer-reviewed publications, their main benefit can be seen as an overall contribution to the

knowledge of climate change–gender interconnections in Central Asia. Each of these publications is novel, at least with reference to the geographical coverage, namely, to one or more CA countries. The current very small set of publications makes the comparison with other studies in this thematic field inconsequent.

The result of the co-occurrence analysis, that is, the collection of the terms, reflects areas that have been earlier acknowledged as having high relevance and importance in CA due to the region's vulnerability to climate change impacts and natural disasters that result in the growing risks of food, water, and energy insecurity (IPCC, 2022, 2014b). Furthermore, the transboundary character and unequal distribution of natural resources, and the reduction in their availability, create tension and conflicts within and between local communities (Pradhan, 2022; Peña-Ramos et al., 2021). One such example is the allocation of water resources for agricultural purposes, which is often made on a temporary basis due to the specificity of local irrigation systems. The respective decision-making processes are men-dominated, which in turn places women in more disadvantageous positions. Overall, all subject areas presented in Figure 28 have a direct or indirect linkage to the livelihood and wellbeing of the CA population, and hence require consideration of gender/women issues and therefore. They can therefore be investigated under vulnerability, benefits, and leadership/empowerment domains.

4.6.2 On-Line Survey

The susceptibility of agriculture, water, and energy sectors to climate change shocks compromises the livelihood and wellbeing of the CA local population (The World Bank Group, 2021). Rural men and women are more vulnerable and experience the impacts to a larger extent compared to those who are residing in urban areas. This expert opinion is consistent with the studies investigating the effects of climate change on rural populations in other world regions (Dumenu and Obeng, 2016; Mekonen and Berlie, 2021; Reyer et al., 2017a). Comparing the problems faced by men and women in the agriculture, energy, and water sectors, the respondents followed a more gender-neutral tone in their replies. One of the reasons might be a low number of studies on climate change adaptation and mitigation in the region, particularly of those with reference to gender and women considerations (Vakulchuk et al., 2022). Furthermore, there is an insufficient quantity of gender-/sex-disaggregated data due to gender-blind or gender-neutral institutional reporting requirements, and exclusion of gender analysis in respective activities. Additionally, gender/women considerations might not yet be perceived as an integral issue to be tackled in the climate change context. Nevertheless, the experts acknowledged the importance of women representation in managerial and leadership positions in men-dominated water, energy, and agriculture sectors, despite their little contribution to decision-making processes. For instance, in Tajikistan, in 2015, women formally managed about 13% of the registered dekhkan (farms based on private, individual, and inheritable land shares) (Mukhamedova and Wegerich, 2018). In the same year, in Uzbekistan, women comprised only 7.6% of members of water consumer associations, and 18.6% occupied managerial positions in water supply and sanitation bodies in 2016 (Asian Development Bank, 2018). In Kazakhstan, three-fourths of the farm households were headed by men, while, in the energy sector, only 12% of senior management positions were held by women (Mynbayeva, 2020; Agency for Strategic Planning and Reforms of the Republic of Kazakhstan Bureau of National Statistics, 2022b). These representation patterns are similar to those in other world regions (World Bank, 2019l; Khandker et al., 2020; Pilgrim et al., 2021).

The exclusion of women from decision-making processes is often attributed to societal stereotypes about the lower significance of their roles compared to men, patriarchal traditions, institutional barriers, and disproportional access to quality education, training, and resources (Ilesanmi, 2018; Mosso et al., 2022). On the other hand, numerous studies demonstrate the effectiveness of more balanced gender representation in leadership and management. Women in these types of positions are considered to be key agents of change, contributing to the adaptation of stringent climate change policies, and renewable energy transition and consumption (Allen et al., 2019; Atif et al., 2021), as well as improving companies' environmental performance (Birindelli et al., 2019). However, the processes of transforming women's role are characterized by their complexity, high costs, limited availability of resources, and prevalence of gender-neutral legislation and policies. This was also confirmed by the survey responses, which showed an insignificant improvement in the role of women in climate change mitigation and adaptation over the years, despite the national governments' efforts to reduce gender imbalances and better include women in socio-economic, environmental, and political areas. Therefore, the engagement of international agencies (donors) in supporting further developments of gender considerations in the climate change context can be considered as an additional stimulus in these processes.

4.6.3 Development Projects Analysis

Over the years, donors have assisted the CA countries in developing and introducing climate change adaptation and mitigation measures and building resilience. A large share of these initiatives has supported water resources, agriculture, and energy, sectors that are highly sensitive to climate change impacts. Types of gender/women considerations addressed in the projects reflect donors' interest in a specific domain of climate change–gender interconnection. The majority of the actions have been taken to improve women's leadership status and empowerment. This has been implemented through the improvement in the access to information and financial resources, provision of opportunities for climate change education, and training and workshops, including those on water resources, agricultural practices, disaster risk, and renewable energy resources. Projects outcomes, such as increased participants' income, better livelihoods, and environmental and health conditions, could be assigned to the benefits domain. At the same time, vulnerability has been rarely specified among objectives, pillars, or outcomes, but addressed indirectly. Its reduction has been often achieved as the result of broader objectives of the large-scale projects, such as rehabilitation of irrigation infrastructure or reduction in (agricultural) land degradation. Donors' support can be perceived as an additional driver to encourage nation- and region-wide inclusion of gender/women consideration in the climate change context in CA. In addition to the financial aid, the countries receive experts' assistance, as well as non-financial resources, to advance the transition to gender-sensitive and -responsive approaches. Furthermore, strengthening gender-related requirements for project implementations will foster a more active collaboration of all stakeholders involved.

4.6.4 Implications and Recommendations

The implications of this study to the overall knowledge of gender considerations in climate change in CA are threefold. Firstly, the work demonstrates a significant prevalence of grey literature compared to peer-reviewed publications, highlighting a

need to stimulate scientific research in the field. Taking into account socio-economic and political settings in the region, this could be implemented through the introduction of specific international research initiatives and national institutional programs.

Secondly, the study emphasizes the importance of considering women's and men's experiences in discussions on climate change, addressing their differences in governments' initiatives, and developing gender-sensitive and -responsive adaptation and mitigation measures. This can be fostered by introducing measures to increase input from women representation, particularly at town and oblast levels. Additionally, government agencies need more evidence-based materials and information demonstrating these differences and the potential benefits of their consideration. On the other hand, the work draws attention to a largely gender-neutral perception of rural men's and women's vulnerability to climate change. Therefore, identifying recommendation areas for action requires various sets of studies focusing on the estimation and evaluation of the impacts of climate change on men and women across key sectors in each CA country. Furthermore, there is a need for the broader integration of gender analysis and collection of gender-disaggregated data to support the effective development and introduction of climate change adaptation and mitigation measures.

Thirdly, the study outlines donors' role in supporting and implementing activities to reduce gender imbalances in climate change in CA. It also shows that donors' standalone gender/women initiatives focus mainly on the leadership/empowerment domain. Consequently, the study highlights areas that require stronger cooperation to mainstream the importance of gender/women considerations among a wide range of stakeholders engaged in climate change and its related fields. Additionally, there is a need to explore the effectiveness of addressing gender inequalities as a (sub-) component in large-scale projects compared to standalone gender/women initiatives. The findings will provide a better overview of the intervention areas.

The study contributes to daily life by providing an overview of climate change impacts on local men and women, and helps in the making of informed and more targeted decisions and interventions in specific areas. Furthermore, the findings could be used to identify challenges and barriers that impede the achievement of national goals towards the reduction of climate change vulnerabilities of the local population.

4.7 Conclusions

More than three decades of independence of CA countries have been marked by continuous socio-economic, legal, and political reforms, along with the growing threats of a changing climate, particularly to agriculture, food, water, and energy security. To reinforce their response to these challenges, the CA national governments have developed and introduced adaptation strategies and instruments, and actively participated in international climate agreements. In this context, it is essential that gender/women considerations are not excluded from adaptation and mitigation measures, to reduce vulnerabilities and enhance the resilience of the local population, where women represent more than 50%.

The current paper examines how gender/women considerations in the climate change context in Central Asia are reflected in the published literature, viewed by experts engaged in climate action, and supported by international donors through the implementation of development projects. The subject is of particular importance in the light of increasing threats of a changing climate to the local population's

livelihood and wellbeing, and efforts to broaden the inclusion of gender/women in adaptation and mitigation and to strengthen the role of women as agents of change.

The results of the bibliometric analysis demonstrated a significant prevalence of grey literature compared to peer-reviewed publications, implying smaller attention has been paid to the topic by the CA academic community. The analyzed publications mainly discussed issues concerning the region's vulnerability to climate change impacts and natural disasters, adaptation and mitigation, sustainable development, empowerment, and biodiversity. The experts, who were participants in the on-line survey, indicated a higher vulnerability to climate change of rural men and women compared to those who reside in urban areas. They also acknowledged the importance of considering women's and men's experiences in discussions on climate change and addressing their differences in governments' initiatives. Furthermore, they emphasized the need to develop gender-sensitive and -responsive climate change adaptation and mitigation measures. The analysis of the development projects showed a still low number of standalone climate-change-related projects focused on gender/women considerations. In the large-scale projects, the issues are addressed as a (sub-) component, objective, or in a gender action plan. Most of the projects focused on more than one domain of climate change–gender interconnections. Leadership/empowerment issues were addressed most often.

The study has several limitations, including several methodological drawbacks. The bibliometric analysis was based on a dataset that only included literature published in English, which may have led to language bias. Additionally, the voluntary participation mode of the on-line survey implies the omission of opinions of those experts who are engaged in climate action but do not consider the women/gender topic to be relevant to their working area. Consequently, the obtained survey results may not fully reflect the current situation. Furthermore, not all information about development projects may be available in open access sources due to organizations'/donors' disclosure requirements.

Nevertheless, this paper represents one of the first studies exploring gender/women considerations in climate change in Central Asia in terms of three areas: published literature, experts' opinions, and international development projects. The work outlines the issues and domains of climate change–gender interconnections that have gained more prominent attention from academia, government, civil society, and international institutions. Furthermore, the obtained findings provide valuable references for developing further steps toward the broader inclusion of gender-sensitive and -responsive approaches, particularly in climate-change-related areas that are often perceived as being gender-neutral. The study demonstrates the need to support research in the field, introduce measures to increase women's participation and input in decision-making processes, and mainstream the importance of gender/women considerations among a wide range of stakeholders engaged in climate change and its related fields.

5. Feminization of Agriculture and Its Impact on Sustainable Development

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5.1 Abstract

Definition
Feminization of agriculture refers to a significant increase in the female share in the agricultural labour force (Katz, 2003; Deere, 2005), compared to past years, regardless of whether women form the majority of those employed in agriculture (Slavchevska, 2016).

5.2 Introduction

In the process of rural development and transformation, globally, the share of agricultural employment has declined from 44% in 1991 to 28% in 2018, but still accounting to 63% in low-income countries, in 2018, only 8% less since 1991 (World Bank, 2019e). Women comprise about 66% and 2% of the agricultural labour force in low-income and high-income countries, respectively (World Bank, 2019h). Among the factors significantly affecting quantity of women and men employed in agriculture, as well as types of their roles are a socioeconomic and political situation in a country, country's geographical location, and culture and traditions.

6. Promoting gender equality across the sustainable development goals

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6.1 Abstract

Gender issues, and gender equality in particular, can be regarded as cross-cutting issues in the implementation of the Sustainable Development Goals (SDGs), even though it is unclear how they are taken into account. This study addresses this information gap by performing an assessment of the emphasis on gender issues across all the other 16 SDGs, in addition to SDG5, through a literature review and case study analysis, the basis for the newly developed framework, highlighting specific actions associated to each SDG. The 13 countries addressed in the 16 case studies include China, India, or Australia and illustrate the inclusion of SDG5 into the SDGs. Using an SDG matrix, the SDG targets are analysed. Those where an emphasis on gender equality is important in allowing them to be achieved are listed. The novelty of our approach resides in offering an in-depth analysis of how gender issues interact with the other SDGs, proposing a new analysis framework clearly identifying SDGs 1, 4, 11, 12, 14 and 16 demanding further attention for successful SD gender implementation and illustrating specific areas where further actions may be necessary, which may be used by policy-makers, raising further awareness on gender equality contribution to achieve the SDGs. A set of recommendations aimed at placing gender matters more centrally in the SDGs delivery are presented as a final contribution. These focus on the need for greater awareness and attention to good practices, to achieve successful implementation initiatives.

6.2 Introducing SDG5–gender equality

In an unprecedented global effort, the heads of state and government and high representatives in the United Nations (UN) meeting of September 2015 put forward the '2030 Agenda', a global plan for human and environmental prosperity, structured in 17 Sustainable Development Goals (SDGs) and 169 targets, indicative of the scale and of the ambition of the global action to be pursued. The 2030 Agenda recognises that the achievements of the 17 SDGs are linked to human and planetary prosperity, strengthening universal peace, greater freedom and promoting the eradication of poverty, discrimination and inequalities in all forms (United Nations, 2015c). In the collective journey of meeting the SDGs and the UN 2030 Agenda targets, countries and stakeholders will act in partnership (Leal Filho et al., 2022e) to take a transformative and inclusive path towards a resilient and sustainable future in economic, social and environmental terms. The 2030 Agenda plans for the SDGs and the related targets trigger action in critical areas for human and planetary welfare. These include (United Nations, 2015c): (i) human existence in prosperity, equality and a healthy environment, (ii) planet conservation through timely climate action, sustainable production, consumption and management of natural resources, (iii) economic, social and technological prosperity in a harmonious symbiosis with nature, (iv) peaceful, just and inclusive societies and (v) revived global partnership of countries, stakeholders and people.

SDG5, 'Achieve gender equality and empower all women and girls', reflects the ever-increasing efforts of the UN towards gender equality, earmarked with the

establishment of the Commission on the Status of Women in 1946 (UN Women, 2020a) and the adoption of landmark agreements such as the Convention on the Elimination of All Forms of Discrimination against Women in 1979 (OHCHR, 2020), the Beijing Declaration and Platform for Action in 1995 (United Nations, 1995), and the establishment of UN Women in 2010 (United Nations, 2012). The important role of gender equality for socio-economic development is well highlighted in the UN publication "We the Peoples" (Annan, 2000), emphasising the untapped development potential due to social, economic and political inequalities arising from gender discrimination, deeply rooted and persistent in many developing and developed economies, related to access to decent work and equal pay, education, healthcare, resources, decision-making, among others (Brixiová et al., 2020; Tsige et al., 2020; Connor et al., 2020; Maheshwari and Nayak, 2020). Women are still more vulnerable to violence, discrimination, and underrepresentation in the political, economic, and business spheres (Milazzo and Goldstein, 2019; European Commission, 2019a). The recognition of the important role of women in global, social, economic and environmental prosperity is clearly stated in paragraphs 236–243 of the 'Future We Want' (United Nations, 2012) and in the Open Working Group Proposal for Sustainable Development Goals (2014).

SDG5 brings forward issues of gender-based discrimination such as unpaid work, sexual and reproductive rights, and gender-based violence (Hirsu et al., 2019). Achieving SDG5 is a priority that contributes to the increase in global well-being. SDG5 includes nine targets that aim at ending all forms of discrimination, as described in Table 6.1. These targets set the sustainable development (SD) goals to be achieved. The indicators provide the monitoring approaches for status, progress, and assessment, chosen according to the respective objectives and measured globally, or at regional and country levels.

Table 6.1 SDG5 Targets and Indicators from United Nations (2021). Source: team of authors.

Target	**Indicators**
5.1 End discrimination against women and girls	5.1.1 Legal frameworks for gender equality and non-discrimination
5.2 End all violence against and exploitation of women and girls	5.2.1 Violence against women from an intimate partner
5.3 Eliminate forced marriages and genital mutilation	5.3.1 Women married before age 15 or 18 5.3.2 Female genital mutilation/cutting
5.4 Value unpaid care and promote shared domestic responsibilities	5.4.1 Time spent on unpaid domestic and care work
5.5 Ensure full participation in leadership and decision-making	5.5.1 Women in political positions 5.5.2 Women in managerial positions
5.6 Universal access to reproductive rights and health	5.6.1 Women's decision-making on contraceptive use and healthcare 5.6.2 Guarantee of equal access to sexual and reproductive health care
5.A Equal rights to economic resources, property ownership, and financial services	5.A.1 Female land rights or ownership 5.A.2 Equal rights to land ownership

5.B Promote empowerment of women through technology	5.B.1 Mobile telephone ownership
5.C Adopt and strengthen policies and enforceable legislation for gender equality	5.C.1 Systems to track gender equality

But despite the relevance of the SDGs as a whole and the importance of handling gender issues, in particular, there is a research gap when it comes to looking at both topics in a combined way. In order to address this research need, this paper reports on a study aimed at fostering a thorough assessment of the emphasis that gender issues should be given in order to achieve all the SDGs. The research question pursued by the paper is the following: *to what extent are gender issues being considered in the overall implementation of the SDGs?*
Through a literature analysis and 16 case studies discussion in a sample of 13 developed and developing countries, e.g., China, India, Spain, and Morocco, this study sheds some light on the topic. The novelty behind this study consists in not only offering a sound analysis of how gender is considered across all other SDGs, but also indicating areas where further actions may be required. The innovation of this work is also based on the fact that it offers specific insights into gender equality and the SDGs. Also, this study may offer further guidance to policy-makers, thus prioritising women's empowerment in developing collaborative initiatives in the area of gender equality. Finally, this paper also serves the purpose of raising awareness about the need for capacity building and sensitisation around gender-related issues and their crucial contribution to the SDGs.

6.3 Research on gender equality and the SDGs: assessing the relations

SDGs have clear, often measurable and very straightforward targets aiming to improve the quality of life and living conditions for all. The interactions between these goals and the larger policy frameworks aiming to ensure economic growth from the country level to the regional level turns out to be more complex and challenging due to numerous types of constraints, from financial to cultural, when considering gender equality and ways of promoting it.
The global agenda for change, intent, purpose and overall goals were generally defined with the publishing of the Brundtland Report (1987), and the progress since then entered a new phase when the SDGs were adopted by the UN as the 2030 Agenda, while SD has been adopted across several economic policy fields in order to define specific objectives and goals. While highlighting SD challenges and opportunities, studies have included the gender dimension to a lesser extent, as illustrated in the existing literature that concerns the SDGs (Magendane and Kapazoglou, 2021; Scharlemann et al., 2020).

Gender inequality is pervasive across the world and women experience a series of disadvantages, in comparison to men. Yet, SD requires that we should all enjoy equal rights and be able to appreciate lives, free from violence and discrimination (UN Women, 2020a). There has been progress in some areas of discrimination, e.g., more girls in education, fewer girls forced into marriage, and more women in leadership roles, but policy decisions related to education, health and other sectors continue to take place in gendered contexts (Morgan et al., 2020). A situation where approximately half of the population is denied equal opportunities, equal

participation in decision-making, and equal access to resources, education and employment will contribute to severely inhibiting SD and global prosperity (Dugarova, 2018).

Thus, and through SDG5, gender equality is rightfully at the heart of the 2030 Agenda for SD (United Nations, 2015c), recognised as an essential human right and important enough to be a goal in its own right, among other 16 SDGs. Its significance is such that it constitutes a cross-cutting theme spanning all the other 16 SDGs, with a total of 45 targets and 54 indicators gender-related. It is suggested that not only is SDG5 critical to all the other SDGs, with gender inequality being an obstacle to progress, but that it has the potential to serve as an SD accelerator, with a positive multiplier effect, to speed up the progress of the 2030 Agenda (UNSDG, 2018). Gender equality and women's empowerment should have a catalytic effect on human development (Odera and Mulusa, 2020) if gender is in fact actively addressed across all SDGs.

There are a number of reasons why gender equality has to be considered in relation to all of the SDGs. If under-utilising part of the world's talent, we fall short of reducing poverty (SDG1) and encouraging economic growth (SDG8). Gender equality in education and the labour market contributes to enhancing the gross domestic product and should help to reduce extreme poverty by 2030 (Dugarova, 2018). Compared to 1998, the gender gaps in the labour force, measured as the difference between the labour force participation rates of women and men, have decreased in most regions of the world in 2018, particularly in Latin America and the Caribbean, and Northern, Southern and Western Europe, but the gap has widened in Eastern Asia and Eastern Europe (Klasen, 2018). According to world regions, the Gender Inequality Index of 2020, can be seen in Figure 6.1. Also, the Life-course Gender Gap in 2019, translating into a deviation from gender parity, reveals the gaps in the adult population (Figure 6.2). The studies on gender equality reveal that women worldwide are more fragile in aspects such as poverty, representativeness in public employment positions, insecurity, or physical and sexual violence, thus emphasising the need to ensure a redesigned gender-responsive approach towards implementing the 2030 Agenda (Hirsu et al., 2019; Liu, 2019; Bourgault et al., 2021). Dugarova (2018) also demonstrates the multiple benefits of gender equality in relation to SD beyond SDG5, including food security, agricultural production, climate change (Caridade et al., 2022) and natural resource management. Similarly, Morgan et al. (2020) raise similar points but focusing on showing the importance of gender in relation to health and well-being (SDG3) and the less obvious connection between water and sanitation (SDG6) and energy (SDG7), illustrating the interconnected nature of SD and meaning that gender equality plays, in fact, an integral role to achieving all of the SDGs. Women are more likely to be impacted by unsafe water and poor sanitation (SDG6) and to die from unclean fuel (SDG7) (James et al., 2020), than men.

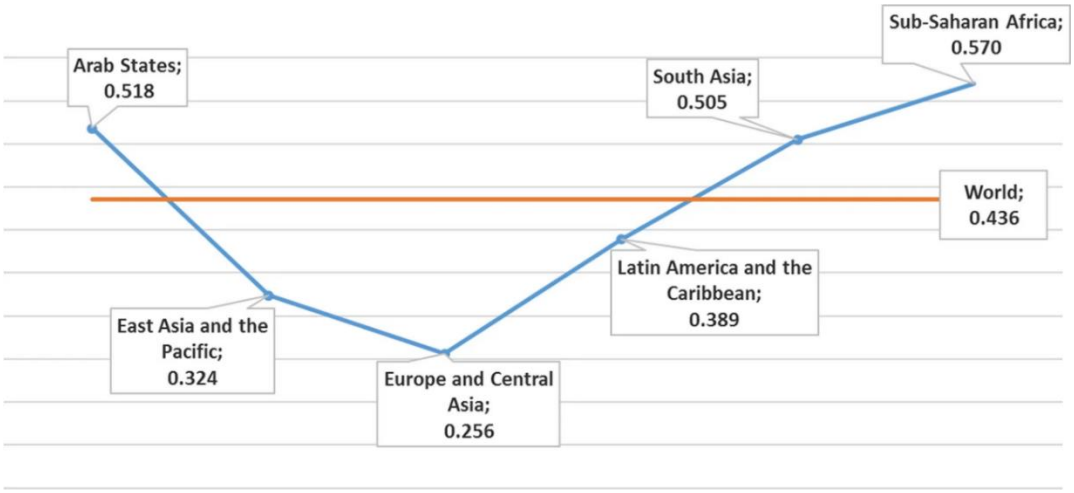

Figure 6.1 Gender Inequality Index, by developing region, 2020, modified from UNDP (2020) Source: team of authors.

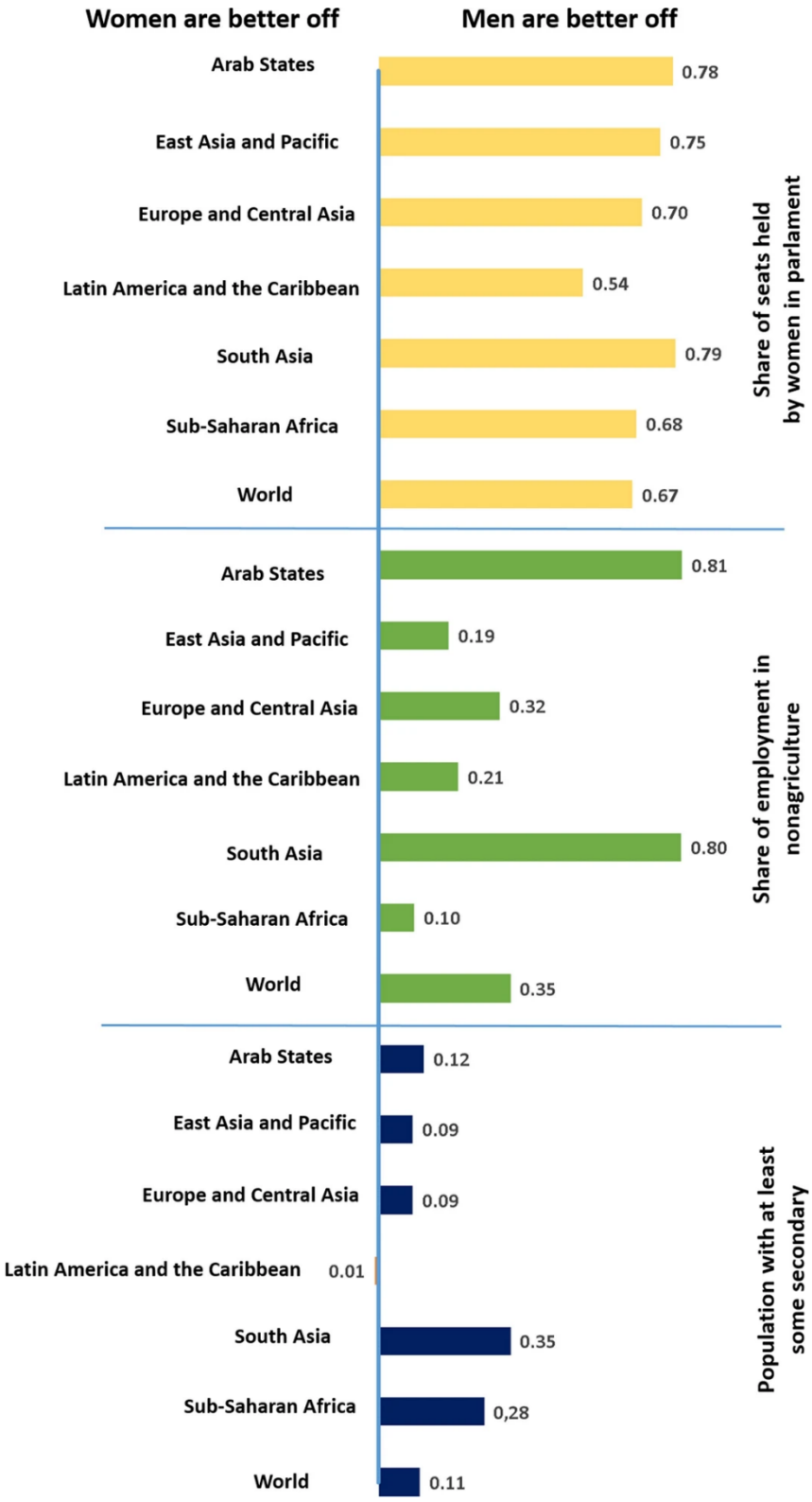

Figure 6.2 Life-course Gender Gap, 2019, modified from UNDP (2020). Source: team of authors.

The World Employment and Social Outlook suggests that women are underpaid and under-employed (ILO, 2018), although playing a central role in the household economy and being important influencers in peaceful societies. The study from Manandhar et al. (2018) suggests that the concept of gender in SDG5, seeking the

achievement of gender equality and empowerment of all women and girls, is narrow, focusing on women-specific limited roles. When considered in terms of social context impact, gender inequality affects justice in opportunities, leading to economic inefficiency and thus inhibiting growth and global SD (de Jong and Vijge, 2021).

According to Agarwal (2018), a bold interpretation of SDG5 and the establishment of synergies with the other SDGs could allow ways for women to contribute to progress in different aspects concerning SD. Asadikia et al. (2020) show the lack of influence that SDG5 alone has on an SDG index based on all observations, clearly highlighting the need to interact with other SDGs to increase SDG5 influence. Accordingly, it is important that other SDGs should refocus on the interactions of gender equality to achieve specific global sustainability objectives by 2030. Fariña García et al. (2020) used a semantic network analysis, including computational linguistics and text processing of SDGs in official documents, to measure interactions in specific countries (Nigeria and Spain), to be used to planners in every country. The results revealed that each SDG is connected with all the other remaining 16 SDGs, despite the language used to search for information. SDGs 2, 8, 11 and 12, known as the driving forces, were found to be always connected to all the others, and SDG5 was not among them, being translated into a difficulty in terms of transitioning from current to sustainable systems of governance and management, and failing to address the gender agenda (Rai et al., 2019).

SDG5 is clearly dependent on how governments interpret targets in order to allow women to access resources and have effective participation in all levels of societal decision-making, by involving various stakeholders in order to implement and reinforce legal and institutional arrangements on gender equality (Obura, 2020). The identification of interlinkage between the SDGs (Bali Swain and Ranganathan, 2021; Del Río Castro et al., 2021) is critical in allowing policy-makers to prioritise SDG5 targets and strategies for SD and achieving the 2030 Agenda indivisibility (Bennich et al., 2020). Biggeri et al. (2019) highlight the importance of adjusting the targets and indicators with specific goals, aiming to increase gender awareness and consciousness in the selection of parameters and to allow different strategic options to be involved in the implementation of the 2030 Agenda (Nilsson et al., 2018; Obura, 2020; Parkes et al., 2020). When assessing the sustainability performance of the Organisation for Economic Co-operation and Development (OECD) countries, Lamichhane et al. (2020) found that only 35% of OECD countries had identified a key national system to monitor all SDGs, a significant gap.

Most studies suggest that progress in achieving gender equality continues to be slow. The Global Gender Gap 2020 (World Economic Forum, 2020) report highlights the urgency of achieving gender equality, while reporting gaps between men and women in health, education and policy areas, and across all forms of economic participation, reinforcing that there is a long way to go with a 31.4% distance to parity. Women are closer than men in indicators related to health (SDG3), but further away from them in terms of employment targets. There are undoubtedly a number of local projects addressing gender equality, but it is predicted that it will take almost 100 years to close the gap in relation to political empowerment. Even in Western Europe, the same report suggests that gender equality will not be achieved for another 54 years.

Many countries are not on track to achieving the SDGs, and the COVID-19 pandemic has and continues to exacerbating widespread gender inequity (Shulla et al., 2021). Lockdowns have further increased the burden placed on women in the

home and putting them at increased risk from domestic violence (Huiskes et al., 2022), with women also accounting for 70% of healthcare workers fighting the virus (UN Department of Economic and Social Affairs, 2020). In this context, and considering that the SDGs are not effectively considering gender in their implementation, the gender gap may widen, rather than narrow.

6.4 Methodology

The work performed in the scope of this study was undertaken in three different phases:

Phase 1:

Documenting the targets of all the 17 SDGs that would require gender issues to be accommodated before the respective SDGs can be implemented

For achieving phase 1, which also attempts to cover an information gap regarding the integration and interaction of the 17 SDGs, an effort was made to identify the main strands dominating the literature concerned with policies, aims, interactions and analytical approaches regarding SDG5 integration in the SDGs. The first step consisted in analysing how SDGs interact in the complex framework generated by the current world's economic and social context, and therefore the methodology was based on reviewing how literature integrates gender equality leading to the UN 2030 Agenda. This resulted in a set of questions for which answers still need to be provided by considering that all SDGs need to be and are in fact interacting, guided by indivisibility, thus requiring inclusiveness as the *sine qua non* condition. Literature review allows to obtain a road overview of the existing scientific research, as well providing the context for new research (Hempel, 2020), forming the basis of all scientific research (Block and Fisch, 2020), while allowing the researcher to establish the key constructs of a future research agenda based on the identified gaps (Paul and Criado, 2020).

Phase 2:

Presenting 16 international case studies in 13 countries that specifically reflect how gender issues are being considered when implementing the 17 SDGs

The case studies in phase 2 were selected using an open international call for collaboration, in the context of which different experts were invited to provide inputs. After a detailed and critical examination of the published research, this study allows to document the cross-cutting gender issues that should be included in the targets of each of the 17 SDGs to achieve SD, while considering SDG5. A case study was associated to each SDG, demonstrating how gender issues have been successfully infused into the actions driving the achievement of all the SDGs. Thus, by setting up the main interactions/relations and policies dominating the policy-making that addresses SDG5, and identifying current vulnerabilities, gaps and delays in this respect, the 16 international case studies reflect how gender issues are taken into account when implementing the SDGs, a necessary step in developing a judicious framework and recommendations for facilitating the achievement of SD across all SDGs, by integrating the SDG5 targets and indicators.

Phase 3:

Develop a framework that is able to consider how gender issues across all the SDGs can be implemented to facilitate the achievement of SD at global level

In phase 3, data was first collected by documenting targets related to gender for each SDG (data from phase 1). Then, a set of case studies reflecting how gender issues

have been successfully infused into the achievement of each SDG was used (data from phase 2). The combined results of both phases 1 and 2 formed the basis for the framework developed in phase 3, analysing the impact of gender issues on all the SDGs. The impact indicator showed the percentage of particular goal targets impacted by gender inequality. It was calculated for each SDG by using the following equation:

$$\frac{IT}{TQ} * 100\% = PI \qquad (1)$$

where *IT* represents the Impacted targets quantity, *TQ*, the total targets quantity of each goal and *PI*, the percentage impact.

The percentage values fall under one of the four categories:

- Low impact: 0%—39.9%
- Average impact: 40%—60%
- Highly impacted: 60.1%—99.9%
- Extremely impacted: 100%

The combined results from the three phases are presented and discussed in the next section.

6.5 Results and discussion

This section reports on the literature search information and data collected. The evidence collected using the case studies allowed the development of a proposed framework that can be helpful to practitioners in promoting a cross-cutting approach to gender issues in the context of all other SDGs.

6.5.1 Gender equality and the SDGs

In the attempt to identify the gender issues predominant trends, the findings based on reviewing specialised literature have shown that contributions to gender equality and SDGs are mostly theoretical, focusing on trade-offs and synergies, followed by studies concerned with policy implications, and possible methodological and empirical approaches about the interactions of all the SDGs, while suggesting a wide number of indicators that are currently used or that need further refinement for properly measuring progress in achieving the SDGs. These frameworks of analyses assume particular relevance in developing countries, but also developed ones alike, as inequalities are still deeply rooted, irrespective of the SD degree.

Studies have referred to interactions among the 17 goals, while neglecting the specifics of interactions with SDG5 on gender equity studies (Abualtaher et al., 2021; Miola et al., 2019), the focus of this study. Moreover, most studies propose models and approaches often contradictory, thus delivering inconsistent outcomes regarding costs and effectiveness of policies or measures and actions for achieving the SDGs. Most of the studies are in an increasing trend of building up on the findings of other studies, while failing the novelty dimension (Magendane and Kapazoglou, 2021).

Faced with the vast volume of recent research and studies in approaching the dimension of the interaction between the SDGs, and by assessing the outcomes of relevant studies at this regard, it may be stated that most studies seek to bring improvements for three main processes: policy development, impact assessment, and how synergies are achieved or not (Alcamo et al., 2020; Biggeri et al., 2019; Scharlemann et al., 2020), while this study aims to cover both the theoretical and practical issues related to gender equity, as included in the 17 SDGs. Based on the

analysed literature review, it is important to be careful about forming a generalised perspective by including general insights and gained knowledge about one SDG in relation to all other SDGs, because the context from the economic, social and environmental perspective is of paramount relevance (Nilsson et al., 2018). Integrated perspectives provide the best opportunities in assessing the relations and interactions with all other SDGs, while allowing for the identification of the main weaknesses, in particular regarding SDG5.

By affirming the overarching relevance of gender equality and its developments in the short time framework between 2015 and 2021 (Dugarova, 2018; Klasen, 2018; Odera and Mulusa, 2020), it was then possible to develop a general theoretic-empirical framework for underpinning the relevance of a gender-responsive approach to implementing the 2030 Agenda (Hirsu et al., 2019; Liu, 2019; Bourgault et al., 2021).

The above information does reveal the need to focus on specific practical implementation at local level, though benchmarking. The case studies presented below aim to illustrate successful implementations.

6.5.2 Case Studies

Gender issues extend beyond SDG5 and needs to be addressed within all the other SDGs. The international case studies included in this section have thus been chosen as illustrative examples of gender equality, considered in relation to each SDG, other than SDG5. Further detail on how a focus on gender has brought a positive benefit in relation to each SDG, as the full list of case studies, is given in Appendix III.

Non-governmental and governmental organisations are working together to help rural women improve the quality of their life by expanding access to sexual and reproductive health care in Tanzania (Engender Health, 2021). The Trans-Boundary Rivers of South Asia programme in Nepal promotes and supports women's leadership in water governance to increase their social accountability (Crawford, 2020). A case study from China demonstrates that the implementation of sustainable consumption and production (SCP) may significantly benefit from the integration of gender analysis into the design of SCP policies, strengthening women's participation in natural resource management and decision-making processes (Fan and Jaffre, 2020). In the frame of the educational programme Soochnapreneur (Information-Preneur) in India, rural women received necessary information and technology training to become change agents and assist in disseminating information regarding government schemes and benefits in communities. Participation in the programme not only develops their entrepreneurial abilities as Digital Information entrepreneurs but also allows them to charge a nominal amount for their services to sustain their livelihood (Soochnapreneur, 2021). In South Africa, the skills-driven project that supports the creation of rural, women-only entrepreneur craft groups contributes towards improving quality of life and developing a more sustainable community (Pretorius and Nicolau, 2020). The Samoa's Ministry of Women, Community and Social Development and the Disaster Management Office are working towards increasing women's engagement and participation in climate change and Disaster risk reduction community discussions and development projects (Aipira et al., 2017). The 'Blue Economy Aquaculture Challenge' initiative supports projects for transforming sustainable aquaculture practises with solutions linked to gender equality, among others (Australian Government, 2018).

The addressed case studies illustrate useful approaches for tackling a variety of local problems in a cross-cutting way, as a support for governments as they focus on gender equality issues, showing that there is room for further similar initiatives in different geographical and socio-economic contexts. The case studies presented clearly indicate that various initiatives related to gender across the globe have been successfully addressed at local levels, and these initiatives have directly and indirectly affected the achievement of the particular SDG under analysis, thus affirming the need to infuse gender issues within all the targets of the 17 SDGs to ensure more productive outcomes and achievements in the drive to SD. It has been shown that governmental and non-governmental organisations cooperate in improving the overall quality of life for women, either in rural or urban areas and in regards to health, education and access to leadership/management positions. Still, it was found that much is still to be done, as shown found below, analysing the interaction with all of the SDGs.

6.5.3 The proposed framework for assessing gender equality impact across the SDGs

Achieving gender equality is a matter of human rights and is crucial to progress across all the goals and targets (Dhar, 2018), as highlighted before. Gender inequalities intersect other inequalities, power imbalance and discriminatory practices, and as such, they unequivocal serve as routes to addressing the causes preventing SD globally (Hepp et al., 2019). We have pointed out that while being a goal in its own right, gender equality cuts across all other SDGs and is reflected in 86 targets for the SDGs.

Through the use of the data collected by documenting targets related to gender for each SDG (see the SDG Matrix–Appendix IV) and the identification of fruitful case studies reflecting how gender issues have been successfully infused into the achievement of each SDG, both based on a detailed analysis and synthesis of the literature, the authors have used the lessons learnt to develop a framework aimed at analysing the impact of gender issues on all the SDGs, illustrated in Figure 6.3. This framework allows to establish which SDGs need the most attention for successful SD implementation and can serve as a guide for all practitioners in accommodating and promoting a cross-cutting approach of contemplating gender issues within the target of all the SDGs.

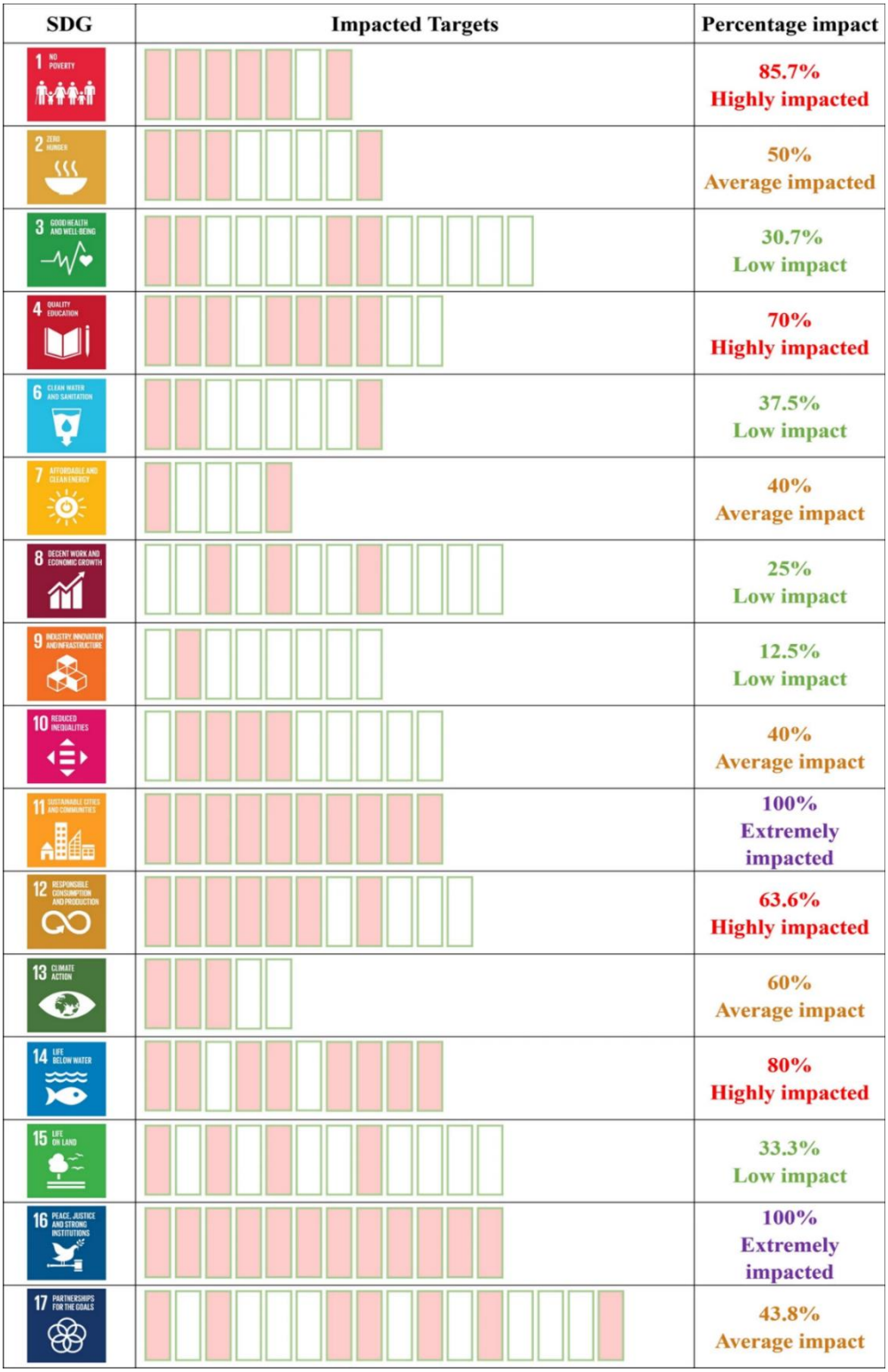

Figure 6.3 Proposed framework for considering gender impact across all the SDGs. Source: team of authors.

According to the results of calculations, the following SDGs are extremely or highly impacted by gender inequality and should be prioritised: SDG1 (No Poverty), SDG4 (Quality Education), SDG11 (Sustainable Cities and Communities), SDG12 (Responsible Consumption and Production), SDG14 (Life below Water) and SDG16 (Peace, Justice and Strong Institutions) (Figure 6.4). If government and non-governmental organisations strive to achieve SD, as proposed by the 2030 Agenda,

they would have to ensure that gender equality is prioritised in their endeavours, particularly in the context of the six aforementioned SDGs (1, 4, 11, 12, 14 and 16).

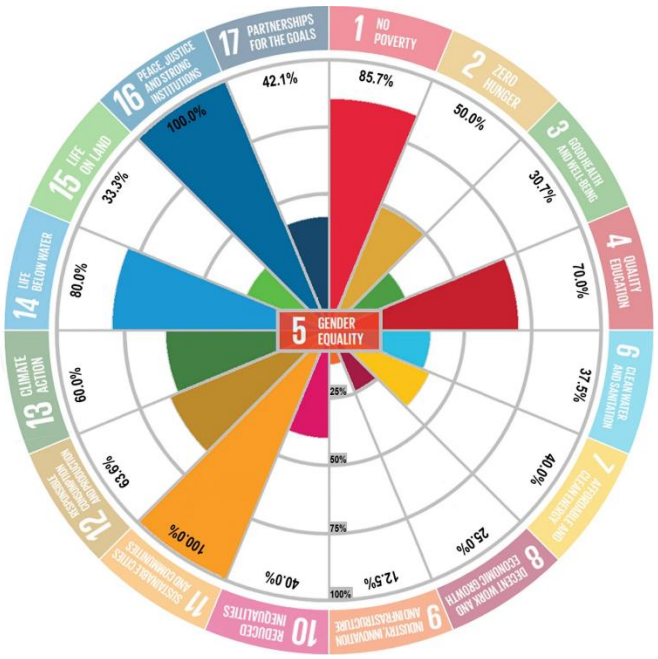

Figure 6.4 Percentage of gender inequality impact on SDG goals, according to the authors' proposed methodology. Source: team of authors.

A fundamental part of achieving SD is the reduction of poverty, and this needs greater priority in policy decisions. The literature makes it clear that high poverty is interlinked with high gender disparities (Warchold et al., 2021), particularly in developing countries (Workneh, 2020). More women are affected by poverty due to their larger share of unpaid work, limited access to resources and social protection, and lack of control over spending decisions when compared to men (United Nations, 2015c). Countries that reflect statistics of more women in remunerated positions have lower poverty rates (Nieuwenhuis et al., 2018), though this might not be the case when the income size is below the poverty line (European Institute for Gender Equality, 2016). The COVID-19 pandemic is expected to have deepen gender poverty gaps, affecting women more strongly than men (Leal Filho et al., 2022a, 2022d). According to the report released by the United Nations Development Programme (UNDP) and UN Women, 232 million women will be living in extreme poverty in 2030, compared to 221 million men (Azcona et al., 2020).

Gender gaps in education negatively affect economic growth (Klasen and Lamanna, 2009). Globally, approximately 17% of women, compared to 10% of men, are illiterate. In developing countries, this gap is much larger. As example, only 26% of women are literate, compared to 46% of men in Mali, 27%, compared to 60% in South Sudan, and 70%, compared to 45% in Afghanistan (World Bank, 2020a, 2020b). Every additional year of primary school increases the future earnings of girls, decreasing their vulnerability to violence and motivating them to marry later (UN Women, 2012). Addressing gender imbalance in land ownership rights and access to natural, social and economic resources is essential for responsible consumption and production (Franco et al., 2018). Women demonstrate a higher tendency towards product reuse, waste reduction, and purchase of organic

and eco-labelled products (Bulut et al., 2017; OECD, 2018). The promotion of peaceful and inclusive societies for SD and access to justice for all are impossible without targeting gender inequalities. In 2020, the United Nations High Commissioner for Refugees (UNHCR) recorded more than 82 million people fleeing war, violation of human rights, persecution or conflict, of which 48% are women and girls (UNHCR, 2021). The COVID-19 pandemic and subsequent lockdowns have intensified domestic violence (Azcona et al., 2020; UN Women, 2020b; Akel et al., 2021; Bourgault et al., 2021). The preliminary data indicate a 25%—100% increase in reported cases globally (UN Women, 2020c), one of the consequences of the inability of institutions to provide equal gender access to justice and essential services, and of gender representation imbalance in global, regional or national governance (UN Women, 2018a). Particularly in developing countries, the achievement of the social inclusion of vulnerable groups such as women can be ensured by local government policies, especially related to well-being gender budgeting (Gunluk-Senesen, 2021). More equal gender participation is one of the key factors to sustainable peace.

6.6 Conclusions

A recent major challenge impairing the proper achievement of gender equality is the COVID-19 pandemic, which is causing an expansion of inequalities in topics related to education, employment and well-being, healthcare, consumption and production, or climate change, being imperative that all stakeholders involved in SD thus prioritise and infuse gender equality in all their endeavours, while policy-makers need to critically reflect on whether their strategies for particular individual goals would be enhanced by a broader consideration of gender equality issues. While most of the previous studies investigated the potential interactions of gender equality with other SDGs (Barbier and Burgess, 2019; Dawes, 2022; Pham-Truffert et al., 2020; Tremblay et al., 2020; van Zanten and van Tulder, 2021; Warchold et al., 2021), this study contributes to a better understanding of gender equality as a cross-cutting issue among all the SDGs, underscoring the need to prioritise gender issues at all scopes of SD.

This study aimed to assess and define the relations and interactions regarding gender inequality, based on specific literature related to main gender inequality concerns, access to education, employment and implicitly to equal pay, along with all other related issues, from legal aspects to metrics of violence. An extensive body of literature was explored in this study, also documenting 16 relevant international case studies in 13 countries to emphasise the significance of positive interventions in terms of gender equality, considered as a cross-cutting issue among all the other SDGs, as reflected in 86 targets. As a result, the study proposes an innovative qualitative assessment framework, according to which targets can be impacted negatively by gender inequality, an important factor that can impair the achievement of a particular SDG. Among the most-impacted SDGs that should more attentively consider the promotion of gender equality as an important condition for their achievement are SDGs 1, 4, 11, 12, 14 and 16, being possible to notice a strong diversity of approaches involved, covering issues of concern that are equally of future interest. Understanding the strong interconnectedness of the SDGs in terms of addressing the issues related to gender equality needs to become a trend. If widely spread, this trend may serve as an accelerator for the achievement of global SD, through the 17 SDGs, and can offer further guidance to policy-makers for prioritising

the achievements of the targets, by empowering women worldwide. The literature review outlines that the progress in achieving gender equality continues to be slow, as many gaps still exist between men and women in health, education, politics, and across all forms of economic participation. However, as demonstrated by the successful case studies implemented worldwide, there is a growing interest among different stakeholders to develop collaborative initiatives that give particular attention to promoting gender equality, and the trend is likely to increase in the future. However, while the presented case studies illustrate positive interventions in terms of SDG5 contribution to SD, they are clearly still insufficient.

One all-encompassing finding is that in spite of a wide range of studies and academic papers related to SDGs and SD, there continues to be divisiveness in assessing the challenges and opportunities of the 2030 Agenda, associated with the need for developing sound frameworks for drafting and assessing *ex-ante* policies, measures and actions for ensuring the integrated interaction among the 17 SDGs, by considering necessary trade-offs and integrating other environmental, social and economic policy objectives. All these, while not explicitly mentioned in this study, have been implicitly considered, along with policy paradigms that consider the lifestyle, technological and even healthcare/educational changes. The 17 SDGs of the 2030 Agenda imply by their formulation a principle of indivisibility, as SDGs address the shared concerns of all humanity. In fact, it is precisely this governing principle which is the foundation for the approach used in this study, guided by the interest in analysing how SDG5 can be assessed and further implemented when associated to the other 16 SDGs, substantiated by the fact that the 2030 Agenda has an implied target-integrated approach regarding the SDGs. Investigating SDG5 relationship with the other 16 SDGs proved to be challenging and promising, as it provided for new insights about the relationships and interactions between all the SDGs. Thus, a key implication of this study is that it illustrates the fact that more attention should be given to mainstreaming the gender equality theme within all development initiatives of every country. Also, considerations to gender issues should be included in the design of targeted policies and programmes, data collection on indicators, and also in the defining of priorities in every region.The study has limitations. The first one is the fact that, being a qualitative study, it was not possible to cover all the works published in the field. Also, the selection of the case studies was not exhaustive or intended to cover all geographical regions, and it should be only regarded as an illustration of gender equality as a cross-cutting issue. Furthermore, the sample of 13 countries does not cater for a worldwide representation. However, despite these limitations, this study represents a significant knowledge addition to the existing literature on the connections between SDG5 and overall efforts to implement global SD and successfully advancing the SDGs.

Based on the evidence collected, the following **recommendations** may help in efforts aimed at placing matters related to gender more centrally in the delivery of the SDGs:

- Inclusion of gender issues as a cross-cutting topic in the implementation of the SDGs.
- A greater emphasis on gender equality in SDGs-related projects across all themes.
- An increased attention should be paid to the opinion, views and voices of women on SDGs-associated policies, a procedure often overlooked.
- More attention should be given to poverty alleviation, a trend often unnoticed in gender discussions.

- A more detailed and continued review of novel case studies across the globe should be undertaken to establish how existing good practices on mainstreaming gender are integrated into the targets of all the SDGs, and then to infuse these local initiatives into policy and development initiatives.

Finally, there is a perceived need to build more capacity among professionals involved in the implementation of the SDGs, so as to better sensitise them about the need to always consider gender issues, raising global awareness about gender-related matters.

7. Climate change, extreme events and mental health in the Pacific region

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7.1 Abstract

Purpose
This paper aims to address a gap in investigating specific impacts of climate change on mental health in the Pacific region, a region prone to extreme events. This paper reports on a study on the connections between climate change, public health, extreme weather and climate events (EWEs), livelihoods and mental health, focusing on the Pacific region Islands countries.

Design/methodology/approach
This paper deploys two main methods. The first is a bibliometric analysis to understand the state of the literature. For example, the input data for term co-occurrence analysis using VOSviewer is bibliometric data of publications downloaded from Scopus. The second method describes case studies, which outline some of the EWEs the region has faced, which have also impacted mental health.

Findings
The results suggest that the increased frequency of EWEs in the region contributes to a greater incidence of mental health problems. These, in turn, are associated with a relatively low level of resilience and greater vulnerability. The findings illustrate the need for improvements in the public health systems of Pacific nations so that they are in a better position to cope with the pressures posed by a changing environment.

Originality/value
This paper contributes to the current literature by identifying the links between climate change, extreme events, environmental health and mental health consequences in the Pacific Region. It calls for greater awareness of the subject matter of mental health among public health professionals so that they may be better able to recognise the symptoms and relate them to their climate-related causes and co-determinant factors.

7.2 Introduction

7.2.1 Introducing climate change, extreme weather events and health

The influence of humans on the climate system is evident. The recent global anthropogenic greenhouse gas emissions due to population growth and massive industrial processes are the highest in history; therefore, they are the leading cause of climate change and global warming (IPCC, 2014a). While the evidence explicitly links anthropogenic climate change with extreme weather and climate events (EWEs) frequency and intensity, indicators suggest human-mediated global warming has likely increased compound EWEs since the 1950s (IPCC, 2012, 2018, 2019, 2021; Mycoo et al., 2022).

Besides its substantial environmental and economic risks, climate change is one of the world's leading health risks (Berry et al., 2018). It is a primary culprit for the

increased rates of many communicable and non-communicable diseases, including zoonoses (Leal Filho et al., 2022c). Of particular concern are the impacts of climate change on mental health and the stress related to it (Searle and Gow, 2010). There is a strong association between EWEs and mental illness (Berry et al., 2018). These impacts may range from significant short-term to long-term impacts. The short-term impacts on mental health occur during or in the few days following a EWE and are likely to subside with time. Heatwaves, for instance, were found to negatively impact mental well-being equivalent to unemployment (Ding et al., 2015). Severe environmental events such as floods result in injuries, loss of properties and businesses and loss of loved ones, aggravating or leading to mental illnesses, such as anxiety, depression, distress and trauma (Berry et al., 2018). Low-income and developing countries are naturally more prone to such effects due to their lack of preparedness and limited adaptation capacity (Alderman et al., 2012). Overall, the most prevalent psychological illness in people affected by EWEs is post-traumatic distress syndrome (PTSD), followed by depression and anxiety (Liu et al., 2006). The magnitude of stress experienced by the victims depends on the extent of the damage, losses and inconvenience caused by the event (Tapsell et al., 2002).

Although there is no solid evidence about how long psychological impacts could last after a flood event, some studies suggest that psychological distress caused by floods affects the quality of life in the long term, too (Berry et al., 2018). For example, the levels of psychological distress in the community affected by the floods in 2000 in Lewes, Southern England, had doubled, and those psychological problems were still recognisable four years after the flood (Reacher et al., 2004). Figure 7.1 presents an overview of some of the impacts of climate change on mental health.

In addition, there is growing evidence linking climate change and extreme environmental events to human migration that together with its accompanying stressors become a significant cause of increased mental illness rates (Bhugra, 2004; Black et al., 2013).

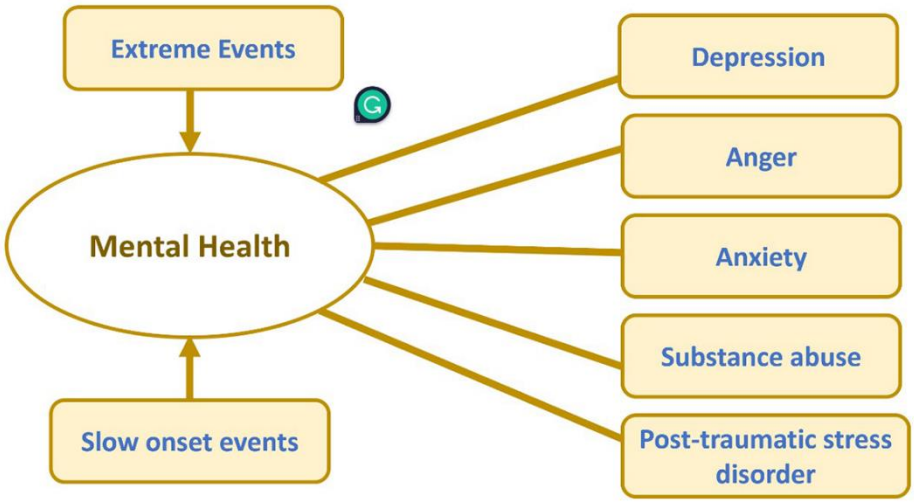

Figure 7.1 Some of the impacts of climate change on mental health. Source: team of authors.

7.2.2 Impacts of climate change and extreme events in the Pacific Island countries

7.2.2.1 Health impacts of climate change and extreme events as a whole

Current projections indicate that climate change and environmental disasters will become among the leading causes of migration in the 21st century (IPCC, 2014a). One of the world's most affected regions by climate change and EWEs is the Pacific Islands Countries (PICs), which comprise hundreds of scattered islands that are small in size and poor in natural resources. PICs have weak economies, poor infrastructure and a combined population of about 6.6 million. Most of the population work in agriculture (WHO, 2013), and 50% live within 1.5 km of the ocean (Tiatia-Seath et al., 2018).

Five PICs are ranked among the top 20 countries in the World Risk Index for countries at-risk of extreme natural events in 2019, having Vanuatu and Tonga islands as first and third on the list, respectively (The World Bank, 2020). Intense cyclones, floods, sea-level rise (SLR), freshwater shortage and changes in seasonal weather are expected consequences of climate change in the Pacific region. Due to the concentration of most people in the coastal areas, only a few people could be safe from these climatic phenomena (Tiatia-Seath et al., 2018). These consequences may have disastrous economic implications such as land and coastal infrastructure losses and severe health impacts such as malaria and dengue fever. Nevertheless, the impacts of EWEs on mental well-being, in particular, have recently gained much recognition by public health experts in the Pacific region. The damaging climate-related impacts on mental health may be direct or indirect. The direct impacts include, for instance, anxiety, depression, distress and trauma occurring following devastating natural events. On the other hand, the indirect impacts include the movement of people due to the destruction of the infrastructure and the subsequent economic and social collapse of the affected cities. Furthermore, climate change in the Asia Pacific region might force up to 75 million people to migrate to other destinations by 2050 (Tiatia-Seath et al., 2018); this kind of forced migration represents a real stressor for the affected people and negatively affects their mental well-being.

The specific impacts of climate change and EWEs on mental health in the Pacific region and the different PICs are not well studied, and only little is known about it up to date. For instance, Gibson et al. (2020) stated,

"Evidence is emerging of the mental health impacts of climate change. Tuvaluans are experiencing distress because of the local environmental impacts caused or exacerbated by climate change and hearing about the potential consequences of climate change."

This paper tries to fill this gap by studying the connections between climate change, extreme weather events and mental health, focusing on the PICs in general, particularly the Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands, Nauru, Pal au, Samoa, Solomon Islands, Tuvalu and Vanuatu. Besides reviewing case studies of EWEs, the paper describes how they disrupt life-support systems and population livelihoods and well-being by affecting determinant factors such as food security, malnutrition, water security, vector- and water-borne diseases and displacement affect the population's mental health/psychosocial condition.

Pacific island countries (PICs) are among those most vulnerable to the health impacts of climate change (Hanna and McIver, 2014) due to their exposure to changing weather patterns (McIver et al., 2016). Consequently, extreme events'

frequency, timing, intensity and duration vary (Karl et al., 1995). Increased precipitation, drought, cyclone, hurricane, windstorm and SLR result in the rise of climate-sensitive health risks and limits the capacity of PICs to manage and adapt in the face of such risks.

The extent to which the impacts of EWEs could affect future susceptibility is determined by whether affected communities can prepare for and cope with the exposure and if the health systems can fully recover from an event before the next occurs (Ebi and Bowen, 2016). Further, EWEs can have prolonged effects on communities and health-care services; their impacts increase the vulnerability to successive events. For example, a hurricane followed by a flooding event in low-lying coastal areas does not allow adequate time for recovery, which can take decades (UNES-CAP, 2015).

Climate change has substantial and diverse impacts on human health (Kotcher et al., 2021). Furthermore, the pathways by which climate change affects health differ according to their modes of action (McIver et al., 2016). The potential health impacts of EWEs include direct impacts, such as traumatic deaths and injuries; indirect impacts, such as illnesses associated with water-borne, food-borne, vector-borne diseases and zoonoses; diffuse or delayed impacts such as mental/psychosocial health disorders, non-communicable diseases (NCDs), health system deficiencies through ecologic or social disruption (McIver et al., 2016; Butler and Harley, 2010).

7.2.2.2 Delayed health impacts of climate change and extreme events on mental health

Several climate-related health risks are of concern in the Pacific not documented elsewhere globally, for example, NCDs, mental/psychosocial health disorders and ciguatera (McIver et al., 2016; Mannava et al., 2015). The countries prone to climate-related mental or psychosocial health disorders (e.g., anxiety, depression and post-traumatic disorder) include FSM, Fiji, Marshal Islands, Nauru, Palau, Solomon Islands, Tuvalu and Vanuatu (McIver et al., 2016). In addition, EWEs affect an individual's emotional or mental health (Ebi and Bowen, 2016; Lawrance et al., 2021) as the aftereffect or recovery phase from catastrophic damages is full of social and financial challenges.

Figure 7.2 schematises the climatic changes and EWEs' direct and indirect adverse impacts on health (e.g., infectious diseases and malnutrition) and mental health (e.g., relocation/resettlement), highlighting the importance of windstorms/hurricanes and SLR on mental health. The most prevalent psychological illness in people affected by EWEs is PTSD, followed by depression and anxiety (Liu et al., 2006). The prevalence of mental illnesses in the first two years following flood events ranges from 8.6% to 53% (Jackson and Devadason, 2019). There is, however, no solid evidence about how long psychological impacts could last after flood events, but some surveys suggested that they may last for as long as six years (Jackson and Devadason, 2019).

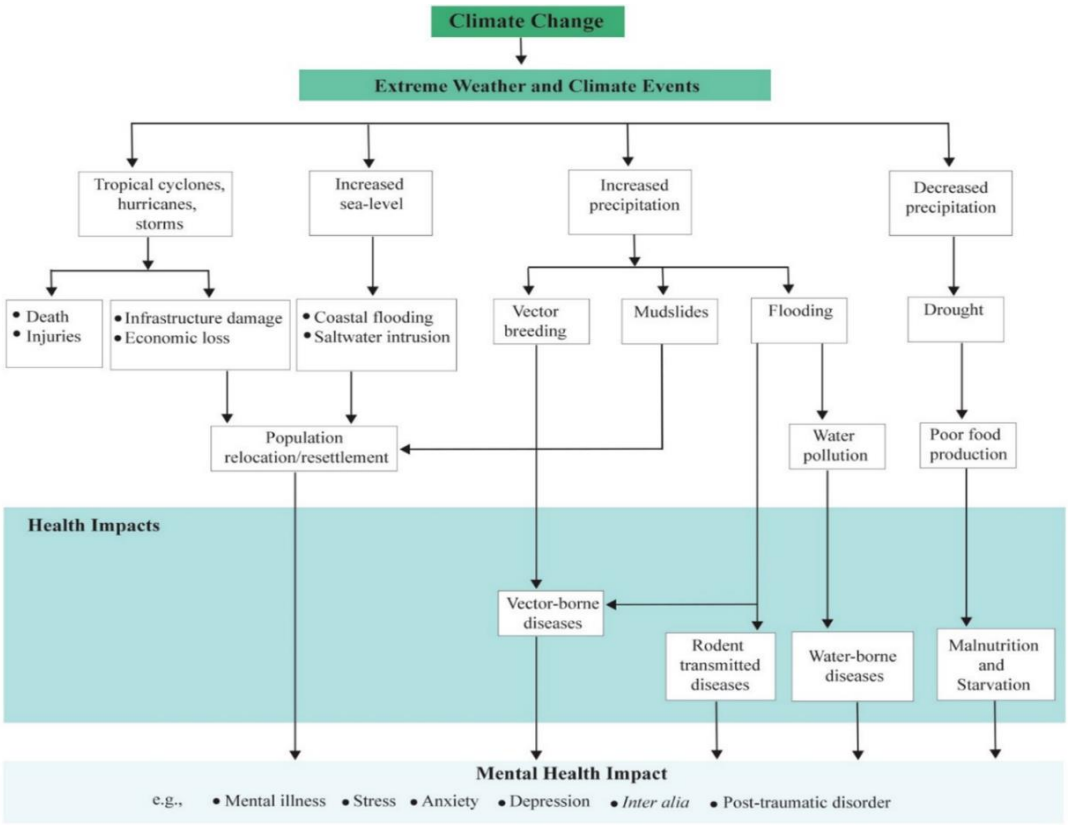

Figure 7.2 A conceptualisation of the pathways by which climate change will affect mental health in the Pacific Islands Countries (PICs) and the significant anticipated impacts throughout the region. Source: team of authors.

7.2.2.3 Zooming in the pacific region: the effects of extreme events

The EWEs cause many deaths and injuries annually in the Pacific region and disrupt the local environment and communities (Lei and Zhou, 2012; NDMO, 2014; OCHA, 2015; UFCOP, 2017; Terry and Lau, 2018). Over the years, the severity of EWEs has forced the people to relocate, for example, the climate-induced relocation of the Vunisavisavi community in Fiji (Singh et al., 2020). For Pacific Islanders, the land (e.g., Vanua in Fiji) provides a sense of place and identity. Therefore, the relocation or resettlement from the roots of their cultural, psychological and spiritual well-being has emotional and psychological implications (McAdam, 2014; McNamara et al., 2021).

In the recent past, PICs have been a hotspot for a series of EWEs such as flooding, tropical cyclones and hurricanes (Chand and Walsh, 2009; Magee et al., 2016), causing injuries, loss of lives, massive destruction to infrastructure (Aquino et al., 2019) and economic loss (Benson, 1997). Cyclones and floods are the most frequent climate-related disaster and the leading cause of death and injuries from EWEs in PICs (Lei and Zhou, 2012; NDMO, 2014). Table 7.1 presents some of these events.

Future climate scenarios project an increase in the frequency of EWEs, SLR and, consequently, an increased risk of floods (Meehl et al., 2000; Vitousek et al., 2017), especially in low-lying coastal areas. The severity of a flood is determined mainly by topography, the surrounding infrastructure of the flooded area, various human-generated factors and the potential of floodwater to spread over a wide area.

Cyclones can be massive, cutting broadband of destruction as they traverse the PICs. For instance, Vanuatu experienced drastic effects from the windstorm in 1999, causing 32 deaths (Lei and Zhou, 2012). Severe drought conditions have been associated with widespread crop failure and food shortages, resulting in malnutrition and starvation in PICs (Barr, 1999; Hoot et al., 2012). Fiji has experienced six prolonged periods of drought events since 1970, affecting over 900,000 Fijians (Government of Fiji, 2017). A historical extreme rainfall deficit and drought occurred in Fiji during the El Niño event of 1997/1998 (Lightfoot, 1999). Thus, the factors that could reduce longer-term resilience from EWEs in PICs would likely include poor food and water security, mental health issues and displacement.

Table 7.1 Examples of extreme weather events in the Pacific islands (2003–2020) Source: team of authors supported by the literature

Name of Event and Year	**Country Affected**	**No of People Affected**	**References**
Drought—2011	Tuvalu	>5200	IFRC (2011), Kuleshov et al. (2014)
Floods—2012	Fiji	±150,000	Kuleshov et al. (2014) ReliefWeb (2012a)
Tropical cyclone (Evan)—2012	Samoa Fiji	>10,000	Kuleshov et al. (2014), ReliefWeb, 2012b)
Floods—2013	Solomon Islands	>10,000	BBC (2014), Noy (2016)
Tropical cyclone (Ian)—2014	Tonga	±5500	United Nations (2015b), World Bank (2014a)
Tropical cyclone (Pam)—2015	Fiji, Vanuatu, Tuvalu, Solomon Islands, Tonga	±166,600	Le Dé et al. (2018), United Nations (2016), ReliefWeb (2015a)
Tropical cyclone (Mitag)—2002	Federated States of Micronesia	>175	Guha-Sapir (2018)
Tropical cyclone (Chata'an)—2002	Federated States of Micronesia	±1448	Guha-Sapir (2018)
Tropical cyclone (Lupit)—2003	Federated States of Micronesia	>1000	Guha-Sapir (2018)
Tropical cyclone (Sudal)—2004	Federated States of Micronesia	±6008	Guha-Sapir (2018)
Coastal flooding—2008	Federated States of Micronesia	>1200	Guha-Sapir (2018)

Tropical cyclone (Maysak)—2015	Federated States of Micronesia	>35,000	United Nations (2016), Guha-Sapir (2018), ReliefWeb, (2015b), Tiwari et al. (2019)
Drought—2016	Federated States of Micronesia	>100,000	Guha-Sapir (2018)
Tropical cyclone (Winston)—2016	Fiji, Vanuatu	±150,000	European Commission (2019b), ReliefWeb (2016), Thomas et al. (2019)
Earthquake—2018	Papua New Guinea	>544,000	OCHA (2019)
Tropical cyclone (Gita)—2018	Tonga	±80,000	OCHA (2019), Foley (2020)
Tropical cyclone (Yasa)—2020	Fiji, Vanuatu	±93,000	Fiji Meteorological Service (2021), ReliefWeb (2020)
Tropical cyclone (Harold)—2020	Vanuatu, Fiji, Solomon Islands	±170,000	Ahmed and McDonnell (2020), FAO (2020c)

7.3 Methods

This paper deployed two main methods and consisted of two steps.

In Step 1, a bibliometric analysis was performed based on the need to review the existing literature. Bibliometric analysis has become an increasingly popular data analysis and visualisation method due to its ability to provide an overview of the structure and trends in a field or sub-field. Specifically, the text mining ability offered by bibliometric analysis tools allows for analysing relationships between specific sets of terms. As such, the authors perform a bibliometric analysis to understand the state of the literature concerning psychiatric conditions and climate change events. The input data for analysis using VOSviewer is bibliographic data of academic publications downloaded from Scopus. Scopus was selected given its broad coverage of quality peer-reviewed academic journals and also the compatibility of its bibliographic outputs with VOSviewer. Web of Science is another frequently used database. However, it was not used in this analysis since its coverage of journals is limited compared to Scopus.

To find relevant documents, the authors designed an inclusive search string of terms associated with mental health and climate change that was not limited by date (Appendix V). The search string was developed iteratively to ensure its comprehensiveness. For example, the authors first searched for "climate change" and "mental health". The authors then checked the returned articles and added other relevant terms to the string. This process was repeated until adding new terms did not result in retrieving new articles. Although some relevant articles may have been overlooked, the authors believe this approach has helped us retrieve as many articles as possible.

Overall, our initial search on 23 October 2021 returned 501 articles written in English. Titles and abstracts of these articles were screened, and 355 articles, book chapters, reviews, conference papers and letters related to this study's scope were selected for bibliometric analysis using VOSviewer. The excluded articles did not include issues associated with mental health. For the selected articles, "full record and cited references" were downloaded from the Web of Science to be used as input data for bibliometric analysis. After inputting these data into VOSviewer, the authors used the term co-occurrence analysis to understand the knowledge structure of the field (Figure 7.3).

Figure 7.3 shows that the output is presented as a graph, where the node size is proportional to the terms' frequency, and the connecting lines' width indicates their strength. Words that frequently co-occur form clusters that show major thematic research areas in a field.

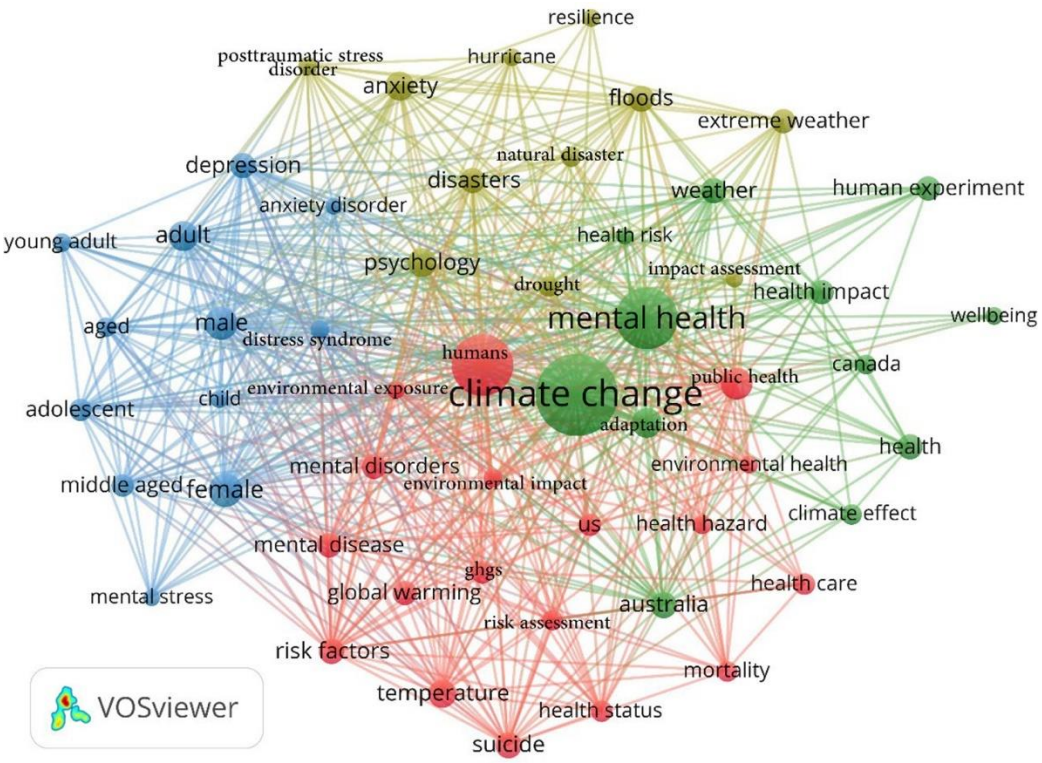

Figure 7.3 Co-occurrence map of mental health and climate change-related terms. Source: team of authors.

In a second step, the authors deployed a follow-up method, namely, a description of case studies. This outline some of the region's EWEs. The case studies, which were compiled based on available evidence and first-hand information gathered by some of the authors in their home countries, provide concrete examples of the impacts of extreme events on the life-support systems, population livelihood, well-being, health (especially malnutrition and infectious diseases), focusing on mental health.

The results of the data collection approaches are presented in the next section.

7.4 Results and discussion

7.4.1 Bibliometric Analysis

Results of the bibliometric analysis are evidenced in Figure 7.3. It can be seen that climate change impacts and extreme events have been linked to various types of mental health issues in the literature. Some key features are as follows:

- Four major thematic clusters link climate change, EWEs and mental health.
- The green cluster mainly focuses on general and mental health impacts.
- Mental health has a central position in the term map and frequently co-occurred with climate change.
- Various climate-related stressors and EWEs indicate that the potential adverse climate-related impacts on mental health and public health are well-recognised in the literature.
- The red cluster mainly focuses on the mental health impacts of slow-onset and long-term climatic impacts such as temperature changes or exposure to environmental pollution exacerbated by climate change. Based on the interlinkages between the terms, it can be seen that in addition to increasing mortality rate, temperature and environmental impacts can be significant risk factors contributing to mental health issues such as mental disorders and suicide.
- The yellow cluster focuses on acute and rapid-onset disasters such as floods and hurricanes, closely linked to mental health issues such as anxiety and post-traumatic stress disorder.
- The blue cluster includes various demographic groups such as males, females, children, adolescents, young adults, middle-aged and aged people. These demographic groups are linked to different mental health issues from other clusters, indicating that climate change will likely impact all demographic groups negatively.

Overall, this term co-occurrence analysis suggests significant documented effects of climate change on mental health, with analyses into the effects of heat and temperature and natural disasters predominating. However, secondary climate change impacts such as loss of culture or community due to forced migration have received relatively less attention in the literature regarding mental health impacts (Hayes et al., 2018). Additionally, many psychological disorders, such as schizophrenia, bipolar disorder or obsessive-compulsive disorder, are not highlighted in this term map but could be significantly impacted by individuals' experiences of their environments that could be affected by climatic changes (Hayes et al., 2018). Additionally, the links between mental and physical health in the face of climate change are unclear in this analysis but remain salient to the discourse. While further research on such issues is needed, it is clear from this analysis that mental health impacts of climate change are essential and need to be appropriately integrated into vulnerability assessment and climate adaptation efforts and processes (Hayes and Poland, 2018). More details about the four clusters highlighted by the term co-occurrence analysis can be found in Section 7.4.3.1.

7.4.2 Case studies: reviewing the impacts of climate change and extreme weather and climate events on the life-support systems, livelihoods, well-being and mental health in the Pacific Islands Countries

7.4.2.1 The Federated States of Micronesia (FSM)

EWEs that disrupt and impact the FSM's lives include tropical cyclones, increased floods and droughts, landslides and coastal flooding events related to SLR (Table 7.1). While direct health effects of EWEs are traumatic injuries and deaths, it also includes psychosocial impacts. Diffuse effects include unspecified detrimental effects of social disruption, e.g., loss of life, land or livelihoods due to climate-change-related phenomena, including anxiety, depression and post-traumatic stress disorder.

Following typhoon Sudal in Yap in 2004, depression, anxiety and substance abuse (especially among youth) as the aftermath of disasters, especially in women and children, were reported in addition to the traumatic injuries. For socially disadvantaged atoll communities, post-disaster permanent displacement is stressful, and it unsettles and harms mental health through the loss of life-supporting traditional food production systems. The stress of migration is further aggravated by a lack of social support, inadequate health systems, economic hardship and lack of access to housing (FSM, 2015).

7.4.2.2 Tropical cyclone Winston 2016-Fiji island

TC Winston affected approximately 40% of Fiji's population, with a death toll of 44 people. Following TC Winston in February 2016, a typhoid outbreak of 35 cases was observed on the Northeast coast of Viti Levu, Fiji's main island, but no fatalities were reported. Also, vector-borne diseases were reported, e.g., Dengue and Zika (Fiji Health and Nutrition Cluster, 2016a, 2016b).

After TC Winston, malnutrition was a severe problem in some areas, especially among children under five (Fiji Health and Nutrition Cluster, 2016c). The cyclone significantly affected local fisheries, with about 96% of fishing boats sunk, affecting household food supplies (92% of which depend on local fisheries for subsistence), reducing the amount of fish delivered to the local school to 0% (World Conservation Society, 2016). On Koro Island, there were some cases of malnutrition. The terrestrial food supplies were disrupted or lost by severe winds, rain and storm surge due to the cyclone's damage to this island, resulting in saltwater pollution of the soil (Government of Fiji, 2016).

The cyclone also prolonged its effect on Koro's livelihoods, as Kava farming provided half of their revenue, which was utterly destroyed after the cyclone (World Conservation Society, 2016). In addition, the food situation was precarious (Government of Fiji, 2016).

Following TC Winston, 8,466 people received psychological first aid. Therefore, the Ministry of Health and Medical Services coordinated training trainers workshops to facilitate the deployment of workers in all areas of Fiji (Fiji Health and Nutrition Cluster, 2016a, 2016b). The cyclone affected people with disabilities as well. UNICEF and the Pacific Disability Forum surveyed 963 people. According to the results, 13.6% of disabled children needed psychological assistance and basic first aid and integrity kits to maintain a standard of hygiene that prevents the spread of diseases (Pacific Disability Forum and UNICEF, 2016).

7.4.2.3 Tropical cyclone Evan 2012-Samoa and Fiji

In December 2012, both Samoa and Fiji were hit by tropical cyclone Evan with a death toll of 14, and 10 sailors went missing. In addition, damage to plants and manufactured structures was substantial due to the storm moving near the Fijian islands, where over 8,000 people had to seek temporary shelter. Cyclone-related economic losses also remained quite large, inflicting considerable negative consequences on the economies of both countries. Fiji's total losses from Evan were about 2.6% of the country's gross domestic product (GDP), plus another 1% due to short to medium-term losses. Economic losses in Samoa were even higher, in the order of US $203.9m (Kuleshov et al., 2014), about 25% of the country's GDP.

7.4.2.4 Floods 2012-Fiji

The March 2012 flood was the worst flood to hit Fiji. The flooding was most severe in the western half of Viti Levu's main island. Thousands of people were displaced, about 3,500 people were placed in temporary shelters, and 8 likely perished in the floods; the majority were on the main island. Power and water supplies were disrupted in several regions, and roads were washed away. Crops and other infrastructure were damaged. The entire cost of the flood in March 2012 was over FJ $70 million (Kuleshov et al., 2014), about 0.9% of the country's GDP.

7.4.2.5 Tc Harold 2020-Vanuatu, Fiji and the Solomon Islands

Tropical Cyclone Harold wreaked havoc on the Solomon Islands, Vanuatu, Fiji and Tonga in early April 2020. Heavy rain and strong winds wreaked havoc on homes, schools and gardens across four provinces in the Solomon Islands. Around 27 individuals were reported missing after being washed away on a ship from Honiara to Malaita. The cyclone caused the heaviest damage in Vanuatu when it landed on 6 April as a category five cyclone with sustained winds of more than 200 km/h. Roads, hospitals, schools, residences and churches were severely damaged on several northern and central islands. The worst-affected areas were home to 92,300 people, accounting for 30% of the country's population (UNICEF Pacific, 2020).

Many more families were displaced, without access to food crops or sanitation services. This circumstance was highly harmful to young children and severely threatened their survival and well-being. In addition, cases of dengue fever and malaria had been reported in Sanma Province. On 8 April, the storm impacted Fiji, causing significant flooding due to heavy rain and strong winds. In its wake, 2,494 homes were damaged. According to preliminary data, 116 schools were destroyed, affecting 11,524 children, with schools in the eastern and central divisions being the most brutal hit. The storm then impacted Tonga, causing damage or destruction to an estimated 428 homes (UNICEF Pacific, 2020).

7.4.2.6 Drought 2011-Tuvalu

Samoa, Tokelau, Tonga and Tuvalu were affected by the La Niña-induced rainfall deficit in 2011. Due to severely low water supplies, Tuvalu's Government announced a state of emergency on 28 September 2011. Households were rationed to roughly 40 litres of fresh water daily since some areas of Tuvalu had just a two-day water supply (Kuleshov et al., 2014).

7.4.2.7 Trends from Kiribati

Kiribati is an island situated in the central Pacific Ocean. The entire population, about 115,840, lives only one kilometre from the sea (WHO, 2018). Due to frequent EWEs, Kiribati might become the first country to lose its national identity (WHO, 2018). The risk of climate-related transmission of vector and water-borne diseases is also high. However, the effects on Mental Health among the Kiribati population are unclear. Although per the WHO mental health report, mental disorders in the Republic of Kiribati have become a significant concern. Limited mental disease prevalence data is available, relying on a small national survey. Based on the disability national survey, 17% or 653 people were found to have a mental illness, including intellectual disability, epilepsy, or psychiatric illness. Moreover, the World Mental Health Survey 2004 reported that approximately 13% of the Kiribati young population (over 15) would experience mental disorders.

7.4.3 Overall Discussion

7.4.3.1 Bibliometric analysis

The green cluster mainly focuses on climate change's general health and mental health impacts. The term "mental health" has a central position in the term map and has co-occurred frequently with the term "climate change" and various climate-related stressors and adverse events such as drought, natural disaster and extreme weather. This indicates that the potential adverse impacts of climate change on mental health and public health are well-recognised in the literature. It is now well-recognised that climate change can have both direct and indirect negative impacts on mental health. The direct pathway occurs when rapid onset climate-induced disasters such as hurricanes, floods and wildfires expose people to trauma. Long-term climatic changes such as extreme weather events, droughts and SLR can also indirectly affect mental health through eroding the physical health and livelihood options of humans and threatening social processes essential for community well-being (Berry et al., 2010; Palinkas and Wong, 2020). It is argued that marginalised, poor and vulnerable groups are disproportionately affected by climate change impacts, including impacts on mental health (Berry et al., 2010). Despite this, the term map shows that literature on the nexus of climate change and mental health mainly focuses on developed countries such as Australia, Canada and the USA. More research on the mental health impacts in other contexts is, therefore, needed.

The red cluster mainly focuses on the mental health impacts of slow-onset and long-term climatic impacts such as temperature changes or exposure to environmental pollution that can be exacerbated by climate change. Based on the interlinkages between the terms, it can be seen that in addition to increasing mortality rate, temperature and environmental impacts can be significant risk factors contributing to mental health issues such as mental disorders and suicide. For example, evidence shows that environmental factors such as extreme heat and humidity have increased hospital admissions of patients with mood and mental disorders such as mania and schizophrenia. Such environmental stressors have particularly affected people with pre-existing mental health diseases and those with a history of drug and alcohol abuse (Hayes et al., 2018). Several studies have also examined associations between climatic changes such as increased heat risk and suicide rates in countries such as Italy, New Zealand and the USA (Dumont et al., 2020; Preti et al., 2007; Williams et al., 2015). Existing research indicates that, while

other confounding factors are also essential and one should be cautious when associating suicide rates with climatic changes, the risk of suicide is higher during hotter and more polluted days (Dumont et al., 2020; Preti et al., 2007; Williams et al., 2015).

The yellow cluster mainly focuses on acute and rapid-onset disasters such as floods and hurricanes. These are closely linked to mental health issues such as anxiety and PTSD. The association between mental health issues and climate-induced disasters such as floods, hurricanes and wildfires has been extensively studied in the literature (Crabtree, 2012; Upward et al., 2021). It has been reported that climate-induced disasters can trigger mental issues such as "post-traumatic stress disorder (PTSD), major depressive disorder (MDD), anxiety, depression, complicated grief, and survivor guilt" (Hayes et al., 2018). Further, major disasters could also trigger substance abuse and suicide ideation (Hayes et al., 2018). Suicide and natural disasters are not closely linked in the term map, and it has relatively been more studied in the context of heat-related extreme events, as discussed earlier.

Finally, the blue cluster includes terms related to various demographic groups such as males, females, children, adolescents, young adults, middle-aged and aged people. These demographic groups are linked to different types of mental health issues from other clusters, indicating that climate change is likely to impact all demographic groups negatively. For example, different studies have discussed the mental health impacts of climate change on groups such as children and adolescents (Clemens et al., 2020), women and older adults (Gifford and Gifford, 2016; Padhy et al., 2015). It is worth mentioning that while all groups are exposed to mental health issues of climate change, evidence shows that some groups, such as women and older adults, experience more issues such as anxiety, distress and mental disorders (Gifford and Gifford, 2016). These groups should, therefore, receive special attention in the resilience-building efforts.

7.4.3.2 Case studies

The tiny atoll ecosystems in the FSM are becoming uninhabitable, forcing communities to abandon their life-supporting systems and become refugees on elevated grounds or urban centres. Climate models show that climate will impact all aspects of life in the FSM yet in varying intensity. As the consequences of climate change are not inevitable, the island communities handle all the other significant challenges and opportunities on their terms and with external support.

These conditions have far-reaching environmental, social and livelihood effects that ultimately affect island communities' health and well-being. However, psychological aspects resulting from the climate-related impacts are largely unexplored in the FSM. While the climate-related mental health implications can affect anyone, the impacts amplify in the marginalised atoll populations. In addition, interference with livelihood opportunities, property and land damage and post-disaster displacement affect atoll communities' mental health and well-being.

Island communities in the FSM have an inseparable connection to and derive their sense of identity from the lands and resources of their islands. Climate change threatens this familial relationship with ancestral resources. It disrupts the continuity required for the health and well-being of these communities (Keener et al., 2018; CDC, 2020). Women are more vulnerable to climate risks due to their economic activities, safety, health and livelihoods. Coastal flooding associated with SLR imperils atoll communities' livelihood opportunities. SLR in the western Pacific is three times higher than the global average, impacting traditional agriculture, coastal

infrastructure, food security and livelihoods. Separation from traditional lands harms the island communities' spiritual and mental health in the FSM. Given the mounting evidence of the link between climate change and mental health and the particular vulnerability to many impacts of climate change, EWEs and climate disasters, island communities, especially the atoll communities, are likely to be at high risk for climate-related mental illnesses. Cultivating resilience and engaging the displaced atoll communities in site-specific adaptation strategies empowered them to face hardships and overcome distress situations followed by disasters (Krishnapillai, 2017, 2018).

EWEs cause disasters in Fiji due to climate instability and transition. These disasters hit the health sector with a rise in hospital admissions and treatments for accidents and infectious diseases, including diarrhoea, typhoid, dengue and leptospirosis. Malnutrition and stress-related illnesses are also on the rise. Dengue fever is one of Fiji's four major climate-sensitive diseases (Guillemot, 2011). Diarrheal, typhoid and leptospirosis are the other three major climate-sensitive diseases.

Mental health is vulnerable to climate-related catastrophes such as droughts and floods (Berry et al., 2010; Cunsolo et al., 2013; Reynolds et al., 2010; Sharpe and Davison, 2021). Anxiety, sadness, excessive concern, PTSD, survivor guilt and "solastalgia" (distress experienced by those affected by the environmental change) may have previously been documented in many places, and the burden of these mental illnesses is considerable (McNamara and Westoby, 2011; Willox et al., 2012; Owusu et al., 2022).

Changes in local settings in the Pacific, where community identity and culture are tied to local settings, contribute to changes in cultural practices and identity, with potentially severe implications for mental health. Also, people in PICs are at high risk for mental diseases due to the link between climate-related disasters and mental health.

As the conditions seem alarming in Kiribati, the Kiribati Government has looked to relocate its population. Meanwhile, the Kiribati Ministry of Health is preparing a National Adaptation Programs of Action to help curb the impacts of climate change. In addition, the Kiribati Government has also drafted the Strategic Health Plan (2008–2011) figured six primary objectives, one of which is to improve, revise the mental health policies, implement the mental health plan and enhance the mental health service delivery (Oten et al., 2013).

On the population level, the residents of Kiribati have begun building walls from coral rocks. They have also intensified planting their lands with mangroves to protect the soil from erosion. Nevertheless, several communities have already moved to other islands (WHO, 2018).

A total of 10% of the Kiribati population will experience mild to moderate mental illness, and nearly 3% will experience a severe form of mental illness. The service utilisation data of 2011 estimates that only 364 people were treated, and those who were treated might have a severe mental disorder. The country holds only one psychiatric unit; there are no community mental health services, so most support and care are given to individual family members (Oten et al., 2013). A significant concern related to extreme weather events in the studied PICs is the decreased access to health services, which often occurs in the setting of disasters.

7.5 Conclusions

Climate change impacts, especially those from extreme events, have significant effects on mental health, though underexplored. The authors first conducted a bibliometric analysis of the relevant literature to explore the relationship between climate change and mental health impacts. The bibliometric analysis results highlighted that effects of heat and temperature predominate the literature, with secondary impacts such as loss of culture or community remaining largely absent in connection with mental health. In addition, anxiety, suicide and depression came up most often, with many other psychological disorders significantly impacted by individuals' experiences of their environments. To better understand the relationship between climate change, extreme weather events and mental health, the authors analysed several case studies in the Pacific region. A common thread amongst the case studies was the importance of place and local communities to small island nations, predominantly indigenous communities. The compound effects of climate-related disasters on critical infrastructure such as housing, food delivery, education and essential service provision can significantly impact Pacific Island communities' physical and mental health. Additionally, the lack of health infrastructure to treat people suffering from mental health issues, especially after a disaster, presents a barrier to receiving care.

The findings illustrate the need for improvements in the public health systems of Pacific nations so that they are in a better position to cope with the pressures posed by a changing environment. Apart from increased funding for handling more patients, a greater awareness about the connections between climate change and mental health is needed among public health professionals, so that they may be better able to recognise the symptoms and relate them to their climate-related causes.

8. Assessing causes and implications of climate-induced migration in Kenya and Ethiopia

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8.1 Abstract

Climate-induced migration is an increasingly pressing issue in many African regions, as rising temperatures and extreme weather events have caused the displacement of vulnerable populations. This is especially so in Eastern Africa and the Horn of Africa, particularly Kenya and Ethiopia, where extreme weather events have led to rangeland degradation, crop failures, water shortages, and food insecurity. Hence, there is a perceived need to understand these processes better. Against this background, this paper reports on a study investigating the processes associated with climate-induced migration in Kenya and Ethiopia. The research method used consisted of an expert-driven assessment approach, which assesses the causes of climate-induced migration in Kenya and Ethiopia and its human and social implications on local communities. Data were collected from 110 experts residing and working on climate and migration-related issues in Ethiopia and Kenya via e-mail, whose knowledge of the current situation has enabled the identification of some important trends. The results show that climate change is a primary trigger of migration both internally and externally. The high number of migrants, many of whom living within levels of poverty in their home areas is straining resources and services in the receiving regions. Their presence is also leading to increased competition for jobs and resources. Additionally, it has increased urban poverty, as many migrants have little access to living space and health care. This paper provides a welcome addition to the literature in that it lists the causes and implications of climate-induced migration and, by doing so, fosters a better understanding of the current crisis and its implications. The implications of this paper to the overall knowledge of climate change and migration are twofold. First, it highlights the need for governments, international organisations, and other stakeholders better to understand the complex linkages between climate change and migration. Secondly, it shows the usefulness of better recognising how climate change can drive migration and the other factors shaping the decision to migrate. The paper concludes by stating the urgent need for policies and programmes that support climate change-induced migrants. Also, it draws attention to the usefulness of promoting sustainable development in their origin countries and destinations, so that migration is not necessarily perceived as the only response to climate change. A further conclusion is that there is a perceived need for providing access to resources such as education, health care, and livelihood opportunities and establishing mechanisms to ensure a safe and dignified return for those who choose to do so.

9. Synthesis of results

Addressing the interconnections between climate change and gender is often presented as one of the integral elements for successful development and implementation of mitigation and adaptation strategies and measures. An analysis of scientific and scholarly contributions that can be referred to one or more of the domains of climate change-gender interconnections shows an increasing attention of experts and research to the subject, particularly concerning vulnerability and associated issues. However, the number of publications remains significantly lower compared to other research areas related to climate change. On the other hand, the obtained findings reflect a notable role played by international organizations in supporting practical activities with specific narrowed-down targeted outcomes. Their focus is more often on empowering women and reducing their vulnerability to climate change impacts at local levels. Overall, the results of the analysis offer insights to develop scientifically-based studies on the domains of climate change-gender interconnections which contribute to effectiveness of inclusive adaptation and mitigation solutions.

Leadership/empowerment, particularly of women, is linked to successfully combating climate change and improving resilience capacity of communities. This is often realized by reducing women underrepresentation in decision-making processes and positions through a wide range of measures including quota systems, eligibility and legal requirements. However, experts participated in the study noted that the number of leadership positions held by women remains low, as does their influence on climate change-related decisions. Such slow progress raises questions about the barriers hindering the process and effectiveness of already taken steps. Economic sectors vary in their what could be called gender-related support and efforts. Agriculture, for example, is undergoing the transition of domination from one gender group to another. The feminization of agriculture has created settings where women's underrepresentation has not been only formally eliminated but also resulted in their overrepresentation. Given the role played by the sector in climate change, the phenomenon of feminization opens discussion and raises a wide range of questions including:

- To what extent a higher share of women in agriculture reduces its contribution to climate change?
- To what extent a higher share of women in agriculture improves the sector's resilience to climate change impacts?
- Is the consideration of climate change-gender interconnections in agriculture among the agenda top priorities in the context of the sector's feminization?
- What are the necessary characteristics of women's empowerment and leadership in agriculture to ensure a significant contribution of the sector, particularly to global climate change mitigation efforts? The characteristics might include the number and type of the leadership positions to be held, their level (local, national or regional), specific areas of empowerment, etc.

Geographical locations also play a role in advancement of the gender/women subject. Despite the overall growing trend, in some regions, for example, in CA, the scientific discussion on gender/women issues in the climate change context, including adaptation and mitigation remains at an initial stage. Consequently, there is a significant lack of scientifically-based evidence from the CA region to be used to foster the development of efforts towards consideration of climate change-gender

interconnections. Those activities that can be linked to this context have mainly been carried out in the frame of development projects funded by international organizations. This type of support implies, among others, the applied nature of narrow-focused interventions to reduce women's vulnerability and increase their empowerment and leadership opportunities. Additionally, the engagement in these projects familiarizes local experts with the widely disseminated notion of women's higher vulnerability to climate change and the importance of their participation in decision-making processes. However, it is worth mentioning that there is still a significant gap between the notion and actual research studies that can provide numerous evidences from each CA country or the region as a whole to support these statements. Another specificity of the CA region is national gender-oriented political and legal systems that ensure equal rights and opportunities for men and women, including quota systems to ensure a minimum share of women in power.

Nevertheless, it remains unclear at what stage 'equality' in climate change-gender interconnections may become a hindrance in the mitigation and adaptation contexts. This, as well as the aforementioned questions are also applied to the CA agricultural sector, considering its role in the national economies, the feminization trend experienced by the countries and their international obligations towards achieving the SDGs. Similar to agriculture, the UN SDGs represent another thematic area where climate change and gender are interconnected. The obtained findings highlight the inclusion of gender equality issues in strategies as one of the key factors to successfully achieve the SDGs. The addressed issues can be referred to one or more domains of the climate change-gender interconnections, depending on the goal, scope and implementation steps. Additionally, national and international SDGs efforts create a narrative with higher visibility of the interconnections and a set of evidences to demonstrate potential gains of their consideration.

Mental health represents another thematic area where the climate change-gender interconnections framework could be taken into account, particularly focusing on the vulnerability domain. The results in Pacific nations demonstrate that the consideration of gender differences, while identifying climate-related symptoms adds value to the improvements needed in the public health systems in the region.

Climate change-induced migration represents different settings for climate change-gender interconnections. Unlike in many other thematic areas (e.g., agriculture), where the discussion is mainly linked to women and associated inequalities, climate change-induced migration is a men-dominated phenomenon. Therefore, it requires a redefined set of imbalances regarding knowledge, access to resources, opportunities, power distribution, and participation decision-making processes. These imbalances are often women-related and are listed among the main causes of their vulnerability to climate change. This type of settings also entails to explore the role and pre-requisites of the inclusion approach as a tool for development of effective solutions for climate change mitigation and adaptation.

The here presented research work has several limitations. Some of these limitations are associated with the complexity and novelty of the subject. The novelty has been associated with the considerably low amount of peer-reviewed literature in English on gender/women in climate change adaptation and mitigation, particularly from the climate change perspective compared to other research areas in other climate-related contexts. This created a challenge in identifying a sufficient number of studies to support the findings of this research work. The complexity of the subject limited the number of variables shaping the climate change-gender interconnections that could be considered and investigated to keep this study feasible.

Another limitation concerns the level of bias in formation of survey respondents' opinions on the subject. Their responses may have been shaped by insufficient gender-disaggregated data, limited related information and local evidences, as well as a societal perception of the role of gender and women in a specific context. Bias also reduced the number of experts engaged in climate change adaptation and mitigation or related fields who were expected to participate in the surveys. Their willingness (not) to participate in the surveys was based on (not) acknowledging the relevance and importance of the consideration of gender differences in their expert area.

Nevertheless, despite the aforementioned limitations, this research contributes to the body of work on the linkages between climate change and gender/women in both adaptation and mitigation contexts. The findings reflect a new perspective under a unified umbrella of the climate change-gender interconnections framework. This research work provides insights into the progress made towards considering men's and women's differences in adaptation and mitigation, including potential added value it might bring from a climate change perspective at global level. It also outlines narrower issues of the three domains across the climate change impacted sectors which require more thorough attention and a broader range of action to better integrate the gender/women variable in adaptation and mitigation solutions. In addition to providing more evidences of disproportional effects of climate change on men and women and collecting sex-disaggregated data, among the other issues are

- transition in power and decision-making;
- impact assessment of gendered measures;
- women agents of change as consumers and users compared to decision-makers; and
- specific role(s) of gender/women in efficient and long-lasting climate policies.

The climate change-gender interconnections framework can be also used to link the outcomes of applied measures that are often detached and scattered across sectors and geographical locations to support their scaling up and replication in a structured and consolidated manner.

10. Outlook for future research

The dissertation lays down the basis for broader multidisciplinary research on the use of climate change-gender interconnections to design new and/or more effective integrated scalable adaptation and mitigation solutions at a global level. Considering the already worldwide recognition of such interconnections, per se, the *following directions* in these efforts may be pursued based on the results obtained here.

The studies have shown the need to *introduce settings and instruments to track the till today progress* in addressing or considering these interconnections and particularly, their *impact* on climate change adaptation and mitigation in a quantitative manner. This will enable experts to establish a baseline to set specific national and international quantitative goals to be attained, followed by the development of quantifiable indicators for reporting purposes.

Along with that, a greater emphasis should be given to *investigate the optimal ways of integrating these interconnections* to achieve maximum outcomes from a climate change perspective. For instance, what might be the optimal men-women ratio of empowered persons and those on leadership positions to design and implement the most effective mitigation and adaptation activities. On the other hand, the indicators will provide an opportunity to continuously assess the national performance with reference to climate change-gender interconnections in adaptation and mitigation. Given the different priorities that gender/women issues have in the climate change context across the nations, more attention should be paid to the development of more detailed implementation steps of global initiatives taking into account countries' environmental, political and socio-economic specificities.

Another point to be further explored is the *minimum combination of additional factors required to maximize the effect* of using climate change-gender interconnections. Among these factors experts often name additional knowledge, statistical gender-disaggregated data, access to a specific type of resources, participation in decision-making processes at various levels, political will, and stronger climate-change-related binding policies and regulations, etc. However, not all of them might have the same value and impact when including the interconnections in mitigation and adaptation measures. Therefore, a more detailed assessment of each factor in this context should be undertaken to establish their ranking to make an 'optimal' choice for different types of interconnections.

The studies conducted in the frame of this dissertation also illustrate the *need to increase the visibility of the actual benefits* of considering women-men differences that represent the 'gender' side of the interconnections to the wider audience. More detailed works should be undertaken to isolate gains that have 'purely' resulted from gender sensitized adaptation and mitigation action.

Another topic that requires increased attention is an *analysis of barriers that impede the implementation* of the already introduced measures that can be referred to one or more domains of the climate change-gender interconnections in the way to achieve planned outcomes. It is worth mentioning that any type of research conducted with reference to the climate change-gender interconnections, whether theoretical or applied, needs to provide a possibility to aggregate and extrapolate obtained findings at a global level.

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12. Appendices

Appendix I

Table 12.1**.** List of Abbreviations of the UNFCCC bodies (based on Gender Climate Tracker). Source: author.

Abbreviation	Name
CTCN Advisory Board	Climate Technology Centre and Network Advisory Board
CC Facilitative Branch	Compliance Committee Facilitative Branch
CC Enforcement Branch	Compliance Committee Enforcement Branch
CGE	Consultative Group of Experts
CDM Executive Board	Clean Development Mechanism Executive Board
GCF Board	Green Climate Fund Board
JISC	Joint Implementation Supervisory Committee
LEG	Least Developed Countries Expert Group
PCCB	Paris Committee on Capacity-building
SCF	Standing Committee son Finance
TEC	Technology Executive Committee
FWG	Facilitative Working Group
KCI	Katowice Committee of Experts on the Impacts of the Implementation of Response Measures
PAICC	Paris Agreement Implementation and Compliance Committee
COP	Conference of the Parties

Appendix II

Table 12.2 Main causes of rural men's and women's vulnerability to climate change. Source: Authors' compilation from the survey responses.

	Water	**Economic Development**	**Education**	**Agriculture**	**Health**	**Information**	**Weather events**	**Other**
Women's	- Low water quality - Water scarcity - Drought - Insufficient water for irrigation purposes - Lack or low level of water supply for household needs and irrigation purposes - Additional to household and job responsibilities burden finding water for irrigation and drinking purposes	- No economic robustness - Decrease in economic status due to reduction in yields and land degradation - Unemployment (men are hired more often because of the physical strength needed for heavy jobs)	- Lack or low level of education including applied education - Low level of knowledge - Lack of technical knowledge of adaptation - Scarcity of trainings, field trainings, publications and videos	- Agriculture is the main source of income - Reduction in crop yields	- Low level of medical service - Endocrine diseases - High percentage of death from cardiovascular diseases - Sanitation and hygiene	- Lack of full access to information among the rural population as a whole regardless of gender	- Temperature increases - Heat strokes and sunburns - Emergency situations	- Household activities - Low trust in governmental authorities - Many project activities on climate change are mainly at the national level, but a larger emphasis should be at the local level - Lack of equal access to employment opportunities and decision making - Lack of capacity - Families of many children - High physical load in household - High physical load needed for

	during drought events - Men farmers can easier and faster negotiate with “water providers” than women.							agricultural production - Traditions/Asian mentality - Low level of culture - Gender inequality in rural areas - Low level of participation
Men’s	- Low water quality - Water scarcity - Drought - Water distribution - Lack or low level of water supply including for irrigation purposes	- Low profitability and income - Decrease in economic status due to reduction in yields and land degradation - Access to loans - Enforced inner migration - Limited access to financial services	- Lack or low level of education, including applied education - Low level of knowledge - Lack of technical knowledge of adaptation - Lack of insufficient knowledge on intensive growth of agricultural crops and water savings (switch to drip irrigation)	- Exposure to natural hazards - Reduction in crop yields - Low level of food security - More problems related to taking care of cattle and harvest - Low level of modernization and mechanization of agriculture - There are no mechanisms (tractors and machines) that ease the workload of rural men;	- Low level of medical services - Deterioration of health - High percentage of death from cardiovascular diseases	- Lack of full access to information among the rural population as a whole regardless of gender - Lack of more precise information on climate change and agronomy	- Temperature increase - Heat strokes and sunburns - Emergency situations	- Men are at risk to their lives in all cases - Stress because of responsibility for family and household - Too lazy to go out to the field - Alcohol addiction

				therefore, the health of rural men decreases every year. - Investments in agriculture are very costly, and the return on these investments is long-term - Increased physical activity in agricultural production - Dependency of crops cultivation and livestock rearing on weather conditions and irrigation water				

Table 12.3 Development projects supported by international organizations/donors. Source: author.

#	Project Title	Donor Organization	Country*	Duration	Short Description	Climate Change–Gender Interconnections Domain	Source
1	Land Rights and Economic Security of Rural Women in Tajikistan	UNIFEM, Government of Tajikistan	Tajikistan	2003–2005	Both projects supported land rights and the sustainable livelihoods of women. Among the outcomes are the development of gender statistics and specific indicators, a creation of a gender network, enhancement of livelihood conditions for women and poor rural families. The projects advanced changes in land policies and legislation, supported farmers' social mobilization.	Leadership/ Empowerment Vulnerability	Mirzoeva (2009)
2	Improved Food Security and Enhanced Livelihoods through Institutional and Gender Sensitive Land Reform in Tajikistan	UNIFEM, Government of Tajikistan	Tajikistan	2007–2008		Leadership/ Empowerment Vulnerability	
3	Surkhandarya Water Supply and Sanitation Project—Outcomes of the Gender Action Plan	ADB	Uzbekistan	2009–2015	The project improves living standards, environment, and public health in the Surkhandarya Province. Beneficiaries of the project are about 340,000 people, approximately 50% of which were women residing in rural and urban areas. Women represented 50% of the participants in all project activities and public meetings; 68% of 153 representatives of consumer and project support groups in all subprojects were women; women contributed to 40% of suggestions for effective project implementation. Women staff contributed to keeping more accurate records of water in branches of the water consumers associations (WCAs).	Vulnerability Leadership/ Empowerment Benefits	Asian Development Bank (2016b)

4	Uzbekistan: Water Resource Management Project	ADB	Uzbekistan	2009–2016	The project aimed at rehabilitating and upgrading selected irrigation systems and improving water management. In the Namangan, Samarkand, and Fergana regions, the number of women farmers increased by 30%–60% and over 5000 seasonal jobs for women were created by female-headed farms. Profits of women farmers increased 37% per hectare making their average profit margin higher in comparison to that of men farmers. Most women in the project area established greenhouses and gardening plots as part of their own business. Women's participation in water consumers associations increased from 3.5% to 7.6%. Rehabilitated pump stations improved the environment and reduced allergies among women and children.	Benefits Vulnerability Leadership/ Empowerment	Asian Development Bank (2017)
5	Central Asia Water & Energy Program	The World Bank	Central Asia *	2012–2024	CAWEP program strengthens the environment to promote energy and water security at CA and country levels by leveraging the benefits of improved cooperation. The program promotes gender aspects in IWRM, female inclusion in all water/energy/climate change activities, and knowledge-sharing events.	Benefits Leadership/ Empowerment	The World Bank (2022)
6	Women & Water in South & Central Asia	CAP, George Washington University	South and Central Asia	2013	The project supported a program of international leadership and exchange of knowledge for innovative conflict resolution with a sustainable and multiplying effect among young	Leadership/ Empowerment	Central Asia Program (2022)

					women social entrepreneurs and activists from Kyrgyzstan, Tajikistan, Afghanistan, India, and Pakistan. The activists receive an opportunity to share their experience in water management, improve their expertise and leadership skills.		
7	ELMARL (Environmental Land Management and Rural Livelihoods)	The World Bank PPCR Global Environment Facility (GEF)	Tajikistan	2013–2018	The project focused on the improvement of natural resource management to increase production and build resilience to climate change. Women represented 40% of the 320,000 project beneficiaries. The project used a community-led, participatory implementation approach with a main focus on women's participation. 15 locally based international agencies or non-governmental organizations focused on community mobilization to promote gender equality and inclusion of marginalized groups.	Vulnerability Benefits	The World Bank (2018)
8	CLIMADAPT	European Bank for Reconstruction and Development (EBRD) PPCR of the Climate Investment Funds (CIF) Government of the UK and the multi-donor	Tajikistan	2016	The project supported gender-sensitive climate resilience investments in Tajikistan. It assisted men and women farmers to cope with climate change impacts and supported the country's transition towards a green economy by promoting the efficient use of resources such as water, energy and land and increasing access to climate technologies.	Benefits Leadership/ Empowerment	Climate Investment Funds (2018)

		EBRD Early Transition Countries Fund					
9	Women, Water Management and Conflict Prevention—Phase II	OSCE	Central Asia	2017–2022	The project specifically supported better inclusion of gender aspects in water management and water diplomacy, as well as the targeted empowerment of women water professionals. The main beneficiaries are men and women working in the water sector, from government bodies, academic institutions, NGOs and technical agencies with particular attention to young professionals.	Leadership/ Empowerment	Organization for Security and Co-Operation in Europe (2022a)
10	Tajikistan: Understanding the Nexus of Migration, Gender, Climate Change and Agriculture	IOM	Tajikistan	2019–2021	The project addressed the migration, gender, climate change, and agriculture nexus in Tajikistan. It also aimed at evaluating capacity-building activities for women from remittance-recipient households to support their adaptation.	Vulnerability	IOM (2019)
11	Central Asia climate information products 2020	Zoï CAREC national partners	Central Asia	2020	Number of new climate information products including "Women, food and climate change in Central Asia"	Leadership/ Empowerment Benefits	CAREC (2020)
12	Women4Climate Mentorship Program (Nur-Sultan)	C40 Cities	Kazakhstan	2021	The program focuses on sharing knowledge and experiences with the next generation of women leaders on climate change issues. In the frame of the project, 10 women work with mentors, and women leaders from various areas of the private and public. It also supports women in broadening their knowledge of climate change and enhancing their leadership skills	Leadership/ Empowerment	Women4Climate (2021)

					through distance learning and increasing networking opportunities.		
13	UNDP-UNEP Poverty-Environment Initiative	UNDP UNEP	Kyrgyzstan Tajikistan		The initiative collaborates with main government partners to raise awareness, influence policy making and strengthen the mainstreaming of the poverty-environment into budget processes, sector programs, and sub-national planning. Relevant actions: - Kyrgyzstan: Increasing knowledge and understanding of the interconnections between gender, women's empowerment, and environmental sustainability to reduce inequality. Supporting local educational institutions in mainstreaming gender-specific activities, including research on gender aspects of poverty, biodiversity, and climate change linkages. - Tajikistan: At least 50% of the green micro-loans were targeted towards women-led initiatives. Collection of sector and local examples on the poverty, environment and gender nexus to inform planning and budgeting for pro-poor environmental sustainability.	Leadership/ Empowerment Benefits Vulnerability	UNDP-UNEP Poverty-Environment Initiative (2015a; 2015b)

14	Green villages Central Asia	WECF international	Tajikistan, Kyrgyzstan		Collaboration with women farmer organizations, renewable energy cooperatives, water providers, and eco-tourism operators. Rural women's organizations work on women's economic empowerment and rights. Networking with local women and environmental partners, cooperation with local authorities, financial micro-credit cooperatives, and United Nations agencies. The Network of rural women organizations in Kyrgyzstan created women's rural cooperatives, and advocates for women's rights and gender equality.	Leadership/ Empowerment	WECF International (2021)
15	Empowering Central Asian Women in Renewable Energy Mentoring Program	OSCE	Central Asia		The program aims at increasing women's representation in managerial and decision-making positions in the renewables sector in Central Asia. It supports mid-career women working in the energy transition to build self-confidence and position themselves for leadership roles.	Leadership/ Empowerment	Organization for Security and Co-Operation in Europe (2022b)
16	USAID programs empower women and girls in Central Asia	USAID	Central Asia		Programs promote gender equity in climate change mitigation, natural resource management and water usage; strengthen women and girls' capacity to support their full engagement as managers, partners, and entrepreneurs in water-related activities.	Leadership/ Empowerment	USAID (2021)
17	Climate and Environment	The World Bank PROGREEN	Central Asia	2021–2026	The program supports CA countries to attain sustainable, resilient, and inclusive economic growth with a	Leadership/Empowerment	The World Bank (2021c)

	(CLIENT) Program in Central Asia				focus on, among other aspects, climate resilience and resilient landscape restoration. Within pillar 3: Communication for Climate and Awareness–C4CA; one of the activities was to implement a feasibility study to raise awareness of climate change, pollution, and landscape restoration practices among Tajikistan's rural youth and women using the AnchorEd Schools project model.		

* if not specified, the project is implemented in all five CA countries

Appendix III

Table 12.4 International case studies illustrating worldwide initiatives that address gender equality among the SDGs. Source: team of authors.

Country	SDG	Case study description	References
International	SDG 1 (No poverty)	Study focusing on "gendered poverty." The study's main aim is on the UN Women and the progress of women in the years 2015-2016, acknowledging that gendered poverty is a consequence of gender inequality.	Bradshaw et al. (2017)
India	SDG 2 (Zero hunger)	Study documenting the relationship between gender inequality and hunger in India. 95 million (2.5% global hunger burden) undernourished people exist. The most vulnerable are women and children. Malnutrition has more effect on women's and girls' health, at a greater risk of giving birth to low-birth weight infants.	Callister (2018)
Tanzania	SDG 3 (Good health and well-being)	Engender Health Tanzania is helping women accessing to reproductive healthcare. With a population of nearly 56.32 million, many Tanzanian women,do not have access to contraceptives, HIV testing/counselling services and health facilities to deliver babies. Since 1982, EngenderHealth has been working with the government, contributing to improving healthcare.	Engender Health (2021)
India	SDG 4 (Quality Education)	Soochnapreneur (Information-Preneur) is a unique project focusing on education about the different government schemes and citizen's rights for people in rural and remote parts of India. Bridging the digital-divide, young rural women and youth, acting as Information-Preneurs, provide the required information to those who have no access to technology, also helping them to generate some small amount of money through information services. 100 Information-Preneurs have assisted more than 7,000 rural people. Many women participate in the project, benefitting directly by earning as Information-Preneurs and indirectly through access to the different government schemes.	Soochnapreneur (2021) Qualcomm Wireless Reach (2018)
Nepal	SDG 6 (Clean water and sanitation)	Study related to the Trans-Boundary Rivers of South Asia (TROSA) programme, an opportunity for women's leadership in water governance to increase social accountability. Women are sensitised on their rights regarding riverine water resource planning and decision-making, advocating for key water governance issues through service providers and local government.	Crawford (2020)

India	SDG 7 (Affordable and clean energy)	Using India as an illustrative case, a mixed-methods study was conducted. Women are neither the sole nor primary beneficiaries of electricity access, even when appliances that would particularly benefit them are affordable. While energy access could improve gender equity, intra-household power dynamics were highlighted as an important boundary condition in realising more equitable energy access.	Rosenberg et al. (2020)
Turkey	SDG 8 (Decent work and economic growth),	Study indicating that a fiscal prioritisation on building a social infrastructure of care, greater than investments in physical infrastructure/construction or cash transfers, presents an enormous potential for decent job creation, particularly in the female-dominated occupations and sectors, promoting gender equality and better access to decent work.	Ilkkaracan et al. (2015)
Comparison France, Spain, Morocco and Algeria	SDG 9 (Industry innovation infrastructure)	Research focusing on the importance of women's participation as a key element in achieving the SDGs, by analysing the existing digital gender gap with the achievement of the SDGs, concluding that equal access to digital technologies is important to achieving all the SDGs.	Kerras et al. (2020)
Philippines	SDG 10 (Reducing inequality)	Research documenting gender-related indicators that can be used to monitor gender equality and women empowerment. An overview of equality of human capabilities, equality of economic opportunity, equality in political voice and leadership, and the safety of women and girls is provided. Priorities for public policy involving gender transformational issues to attain equality and women's empowerment are given.	David et al. (2018)
South Africa	SDG 11 (Sustainable cities and communities)	Skills-driven project enabling a rural community to drive changes that will improve quality of life. The creation of a female-only entrepreneur craft group is included. The craft group initiative gives the group of women the opportunity to contribute meaningfully towards a collective drive to a more sustainable community.	Pretorius and Nicolau (2020)
Peoples Republic of China	SDG 12 (Responsible consumption and production)	Study focusing on gender awareness in sustainable consumption and production (SCP). Research concludes that integrating gender analysis into the design of SCP policies, addressing remaining gender gaps, and strengthening women's participation in natural resource management and decision-making can have a positive effect and support the shift towards SCP.	Fan and Jaffre (2020)

Pacific Countries	SDG 13 (Climate action)	Study focusing on the findings of research by United Nations (UN) Women 2015 to investigate the connection between gender and climate change in the Pacific Region. The study provides evidence-based information about the gender impact of climate change, how the gender inequalities are directed by climate change adaptation and how to enhance women empowerment.	Aipira et al. (2017)
Australia	SDG 14 (Life below water)	For implementing SDGs 14, Australia funded the "Blue Economy Aquaculture Challenge" initiative, in order to support, projects for transforming sustainable aquaculture practices. Many of the solutions promised outcomes linked to other SDGs, such as gender equality (SDG5), health and nutrition (SDG3) employment, and SDP (SDG 12).	Australian Government (2018)
Latin American countries	SDG 15 (Life on land)	Research focusing on women's unequal access to land and the proposed indicators to measure progress. The study in Latin America demonstrates the current degree of inequality in the gender distribution of landholders and landowners, and why it is important that countries improve gender statistics, collecting gender disaggregated data on both land ownership and agricultural decision-making.	Deere (2018)
Australia	SDG 16 (peace, justice and strong institutions)	The Australian government supports global peace and justice, by acting as a global leader for advancing commitments to the Women, Peace and Security Agenda. Considerable work was done to integrate a gender perspective into international peace and security policy outcomes, training Australian personnel to safeguard the needs of women in conflict zones.	Australian Government (2018)
Australia	SDG 17 (Partnerships for the goal)	The Australian government, in partnership with the Australian National University and the International Women's Development Agency, has introduced the Individual Deprivation Measure (IDM), a gender-sensitive, multidimensional and below household level (individual level). It aligns with 25% of the 53 gender-related SDG Indicators and identifies gender sensitive deprivation, in order to address poverty.	Australian Government (2018)

Appendix IV

Table 12.5 SDG Matrix. Source: team of authors.

SDG Number and Target	Target description	Implications	References
SDG 1 End poverty in all its forms everywhere			
Target 1.1	By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	Women and the most vulnerable in society are for the most part more impacted by poverty. As such, ensuring the eradication of extreme poverty will benefit more women and help end and/or reduce poverty. Extreme poverty and its impact on women is exacerbated by discriminatory social norms that alienate women when it comes to equal opportunities in education as well as employment and as such leads to those affected living on less than $1.25 a day in mostly the developing world.	Olinto et al. (2013) Lang and Lingnau (2015) Franco and Minnery (2020)
Target 1.2	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	Strong and robust policies can play a role in reducing poverty. For example, as poverty takes many forms including that of energy, a consideration of place of residence, house ownership status, family size, and the age of the primary breadwinner can mitigate against multidimensional energy poverty and play a significant role in national definitions of poverty. Such considerations could have an impact on poverty reduction in at least half of the proportion of men, women and children in the most deprived areas of society.	Abbas et al. (2020)
Target 1.3	Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	Social security is an important human right which is central to the reduction of poverty, achieving equality and avoiding social exclusion. These aspects allow for the promotion of equal opportunities including gender equality, which if properly implemented can assist with the development of appropriate social security systems and measures that could have a positive impact for both men and women.	ILO (2012) Kaltenborn (2017)
Target 1.4	By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land	Land and resource tenure, including inheritance, access to and use of technology, financial services, and access to microfinance are important for meeting SDG targets such as the one in question. For example, when it comes to land ownership, because of unequal rights to land, there ought to	Katila et al. (2020) Hansen et al. (2020)

	and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	be explicit protection of land rights that are recognised by both customary and statutory law for women, which can allow them to fairly participate in land ownership, management and administration. Furthermore, microfinance gives women the opportunity to empower themselves and improve their lives. This has the ability to remove them from poverty.	
Target 1.5	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	Technical, policy, capacity enhancement and finance that are among the elements of transformative approaches in agriculture and food security will be necessary to tackle climate change. In particular, because women are most impacted by poverty and hunger, climate change has a direct impact on them in this respect.	Campbell et al. (2018)
Target 1.b	Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions	The participation of women in policy making and the holding of high office such as parliamentary seats has a positive impact on women's well-being, including girls' education, fertility, child and infant mortality, and early marriage	Konte (2020)
SDG 2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture			
Target 2.1	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year-round.	It is well understood that due to gender inequalities, women and the more vulnerable in society will be more affected by hunger. Due to evident societal gender inequalities resulting from social, political and economic marginalisation of women, such inequalities have an impact on food security and resulting hunger, not only for women but for infants as well. With hunger come issues around health and the inability, as well as a lack of capability, to be able to effectively contribute to sustainable development in society	Larson and Larson (2019)
Target 2.2	By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	Women are more likely to be overweight and obese. In addition, one in three women of reproductive age suffer from anaemia. This has implications for children as well as pregnant and lactating women, due to the lack of nutrients that such ailments have. As such, it is imperative that nutrition takes into consideration healthy and sustainable dietary needs when looking to end all forms of malnutrition. Healthy, nutritional and sustainable diets will need to be considered into ethically thought-out national policies that cover issues around taxes, incentives, nudges, and subsidies, especially for those most affected.	Fanzo (2019) Ghosh-Jerath et al. (2020)

		Furthermore, encouraging indigenous food systems in traditional communities can play a role in sustainable nutritional diets that can help end malnutrition. When it comes to the developing of national policies around and/or encouraging good dietary consumption of indigenous food systems, mothers, who are usually responsible for family food and meals, should be a targeted priority.	
Target 2.3	By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	Equal participation of all relevant stakeholders, which should include women in agricultural productivity, will result in increased productivity. In particular, development policies should not only favour urban industrial areas but should be inclusive of agricultural and rural settings where there might be more women inhabiting such spaces in order to increase agricultural productivity for sustainable development that could help end hunger.	Rodríguez-Pose and Hardy (2015)
Target 2.c	Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	Without a consideration for gender inequalities, particularly when it comes to recognising the need for information on food commodity markets and the fact that most small, medium-sized and family farms are run by women, it might prove a challenge to have proper functioning food commodity markets. Therefore, measures and policies that consider necessary policy measures that address and acknowledge this phenomenon will go a long way in achieving the target in question.	Fontefrancesco (2019)
SDG 3 Ensure healthy lives and promote well-being for all at all ages			
Target 3.1	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	Equalising the social and economic status of women would improve the women's health outcomes	Abebe (2016)
Target 3.2	By 2030, end preventable deaths of new-borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births	Giving indistinguishable preference to all genders will ensure child survival with the reduction in excess male over female child mortality	Iqbal et al. (2018)
Target 3.7	By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and	Giving equal opportunity and easy accessibility to formal and quality education to females will impact by generating responsible attitudes towards health	Queen Mary University of London (2018)

	the integration of reproductive health into national strategies and programmes.		
Target 3.8	Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.	Inclusion of women in economic and decision-making activity will increase the ability to access existing maternal and child health services	Singh et al. (2015)
SDG 4 – Ensure access to inclusive and equitable quality education for boys and girls, from pre-primary through to secondary education, and promote lifelong learning opportunities for all			
Target 4.1	By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	Education of girls is also important for the achievement of a sustainable future.	Herbert et al. (2020) Spiteri (2020) Spiteri (2018) UNESCO (2018a) Stromquist (2020)
Target 4.2	By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	All children need good-quality early childhood education, which sets the foundations for lifelong learning. It helps to improve their future outcomes and alleviate poverty.	
Target 4.3	By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	Lifelong education for women is important at every stage of life.	
Target 4.5	By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	Women should have equal access to education to benefit from future employment prospects.	
Target 4.6	By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	The education of women is important for the achievement of a sustainable society.	
Target 4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human	Education, and education for sustainable development (ESD) in particular, help promote gender equality and human rights, thus encouraging children and adults to become ecologically responsible citizens. Therefore, barriers to access to education need to be overcome by governments to ensure quality education for all and eliminate gender disparities.	

	rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and the appreciation of cultural diversity and of culture's contribution to sustainable development		
Target 4.A	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all	Girls and boys with disabilities have a right to good quality education that promotes sustainable behaviours in children.	
SDG 6 Ensure availability and sustainable management of water and sanitation for all			
Target 6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all.	Proportion of population using safely managed drinking water services	Freistein and Mahlert (2015)
Target 6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.	Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water	Nygård (2017)
Target 6.b	Support and strengthen the participation of local communities in improving water and sanitation management	Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	Klarin (2018)
SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all			
Target 7.1	By 2030, ensure universal access to affordable, reliable and modern energy services.	Proportion of population with access to electricity	
Target 7.b	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support	International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems. Installed renewable energy-generating capacity in developing countries (in watts per capita)	Bhandari and Shvindina (2019)
SDG 8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all			

Target 8.3	Promote development-oriented policies that support productive activities …access to financial services.	SDG 8 promotes "sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". Businesses play a key role for job creation and economic growth. Instituting non-discriminatory practices and embracing diversity and inclusion will also lead to greater access to skilled, productive talent.	Dugarova (2018) Pandey and Kumar (2019) Buhmann et al. (2019) Rai et al. (2019) Manandhar et al. (2018) Alarcón and Cole (2019)
Target 8.5	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.	SDG 8 promotes 'sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all'. Businesses play a key role for job creation and economic growth. Instituting non-discriminatory practices and embracing diversity and inclusion will also lead to greater access to skilled, productive talent.	
Target 8.8	Protect labour rights…and those in precarious employment	The main objective is to achieve an inclusive employment. Protection of labour rights by enhancing health and safety at work. Key themes: economic inclusion; non-discrimination	
SDG 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation			
Target 9.2.	Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries.	Increasing investments in infrastructure has positively affected gender equality by reducing unpaid care and domestic work. Better infrastructure can improve health and education for women and children. Women's access to education and employment contributes to industrialisation. Investing in social infrastructure could increase employment both in emerging countries and in developed economies. Reducing gender gap and subject segregation in education (by increasing gender diversity in STEM) can boost innovations.	Sinha et al. (2020)
SDG 10 Reduce inequality within and among countries			
Target 10.2	By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	Improving the labour market conditions by promoting decent work and equal employment opportunities to all genders	Abebe (2016)

Target 10.3	Ensure equal opportunities and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard	Promoting equal pay for equal work, irrespective of gender, will encourage the suppressive gender to join the workforce, enjoying equal status	Abebe (2016)
Target 10.4	Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality	Reinforce labour laws, including minimum wages, prevention of sexual harassment of women at the workplace, decent work, freedom of association and collective bargaining	United Nations System Chief Executives Board for Coordination (2017)
Target 10.5	Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations	Promoting transparency and accountability of private companies to reduce inequalities among different genders	SDG Compass (2021)
SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable			
Target 11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	Proportion of urban population living in slums, informal settlements or inadequate housing	Lucci et al. (2015) Nzau and Trillo (2020) Nabutola (2004) Hoek-Smit et al. (2020) JLL (2016) Chattopadhyay et al. (2016) Kaur (2018) Teotia (2015) Nallathiga (2019) Arimah (2001) Santoro (2015) Gopalan and Venkataraman (2015) Woetzel et al. (2014)
Target 11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities	Kett et al. (2020) European Institute for Gender Equality (2020) Leach (2015) UN Women (2018b) Liu Z. et al. (2020) ESCAP (2017)

Target 11.3	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	Ratio of land consumption rate to population growth rate	Blei et al. (2018) Agyemang and Morrison (2017) United Nations Environment Programme (2017) European Environment Agency (2015) Desai (2020) Mansell et al. (2020) Abdulkadir et al. (2019) Nicolau et al. (2019)
Target 11.4	Strengthen efforts to protect and safeguard the world's cultural and natural heritage	Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage.	Wang et al. (2018a) Satterthwaite (2017) Smiciklas et al. (2017) Idowu et al. (2020) Sterling (2016) Seto et al. (2014) OECD (2018)
Target 11.5	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	International Council for Science (2011) Smas et al. (2013) Hoornweg and Pope (2017)
Target 11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities	United Nations (2018) Ros-Tonen et al. (2016) Keivani (2010) Overseas Development Institute (2018)
Target 11.7	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces,	Provide universal access to safe, inclusive and accessible green and public spaces by 2030.	Damodaran et al. (2015) Devisscher et al. (2019)

	in particular for women and children, older persons and persons with disabilities		Guedes Vidal et al. (2019) Santiago Pineda et al. (2017) DIAUD/ CBM (2016) Daniel (2016)
Target 11. 8	Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city.	Grogan (2020) Clos (2016) Cohen (2006)
Target 11.9	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	Substantially increase the number of cities and human settlements adopting and implementing holistic disaster risk management at all levels	United Nations Statistics Division (2016)
Target 11.10	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource-efficient buildings utilising local materials	The Economist Intelligence Unit (2019) Norichika and Biermann (2017) Servaes (2017)
SDG 12 Ensure sustainable consumption and production patterns			
Target 12.1	Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	Gender issue is underestimated when it comes to sustainable production and consumption. In general SDG 12 has been considered ‘gender blind’.	Herbert et al. (2020) UN Women (2020f) Pudaruth et al. (2015) Cho et al. (2018)
Target 12.2	By 2030, achieve the sustainable management and efficient use of natural resources	Women are under-represented in decision-making related to sustainable management and efficient use of natural resources, so it is important to	

		increase their participation in leadership and decision–making processes, for the sustainable management of production and consumption patterns	
Target 12.3	By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	Women have an important role in achieving this goal, however the recognition and actions to address this are rather limited still.	
Target 12.4	By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	Women are under-represented in decision-making related to management of chemicals in the life cycle.	
Target 12.5	By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	Women are known to be more in contact with packaging, and their role in reduction, recycling and reuse of plastic waste in specific should be considered crucial.	
Target 12.6	Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	Women are under-represented in leadership of large and transnational companies due to difficulties found in work-life imbalance in many countries.	
Target 12.8	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	Women in general are more interested in increasing awareness for sustainable development and lifestyles in harmony in nature, and therefore their role in achieving this target is crucial.	
SDG 13 Take urgent action to combat climate change and its impacts			
Target 13.1	By 2030, strengthen resilience and adaptive capacity to climate-related hazards and natural disasters worldwide	Climate change is experienced differently by women and men because of the interplay between gender, poverty and participation in the political arena. When taking action, the interplay between gender relations and the vulnerability of women needs to be taken into consideration. An understanding of gender relations is important for the transformation in social behaviour with climate change.	Herbert et al. (2020) Pearse (2016) Equal Measures 2030 (2021)
Target 13.2	By 2030, integrate climate change measures into national policies, strategies and planning	Since women are underrepresented in government agencies and policy-making, they are negatively affected by this. This also limits their agency in climate advocacy and mitigation measures.	

Target 13.3	By 2030, improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Gender inequalities are evident, in that women, especially those living in the global South, are more prone to resource scarcity, poverty and risks, such as environmental stress, posed by climate change. Also, socio-cultural and economic circumstances negatively affect women's economic status (poverty) and education, and women become more susceptible to climate risks.	
SDG 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development			
Target 14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	Women empowerment and education related to marine pollution in sea-based livelihoods is important so that they can lead sustainable development initiatives for pollution prevention	UN Women (2018a) IISD (2017) UN Sustainable Development Goals (2020)
Target 14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	Women are under-represented in policy and management in the fishing industry, so it is important to increase their participation in leadership and decision–making processes for the sustainable management of coastal ecosystems	
Target 14.4	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	Women are mostly affected by unsustainable fishing because the majority of them deal with fishing activities near shores, not having the resources for sophisticated equipment. Usually they possess only simple instruments for fishing.	
Target 14.5	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information	Equal participation and co-management of resources is important in order for policies of conservation to be accepted by coastal female communities. Also, equal access to knowledge production and information related to coastal conservation.	
Target 14.7	By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	Providing women in small islands developing states and least developed countries with equal opportunities in training and new skills acquisition in the fisheries sector can ensure a more equal access to resources and improve their economic conditions, thus contributing to the GDP increase by sustainable fisheries.	

Target 14.a	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries	Women are under-represented in marine science, so it is important to provide budget and support and to create a safe environment for them, so that their participation in science and the knowledge exchange in the field of marine technology and ocean-related industries can be increased.	
Target 14.b	Provide access for small-scale artisanal fishers to marine resources and markets	Promotion of female fishing leaders and protecting their rights is important to increase their access to small-scale fisheries and marine resources markets, because often they are underpaid or without contracts or health and safety insurance, even though, according to the Food and Agriculture Organization, '*women represent nearly half of the estimated 180 million people worldwide working in fisheries and aquaculture'*.	
Target 14.c	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want	Increased female representation in international advocacy can support the processes of ratification by countries of institutional frameworks, ocean-related instruments, etc., for conservation and sustainable use of the oceans and their resources.	
SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss			
Target 15.1	By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Gender differentiated responsibilities vary region to region, but in many communities around the world, women act as primary caretakers and natural resource managers – procuring water and firewood, managing waste and providing health care, often through plant-based medicines. Women's roles also mean they hold vast knowledge on sources of water, storing and caring for seeds, and the diverse uses and benefits of plants, including for food, medicine, art, and avoiding and mitigating land degradation. This knowledge is crucial to preserving biodiversity, addressing climate change and supporting livelihoods.	Agu and Gore (2020) Broeckhoven (2014)

Target 15.3	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	The role of women in international law and policy is still low, especially in developing countries, and the decision-making about combating desertification and restoration of land and soil is limited.	
Target 15.5	Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	Especially in developing countries, the role of women in the reduction of natural habitat destruction and biodiversity loss has been considered important. Women need to be equally and actively involved in processes to conserve and sustainably use biodiversity because they play critical roles as primary land managers and resource users, and they face disproportionate impacts both from biodiversity loss and gender-blind conservation measures.	
Target 15.8	Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products	Efforts to overcome challenges to combatting wildlife trafficking will likely benefit from increased attention to, and mainstreaming of, the role of women in wildlife trafficking, especially in Africa. The role of women has been considered low in Asia.	
SDG 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels			
Target 16.1	Significantly reduce all forms of violence and related death rates everywhere	Significantly reduce all forms of violence and related death rates across all countries by 2030	Leal Filho et al. (2021) Institute for Economics and Peace (2014) Pathfinders for Peaceful, Just and Inclusive Societies (2017) UNICEF Office of Research (2017) Bolaji-Adio (2015) Shakti (2017)
Target 16.2	End abuse, exploitation, trafficking and all forms of violence against and torture of children	Proportion of children aged 1–17 years who experienced any physical punishment and/or psychological aggression by caregivers in the past month.	Council of Europe (2017) Hyder and Malik (2007) Raman et al. (2020) UNICEF (2009) Peterman and O'Donnell (2020)

			WHO (2020) Save The Children International Asia (2020) Fabbri et al. (2020)
Target 16.3	Promote the rule of law at the national and international levels and ensure equal access to justice for all	Proportion of victims of violence in the previous 12 months who reported their victimisation to competent authorities	Hillis et al. (2016) Rabinovych (2020) Beqiraj and McNamara (2016) Quinn and Sannerholm (2019) Government of Canada (2020) Lima and Gomez (2019) Alffram (2011) Open Government Partnership (2019) Satterthwaite and Dhital (2019) UNICEF and Regional Office for CEE/CIS (2015) OECD (2019) Manuel and Manuel (2018)
Target 16.4	By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime	Total value of inward and outward illicit financial flows	Arib (2017) Reuter (2017) Bromley et al. (2019) UNCTAD and UNODC (2021) Fisher (2020)
Target 16.5	Substantially reduce corruption and bribery in all their forms	Substantially reduce corruption and bribery in all their forms across all countries by 2030.	Hoffiani (2019) Whaites (2016) Hope (2020)

			Mugellini and Villeneuve (2019) V-Dem Institute (2017) Department for International Development (2015) Bahoo et al. (2020) Mackey et al. (2016) Sartor and Beamish (2020)
Target 16.6	Develop effective, accountable and transparent institutions at all levels	Primary government expenditures as a proportion of original approved budget, by sector (or by budget codes or similar)	United Nations (2015d) Tully (2015) Poisson (2016) OECD (2019b) V-Dem Institute (2015) Carothers and Brechenmacher (2014) Blind (2019) International Bank for Reconstruction and Development and World Bank (2020)
Target 16.7	Ensure responsive, inclusive, participatory and representative decision-making at all levels	Proportions of positions (by sex, age, persons with disabilities and population groups) in public institutions (national and Local legislatures, public service, and judiciary) compared to national distributions	Hayes and Bulat (2017) WHO (2011) European Union Agency for Fundamental Rights (2020) Mijatović (2018)
Target 16.8	Broaden and strengthen the participation of developing countries in the institutions of global governance	Proportion of members and voting rights of developing countries in international organisations	Glass and Newig (2019) Qoraboyev (2021) Weiss and Wilkinso (2018) Gellers (2016) OECD (2019a)

Target 16.9	By 2030, provide legal identity for all, including birth registration	Proportion of members and voting rights of developing countries in international organisations	van der Straaten (2015) Manby (2017) Vandenabeele and Lao (2007) Dahan and Gelb (2015) Perrault and Arellano (2011)
Target 16.10	Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements	Number of verified cases of killing, kidnapping, enforced disappearance, arbitrary detention and torture of journalists, associated media personnel, trade unionists and human rights advocates in the previous 12 months	Slutskiy (2020) Berger (2020) UNESCO (2018b) Phogat (2015) United Nations (2008)
Target 16.11	Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime	Existence of independent national human rights institutions in compliance with the Paris Principles	Manuel and Manuel (2018) Hilderbrand (2015) Zamfir (2020)
Target 16.12	Promote and enforce non-discriminatory laws and policies for sustainable development	Proportion of population reporting to having personally felt discriminated against or harassed in the previous 12 months on the basis of a ground of discrimination prohibited under international human rights law	Pisano et al. (2015) British Council (2018) IOM and Joint Migration and Development Initiative (2015) Government of Andhra Pradesh (2017) United Nations Human Rights (2020) Lindsey and Chapman (2017) United Nations System Chief Executives Board for Coordination (2017)
SDG 17 Strengthen the means of implementation and revitalize the global partnership for sustainable development			

Target 17.1	Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection	Creating equal working conditions and opportunities for women especially in the Global South, where the majority of women do not work formally, and thus do not contribute to the income taxes.	Joshi et al. (2020) UN Women (2020g) OECD (2020b)
Target 17.3	Mobilize additional financial resources for developing countries from multiple sources	It is important that foreign aid considers gender equity and provides funds for empowering woman. According to UN Women, '*Only 5 per cent of foreign aid funds had gender equality as a principle objective in 2012-2013*'.	
Target 17.7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed	Clean technologies related to everyday work and activities of women (i.e., clean cooking technologies) can affect their health and improve their life conditions.	
Target 17.8	Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology	Women are under-represented in IT jobs, top management and academic careers, but it is important that woman are included in digital transformation and that there is no digital gender divide. In many countries, women have less access to technological devices. According to the OECD, approx. 327 million fewer women than men in the world can use a smartphone or can have access to mobile internet.	
Target 17.10	Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda	Women can be empowered and protected by fair trade practices, which consider labour conditions, prevent discrimination, promote equal access to employment, etc.	
Target 17.12	Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access		

Target 17.17	Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships	It is important that female organised networks or civil society organisations that deal with gender equality, women rights, etc. are part of the partnerships and coalitions for goals, in order to increase their representation in national and international processes	
Target 17.19	By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries	Many countries do not have enough data that identify women's issues or gender-based data, which is a critical aspect for supporting policies for gender equality. According to UN Women, around a third of countries have an office for gender statistics.	

Appendix V

The keyword search for the bibliometric analysis was as follows:
TITLE-ABS-KEY (“anxiet*” OR “schizophrenia” OR “mood disorder*” OR “depression” OR “suicide” OR “aggressive behavio*rs” OR “despair” OR “mental health”) AND (“extreme weather event” OR “loss of landscape” OR “climate change*” OR “global warming” OR “climatic change*”).

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A journey of a thousand miles begins with a single step.
Lao Tzu

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