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Central Asia: Exploring Insights on Gender Considerations in Climate Change

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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.

Keywords: climate change; gender; Central Asia; women

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1. 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 [1]. 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 [2–6].

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 [7–9]. Studies report that men farmers, for instance, are found to be more vulnerable to higher temperatures and changes in rainfall patterns [10]. 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 [5,11–13].

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 [14,15]. 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 [16–19]. 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 [20]. 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 [21]. 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 [22].

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., [12,23,24]), consequently creating additional benefits for adaptation and mitigation measures, poverty reduction, resilience, and capacity building [25,26]. For instance, highly qualified women, members of board committees, who are actively involved in companies' governance, undoubtedly affect their voluntary climate change disclosure [27]. There is also a positive correlation between the percentage of women occupying managerial positions and the reduction of carbon emissions in a company [28]. 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 [2,29].

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.

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

2.1. 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 [30], heavily relies on natural resources and is mainly engaged in agricultural activities [31,32], and constantly experiences growing climate change impacts, including alterations in precipitation patterns, increasing aridity, and seasonal climatic shifts [33–38]. 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 [39,40]. 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 [35,40,41].

Additionally, the vulnerability of the local communities is aggravated by poverty, intensive outmigration, and relatively low levels of coping capacity [42–47]. 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 [48]. A changing climate also affects key economic sectors that already face consequences of ineffective environmental management implemented during the Soviet Union period (e.g., [23,49,50]). 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 [51]. Currently, it contributes between 5% and 25% to the national GDPs [52,53] and employs between 15% and 45% of the total labor force, of which between 13% and 60% are women [30].

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 [54–56], 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" [57–61]. 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 [62].

2.2. Gender/Women

In Central Asia, women comprise a larger share of the population (Table 1). Between 36% (Kazakhstan) and 70% (Tajikistan) of women reside in rural areas [52,63]. 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 [64–67]. 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 [30,68,69].

Table 1. Central Asia countries' characteristics.

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. Source: Authors compilation based on data from the World Bank, UNDP, national official websites, and statistical offices.

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 [70–80]. 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% [81–83]. However, today, women occupy between 17% and 32% of the seats in national parliaments (Table 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 [84–86]. 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 [68]. 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 [22].

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., [59,87,88]). 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 [89]. 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 [90]. 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 [91].

2.3. 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 [92–94]. Table 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 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 3) [95,96]. 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 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.

3. 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.

3.1. 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 [97]. Both Scopus and GS databases represent the largest collection of scientific and scholarly works published globally. Table 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:

Table 4. Selection criteria.

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

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.

The search and selection of literature from GS were undertaken using the Publish or Perish software program [98]. 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 [99].

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 [100]. 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.

3.2. 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 [101]. The approach is among the key elements used across various fields, including women roles and climate change adaptation and projections [102–104].

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.

3.3. 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 [1].

4. Results

4.1. 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 [105], extreme heat on the risk of preterm birth and stillbirth [106], seasonality on anemia and eclampsia [107], and desertification in the Aral Sea Basin on the local communities' health [108,109], 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 [110]. Another two publications discussed the relationship between social movements and the global carbon budget [111] and the effects of the socioecological transformations such as climate change on local populations [112]. Kumar et al., 2021 focused on gender diversity in enrolment in Geo-Spatial Technology and Applications programs [113]. In the energy context, the authors investigated various factors, including the gender-shaped perception that affected energy security [114,115]. Water-related studies discussed the impacts of climate change on water resources and their effects on women and girls [116], and adaptation to climate-change-exacerbated water scarcity, droughts, and flash floods [117]. 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 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 [1] 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.

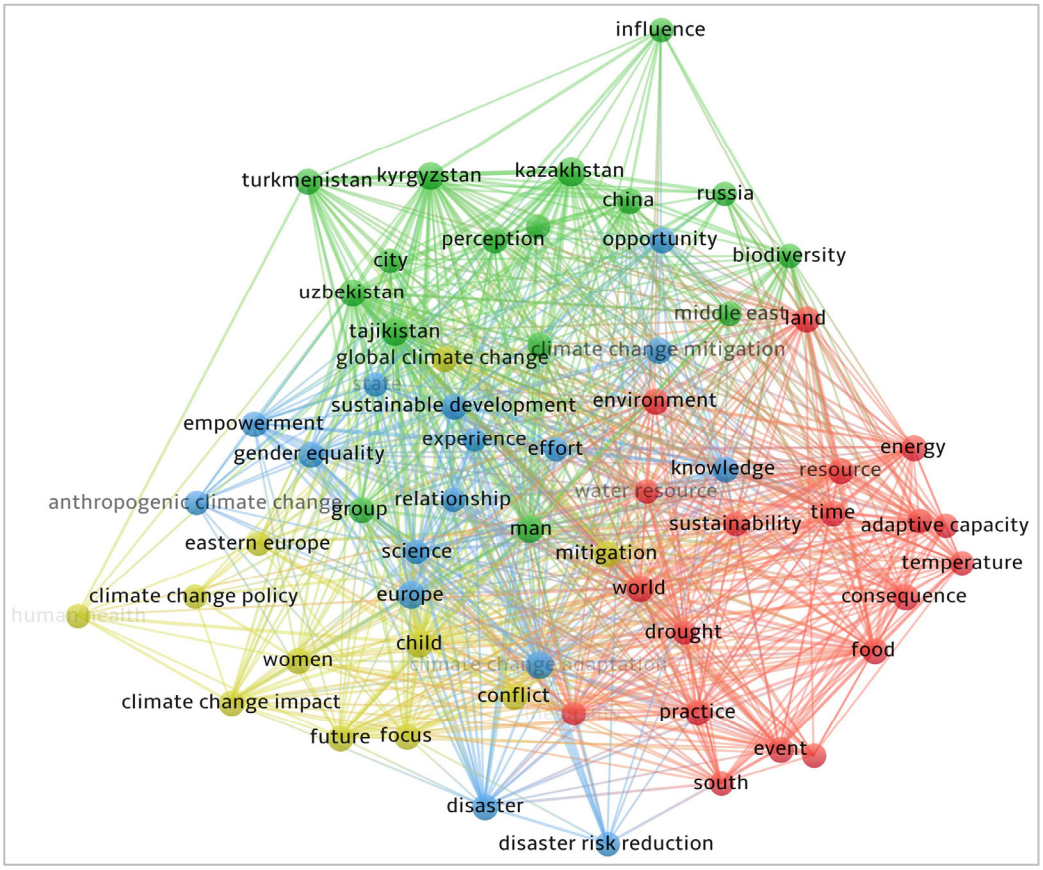

Figure 1. Co-occurrence map of terms (merged Scopus/GS dataset). Created with VOSviewer.

4.2. On-Line Survey

4.2.1. 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 5 summarizes the respondents' characteristics.

Table 5. Socio-demographic characteristics of the on-line survey respondents.

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%		

4.2.2. 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 2).

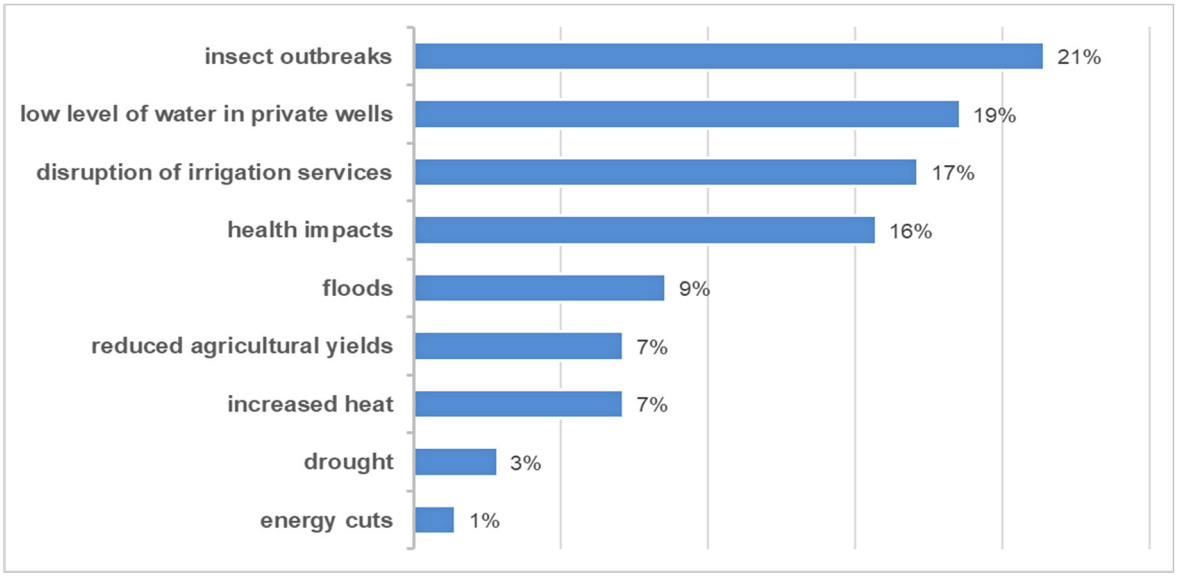

Figure 2. Main impacts of climate change on the rural population. Source: Authors.

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 3).

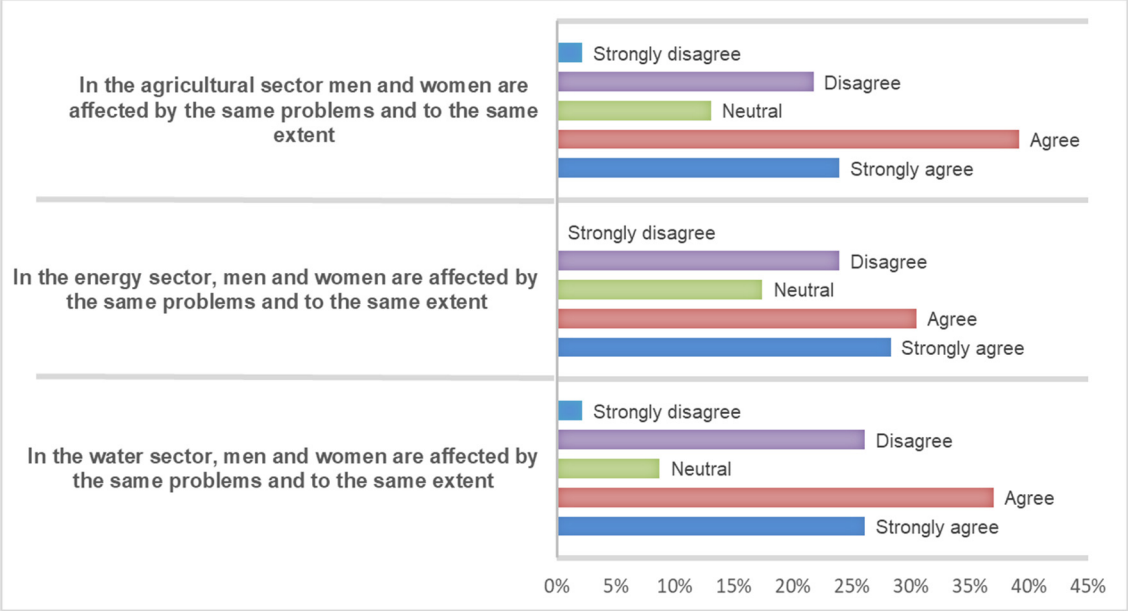

Figure 3. How men and women are affected in the key sectors. Source: Authors.

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 Table A1 of Appendix A. 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).

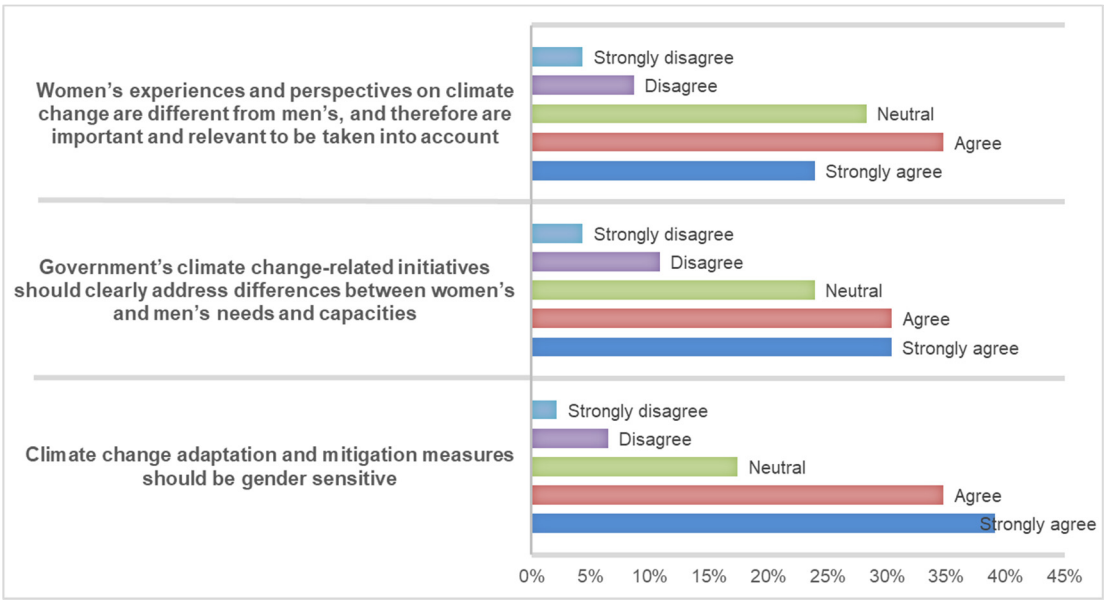

Figure 4. Inclusion of women's and men's differences. Source: Authors.

Additionally, the survey participants outlined the importance of increasing rural women's participation in decision-making processes, particularly at the town/village level (Figure 5), despite them having a still small input into decisions on water distribution, use of renewables, and water efficient and adaptation practices (Figure 6).

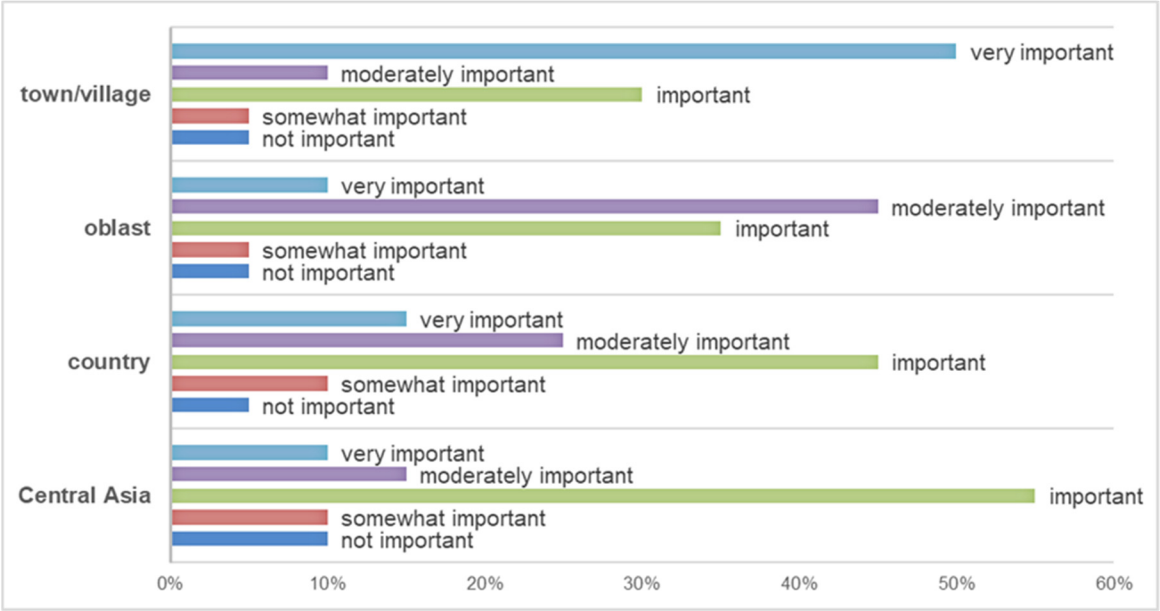

Figure 5. Importance of including more rural women in decision-making processes on climate-change-related issues across all levels. Source: Authors.

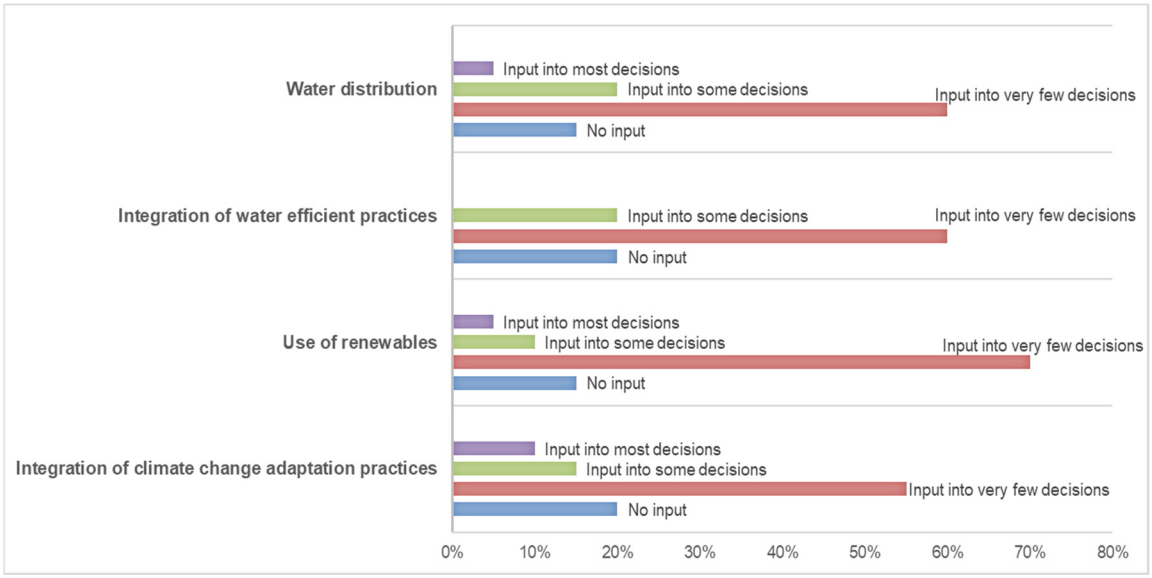

Figure 6. Rural women's input in decision-making processes at the town/village level. Source: Authors.

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 7).

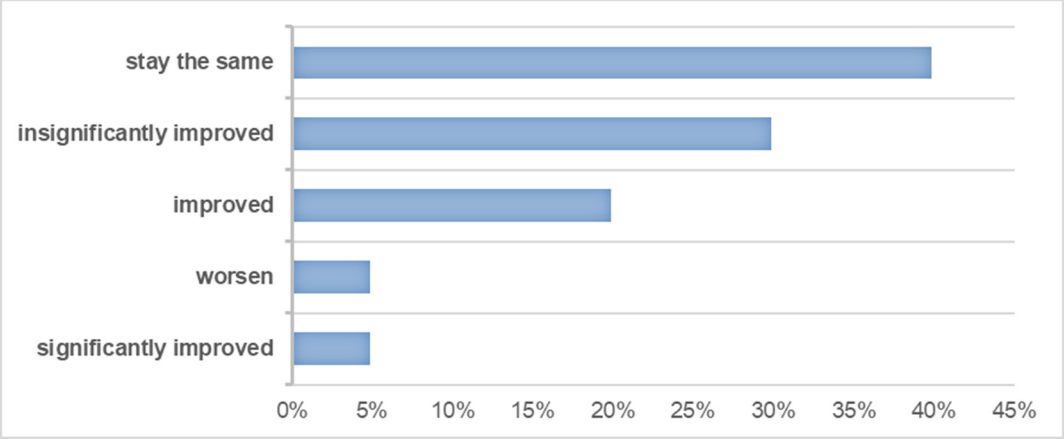

Figure 7. Change in women's role in climate change adaptation and mitigation (over the last five years). Source: Authors.

4.3. 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 Table A2 of Appendix A. 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 [118]. 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 [119,120]. 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 [121]. 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 [122].

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 [123]. 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 [123].

5. Discussion

5.1. 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 [124], 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 [35,125]. 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 [32,126]. 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 1 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.

5.2. 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 [44]. 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 [127–129]. 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 [124]. 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) [130]. 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 [131]. 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 [132,133]. These representation patterns are similar to those in other world regions [134–136]. 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 [137,138]. 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 [139,140], as well as improving companies' environmental performance [141]. 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.

5.3. 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.

5.4. 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.

6. 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.

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Appendix A

Table A1. 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 during drought events - Men farmers can easier and faster negotiate with "water providers" than women.	- 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 agricultural production - Traditions/Asian mentality - Low level of culture - Gender inequality in rural areas - Low level of participation

Table A1. *Cont.*

	Water	Economic Development	Education	Agriculture	Health	Information	Weather Events	Other
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; 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	- 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

Table A2. Development projects supported by international organizations/donors. Source: Authors' compilation.

#	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	[118]
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	[142]
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	[123]
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	[143]

Table A2. *Cont.*

#	Project Title	Donor Organization	Country *	Duration	Short Description	Climate Change–Gender Interconnections Domain	Source
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 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.	Leadership/ Empowerment	[119]
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	[144]
8	CLIMADAPT	European Bank for Reconstruction and Development (EBRD) PPCR of the Climate Investment Funds (CIF) Government of the UK and the multi-donor EBRD Early Transition Countries Fund	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	[122]
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	[145]
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	[121]

Table A2. *Cont.*

#	Project Title	Donor Organization	Country *	Duration	Short Description	Climate Change–Gender Interconnections Domain	Source
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	[89]
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 through distance learning and increasing networking opportunities.	Leadership/ Empowerment	[120]
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	[146,147]

Table A2. *Cont.*

#	Project Title	Donor Organization	Country *	Duration	Short Description	Climate Change–Gender Interconnections Domain	Source
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	[148]
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	[149]
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	[150]
17	Climate and Environment (CLIENT) Program in Central Asia	The World Bank PROGREEN	Central Asia	2021–2026	The program supports CA countries to attain sustainable, resilient, and inclusive economic growth with a 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.	Leadership/Empowerment	[151]

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

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