



## OPEN ACCESS

## EDITED BY

Massimiliano Agovino,  
University of Naples Parthenope, Italy

## REVIEWED BY

Casper Boongaling Agaton,  
University of the Philippines Los Baños,  
Philippines  
Esther Leah Achandi,  
International Livestock Research Institute  
(Ethiopia), Ethiopia

## \*CORRESPONDENCE

Shristi Shakya  
✉ shristi.shakya06@gmail.com

RECEIVED 06 February 2023

ACCEPTED 26 September 2023

PUBLISHED 25 January 2024

## CITATION

Khadka M, Uprety L, Shrestha G, Shakya S,  
Mitra A and Mukherji A (2024) Can water,  
energy, and food policies in support of solar  
irrigation enable gender transformative  
changes? Evidence from policy analysis in  
Bangladesh and Nepal.  
*Front. Sustain. Food Syst.* 7:1159867.  
10.3389/fsufs.2023.1159867

## COPYRIGHT

© 2024 Khadka, Uprety, Shrestha, Shakya, Mitra  
and Mukherji. This is an open-access article  
distributed under the terms of the [Creative  
Commons Attribution License \(CC BY\)](#). The  
use, distribution or reproduction in other  
forums is permitted, provided the original  
author(s) and the copyright owner(s) are  
credited and that the original publication in this  
journal is cited, in accordance with accepted  
academic practice. No use, distribution or  
reproduction is permitted which does not  
comply with these terms.

# Can water, energy, and food policies in support of solar irrigation enable gender transformative changes? Evidence from policy analysis in Bangladesh and Nepal

Manohara Khadka<sup>1</sup>, Labisha Uprety<sup>1</sup>, Gitta Shrestha<sup>1</sup>,  
Shristi Shakya<sup>1\*</sup>, Archisman Mitra<sup>2</sup> and Aditi Mukherji<sup>2</sup>

<sup>1</sup>International Water Management Institute, Lalitpur, Nepal, <sup>2</sup>International Water Management Institute, Delhi, India

Solar irrigation pumps (SIPs) are emerging as a popular technology to address water, energy, and climate change challenges in South Asia while enhancing livelihoods and food security. SIPs are deemed to be a women-friendly renewable energy technology (RET) due to their design, operating system, and safety. While the gender dimensions of natural resources are well documented, the extent to which the water, energy, and food (WEF) policies—including policies to promote SIP technologies in the countries of South Asia—conceptualize and operationalize gender equality and social inclusion (GESI) is not well understood. Therefore, in this study, we reviewed 39 WEF sectoral policies of Bangladesh and Nepal by adopting a gender-transformative analysis approach to rank the policies on a continuum ranging from a scale of 0–3 (denoting gender-unaware, gender-aware, gender-responsive, and gender-transformative). We found that the governments in both countries commit to gender equality and women's advancement in their WEF sector policies, institutions, and decision-making by ensuring gender and justice principles in their constitutions and national development frameworks. However, these higher-level aspirational principles are not always operationalized in the WEF sector policies. We found that the WEF policies are aware of the need to include GESI and social equity in sectoral programming, yet operational rules for their implementation often fail to challenge structural barriers. Such barriers hinder women and marginalized groups from participating in and benefiting from WEF policies, including the deployment of SIP technologies. This calls for a transformation not only in project implementation but also in the policymaking processes of WEF sectors in the South Asian region.

## KEYWORDS

gender, solar irrigation, water, food, energy, transformation, equity, inclusion

## 1 Introduction

Countries in South Asia are promoting policies and programs on solar irrigation pumps (SIPs) as a climate-smart water solution to increase agricultural yield. Most of them mention SIPs in their nationally determined contributions (NDCs) [GoN (Government of Nepal), 2020b; GoB (Government of the People's Republic of Bangladesh), 2021; GoI (Government of India), 2022].

SIPs provide major adaptation benefits by augmenting the livelihoods of smallholder farmers while also offering mitigation benefits like reducing carbon emissions from irrigation and reducing the dependence on exported diesel (Mukherji et al., 2017; Shah et al., 2018).

SIPs are easy to operate, work during the day, and may be owned individually or collectively. They can support the production of profitable and highly nutritious value crops, including off-season vegetables (GC, 2020; Sugden et al., 2020). As a result, they can be adopted as promising technologies to provide socioeconomic opportunities and improve the capabilities of women and smallholder farmers, who constitute the major workforce in agricultural and food supply chains in the region (Agarwal, 1994; Rahman, 2000; FAO (Food and Agriculture Organization), 2019).

However, access to WEF resources, technologies, and information, as well as decision-making power, is largely influenced by deeply entrenched gender and social inequalities. In the context of South Asia, increasing male outmigration has led to a substantial increase in women's farm-related work; 69% of women are engaged in the agriculture sector (World Bank, 2020). However, widely used irrigation technologies are not women-friendly. Diesel pumps are heavy and need to be carried to the field; in addition, they are difficult to operate. Electric pumps, while easier to use, require sustainable grid connection to operate, a prerequisite that is often not fulfilled in most rural Nepal. Additionally, women only serve as token representatives in water users' associations, which hinders their access to information and decision-making on surface irrigation. Gender gaps persist in land ownership, and most agricultural development programs continue to be linked with asset ownership (Manjula, 2021).

Gender and energy literature points out that access to energy technologies, when gender-sensitive, can support a shift in traditional gender roles in households and economic spaces such that women become technology owners and entrepreneurs (Osunmuyiwa and Ahlborg, 2019). Therefore, consideration of existing gender and social inequalities and power relations in technology design, planning, implementation, and policymaking can address the differentiated energy needs of women and marginalized groups. Studies (Gonda, 2016; Winther et al., 2018) show that inequity and marginalization of women from technology access and adoption persist when policies and programs undermine gender aspects. Winther et al. (2018) found that the service supply system dominated by "gender-neutral" policies and strategies along with local norms and practices hindered women's empowerment (decision-making, access to resources, and right to participate) since men control and dominate the process of electricity access. Gender inequalities in access to technologies and water resources are also intersected by class, caste, ethnicity, age, and other identities of women and men (Joshi, 2011; Gonda, 2016; Leder et al., 2019). However, research on solar energy and SIPs in South Asia has predominately focused on the technical and financial models of SIP investment (Mukherji et al., 2017; Shah et al., 2018), with less emphasis placed on gender and inclusion dynamics in the energy sector (Mohideen, 2018; Patnaik and Jha, 2020). Arguably, embedding GESI considerations into SIPs can promote the technology not only as a technical solution to reduce carbon emissions but also as a tool to promote women's agency and their decision-making in agriculture and help achieve food security and gender and social equality in the region.

Policies that enable women and marginalized groups to participate in and benefit from WEF resources and SIPs are crucial for inclusive development (Agarwal, 1994). Energy policies and interventions can also provide opportunities to create gender equality when they are

aligned to understand and tackle gender differential energy needs, assets, skills, constraints, and capabilities of women and men and existing gender norms (Kooijman-van Dijk, 2020). Feminist political ecology scholars (Nightingale, 2006; Leach et al., 2016; Clement et al., 2019) argue that equity, inclusionary, and gender equality outcomes are shaped by how policy and implementation practices of implementing actors conceptualize gender, inclusion, and equity. Gender and social inequalities are dynamic issues and are not linked only to households but also to the state, markets, and community spheres (Kabeer, 2005; Cornwall et al., 2008). Gender mainstreaming across the WEF sectors, including agriculture and energy, has been a prime agenda in international as well as national policy frameworks. However, the inclusion of gender and social justice components in policy processes remains insufficient (Rai Paudyal et al., 2019). As the governments and development partners in South Asia have renewed their commitment to economic growth, gender equality, and inclusive development within the overall context of climate change (KfW, 2006; NPC (National Planning Commission), 2019; ADB, 2020), it is unknown as to what extent WEF policies that underpin SIP implementation are sensitive to gender and social inequalities.

This study fills this knowledge gap by assessing the incorporation of gender equity and social inclusion principles in WEF policies, particularly focusing on SIP interventions in Bangladesh and Nepal. Both countries are rapidly promoting alternative energy for irrigation and agriculture development to uplift the situation of their agricultural labor force, of whom over 70% are women, tenants, landless, and smallholder farmers (Jaim and Hossain, 2011; MoAD, 2016). In light of socioeconomic and political contexts that constrain the opportunities and outcomes of women, the poor population, and the marginalized population to benefit from technological advancements and agricultural developments, this study shall offer insights into critical components that need to be incorporated into WEF policymaking to unlock their potential for gender and social transformation. This is particularly important in Bangladesh and Nepal, where women and marginalized groups are underrepresented in decision-making and opportunities for water, energy, and natural resources management.

For this research, we specifically ask the following questions: (i) to what extent has GESI been conceptualized and incorporated into the WEF sector policies? and (ii) to what extent have SIP subsidy policies and financing mechanisms incorporated GESI principles? In this study, we have used the gender-transformative approach (GTA) (Pederson et al., 2014; Hillenbrand et al., 2015; Mullinax et al., 2018) as a guiding method to analyze these WEF policies and implementation strategies.

## 2 Agriculture and energy development in Bangladesh and Nepal

Bangladesh and Nepal have envisioned the agriculture sector as an engine of economic growth leading to a reduction in poverty and increased food and nutrition security [CIAT (International Center for Tropical Agriculture) and World Bank, 2017; NPC (National Planning Commission), 2019]. Both countries are promoting renewable energy to increase agricultural productivity, alongside decreasing carbon emissions and enhancing socioeconomic development. Bangladesh's 20 years Perspective Plan (2021–2041) sets a target of 3% annual contribution of renewable energy to total energy production [BPC (Bangladesh Planning Commission), 2020]. In line with these targets,

it has developed a strategy for scaling SIPs to be cost-effective, less labor-intensive, and more efficient and clean irrigation technology. To date, close to 2,000 SIPs have been installed in the country with the aim of replacing diesel pumps for irrigation. Currently, there are 1.58 million irrigation pumps in Bangladesh, of which 78.4% are diesel-operated, 21.5% are operated with grid electricity, and only 0.1% are SIPs [BADC cited in Sayeed et al. (2020), p. 1].

In Nepal, electricity and other renewable resources contribute to 1.47 and 0.48% respectively of the total energy produced (Bhatt, 2017). Over 50% of the farmers in Nepal rely on groundwater for irrigation, drinking, livestock, and sanitation and use diesel and electric pumps. While buying and operating diesel pumps by smallholder farmers is costly, electric pumps are unreliable due to poor electricity supply (Urfels et al., 2020). As of 2023, there are over 3000 SIPs installed (AEPCC 2023)<sup>1</sup>, mostly in the Terai, while in the mid-hills, solar energy is being used for pumping surface water for multiple –use water services (MUS), including drinking water supply.

The Alternative Energy Promotion Center (AEPCC) in Nepal and the Infrastructure Development Company Limited (IDCOL), Bangladesh Agricultural Development Corporation (BADC), Bangladesh Rural Electrification Board (BREB), and Barind Multipurpose Development Authority (BMDA) in Bangladesh are the key government agencies in the two countries that promote renewable energy technologies such as SIPs. However, despite efforts, there is often a gap between the policies that govern these institutions regarding gender and their actual implementation (Skutsch, 1998). A major roadblock to successful gender integration in such sectors is the ambiguity of why gender sensitivity is needed in the first place (Skutsch, 1998). Consequently, the purpose of the need to be gender sensitive is unclear to those implementing it.

### 3 Methodology: using the gender continuum scale to assess WEF policies

In Bangladesh and Nepal, solar energy is embedded with policies on renewable energy, water, agriculture, and climate. Therefore, we reviewed policies in three interrelated WEF sectors: water, energy, and agriculture, with an aim to gain an overarching view of how GESI has been conceptualized and incorporated within WEF policies in Bangladesh and Nepal. We identified 39 WEF policies (Bangladesh = 20, Nepal = 19) for review. Bangladesh's WEF policies included seven on water, ten on energy, and three on agriculture (see Table 1). In Nepal, five were on water, nine on energy, and five on agriculture. These policies were selected because they were key strategic frameworks guiding development, poverty reduction, and solar irrigation interventions in the WEF sectors of Bangladesh and Nepal.

We reviewed the WEF policies<sup>2</sup> using gender equality and women's empowerment perspectives (Agarwal, 1994; Kabeer, 1999;

Elmhirst and Resurreccion, 2008; Kooijman-van Dijk, 2020). We used the gender-transformative approach (GTA) (Pederson et al., 2014; Hillenbrand et al., 2015; Mullinax et al., 2018) to review the policies. GTA calls for interventions that empower women and girls and challenge social norms (e.g., beliefs, mindsets, perception, patriarchy), structures (e.g., policies, laws, governance), and power relations contributing to gender inequality and helps understand issues beyond 'technical fixes' perspectives (Mullinax et al., 2018). The gender continuum scale—gender-unaware (0), gender-aware (1), gender-responsive (2), and gender-transformative (3) (Pederson et al., 2014; Hillenbrand et al., 2015; Mullinax et al., 2018)—was used as a methodological framework to assess the extent of gender consideration in the WEF sectors policies (Figure 1). We used this framework because it allows WEF sector actors, including policymakers, practitioners, investors, and researchers, to understand and use key domains and indicators for achieving gender and social inclusion outcomes. In Bangladesh and Nepal, there is evidence that the implementation of GTA has brought about a change in discriminatory norms and led to the empowerment of men and women (Osmani et al., 2016; Quisumbing et al., 2021; Mercy Corps, 2022). Despite its potential, we are also aware of the emerging criticisms in the use of the language of gender transformation and the limitations of the approach itself (see Malhotra, 2021; McDougall et al., 2021; FAO, 2023). It is, therefore, pertinent to note that the study limits the use of the approach to assess the extent to which WEF policies have the potential to promote transformative outcomes rather than to evaluate the policymaking processes or outcomes.

To further operationalize the gender continuum scale, indicators were developed to assess WEF policies around three domains of gender-transformative change—agency, relations, and structure (Kabeer, 1999).

The 'agency' domain of change relates to empowering women and disadvantaged groups (DAGs) through the advancement of their ability (knowledge, skills, information, networks) and the promotion of their critical reflections on the root causes of their discrimination and exclusion. The 'relation' domain refers to reshaping existing unequal power relations between women and men in institutions at scales (e.g., households, communities, markets, and organizations). This domain of change views gender equality as a political project that intends to empower women and DAGs by building their agency and networks with the state and non-state actors. The 'structure' domain of change is related to the change in informal and formal institutional rules and practices that influence collective, individual, and organizational actions toward GESI. This approach focuses on the empowerment of women and DAGs by addressing systemic barriers through changes in formal and informal institutions. The transformation in formal institutions includes laws, policies, and strategies in favor of women and DAGs. The informal institutions or the 'embeddedness environment' (Minh et al., 2021) require change, including social norms, discriminatory practices, traditions, beliefs, attitudes, behaviors, and mindsets affecting institutional practices at scales.

For each domain of change, we first developed a GESI-transformative outcome indicator. Then, to assess each outcome, we developed related criteria. Two criteria each were defined to measure outcomes in the 'agency' and 'structure' domains, and one criterion to measure outcomes in the 'relation' domain (Figure 2). We used this broader policy review framework presented in Figure 2

1 Source: adapted from <https://www.aepcc.gov.np/documents/reports>.

2 Policies in study refer to official documents from Nepal and Bangladesh that provide frameworks or guidance for the WEF sector interventions and investments. These include draft bills, bylaws, master plans, policies, strategies, guidelines, and directives officially published and/or accessible.

TABLE 1 WEF policies reviewed—Bangladesh and Nepal.

Sector	Policy no.	Bangladesh	Sector	Policy no.	Nepal
Water	WP1	National Water Policy, 1999	Water	WP1	Water Supply and Sanitation Act, 2022
	WP2	National Water Management Plan. December 2001, Volume 2, Main Report, Approved in 2004		WP2	Draft Water Resources (management and regulation) Bill, 2020
	WP3	Water Act, 2013		WP3	National Water Resources Policy, 2020
	WP4	Bangladesh Water Rules, 2018		WP4	National Irrigation Master Plan, 2019
	WP5	Integrated Micro-Irrigation Policy, 2017		WP5	National Irrigation Policy, 2013
	WP6	Groundwater Management in Agricultural Activities Act, 2018	Energy	EP1	Draft Electricity Bill, 2020
	WP7	Groundwater Management Rules, 2019		EP2	White paper on the status and future roadmap of energy, water resources, and irrigation sector, 2018
Energy	EP1	Import Duty Exemptions for Solar and Wind of Bangladesh (Statutory Regulatory Order), 2004	EP3	National Renewable Energy Framework, 2017	
	EP2	Private Sector Power Generation Policy, 1996 (revised in 2004)	EP4	Renewable Energy Subsidy Policy, 2016	
	EP3	Bangladesh Energy Regulatory Commission Act, 2003	EP5	Renewable Energy Subsidy Policy, 2022	
	EP4	Renewable Energy Policy, 2008	EP6	Renewable Energy Subsidy Delivery Mechanism, 2016	
	EP5	Rural Electrification Board Act, 2013	EP7	National Energy Strategy, 2013	
	EP6	Sustainable and Renewable Energy Development Authority (SREDA) Act, 2012	EP8	Rural Energy Policy, 2006	
	EP7	Guidelines for the implementation of Solar Power Development Program, 2013	EP9	National Energy Efficiency Strategy, 2018	
	EP8	Electricity Act, 2018	Agriculture	FS1	Agriculture Development Strategy (ADS), 2016
	EP9	SREDA Energy Efficiency and Conservation Master Plan up to 2030, 2015		FS2	GESI Strategy (for the ADS), 2017
	EP10	Guidelines for Grid Integration of Solar Irrigation Pump, 2020		FS3	Agricultural Mechanization Promotion Policy, 2014
Agriculture	FS1	National Agriculture Policy, 1999	FS4	National Land Policy, 2018	
	FS2	National Agriculture Policy, 2013	FS5	National Agriculture Policy, 2004	
	FS3	National Agriculture Policy, 2018			

and its detailed guiding framework presented in Annex 1 to review GESI provisions in the WEF policies and rate the policy for each of the five indicators on the gender continuum scale from 0 to 3. Finally, we derived the overall rating<sup>3</sup> of each WEF sector’s policies, presented in Figures 3–7. The word count in each of the indicators while reviewing each policy also validated the scoring (see Annex 2 for word counts).

We also compared the gender continuum scale of the policies between Nepal and Bangladesh using narrative summaries. To substantiate our analysis, we further reviewed the project

evaluation and progress documents and scientific and grey literature on GESI, solar energy, solar irrigation, agriculture, and water. Documents in languages other than English were translated and scored.

## 4 Results

### 4.1 GESI considerations in water policies in Bangladesh and Nepal

The evidence providing the basis for scoring GESI provisions in the water policies reviewed has been presented in Annexes 3, 4. Reviewing the 12 water policies of Bangladesh and Nepal revealed that the policies scored less than 1 on average, with only a few GESI clauses in the

3 This rating was derived by calculating the average scored by each policy in each criterion.

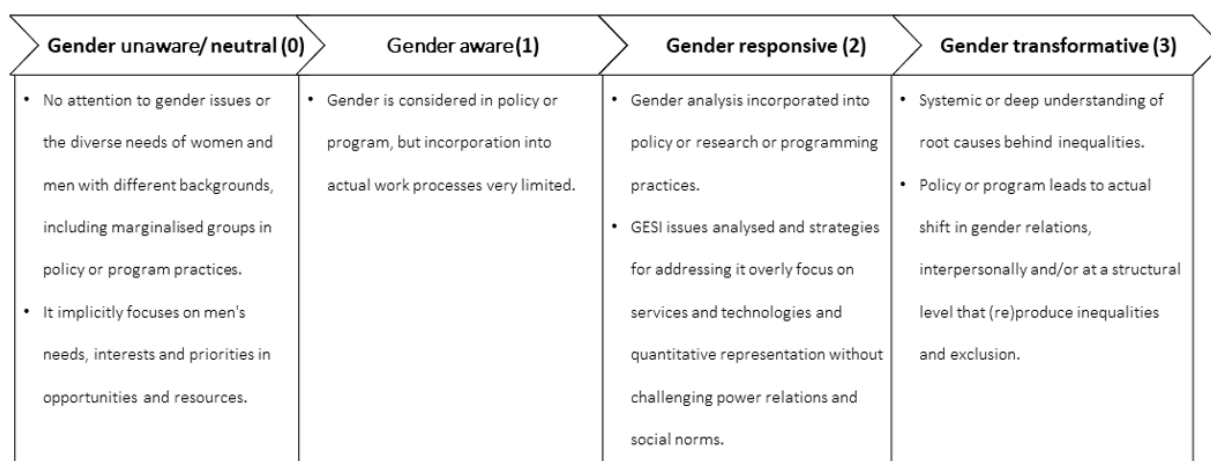


FIGURE 1 Definition of gender continuum scales. Adapted from Kabeer (1999), Pederson et al. (2014), Mullinax et al. (2018).

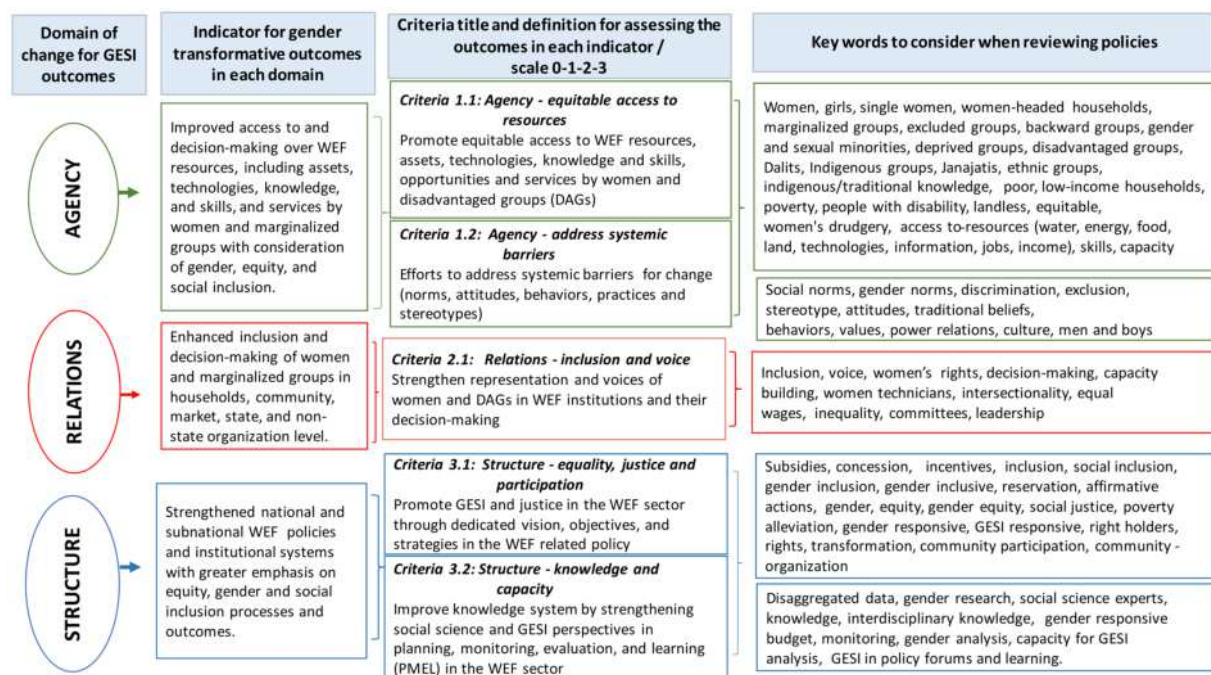


FIGURE 2 Domains of change for GESI outcomes and related indicators and criteria for assessing GESI provisions in WEF policies in South Asia. Adapted from Kabeer (1999).

indicators pertaining to 1.1 (Agency—equitable access to resources), 2.1 (Relations—inclusion) and 3.1 (Structure—dedicated objectives on equality, justice, and participation in policy). These are gender-aware policies as they have provisions that aim to increase access of women and DAGs to water resources, skills, information, and technologies, increase the representation of women in water user groups, and consider equitable design in water projects (see Figure 3). However, the policies do not qualify for indicator 1.2 (Agency—address systemic barriers), which aims to challenge gender and social norms preventing women's and DAG's access to and control over water resources and

irrigation. The water policies we reviewed perceive women's roles in household activities to be water providers and participants in pre- and post-harvest of agricultural produce (e.g., Government of Bangladesh, 1999), which reinforces gender stereotypes.

The water policies are silent regarding the inclusion of women and marginalized groups in water-related decision-making. For example, one of the ten objectives of the 2017 National Micro-Irrigation Policy implemented in Bangladesh is aims to promote the participation of youth, women, poor and marginalized groups in irrigation activities (MoA, 2017). However, this 26-page policy document mentions

Indicators of gender transformative change provisions in water policies	Bangladesh							Nepal				
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP1	WP2	WP3	WP4	WP5
1.1: Agency- equitable access to resources												
1.2: Agency- addressing systemic barriers												
2.1: Relations - inclusion & voice												
3.1: Structure - equality, justice and participation												
3.2: Structure- GESI knowledge and learning												

FIGURE 3  
GESI provisions in water policies of Bangladesh and Nepal. Authors' analysis. Light to darker shades of black colour denotes the GESI consideration in water policies of Bangladesh and Nepal. The gender continuum scale ranges from gender-unaware (light black -0), gender-aware (1), gender-responsive (2), and gender-transformative (dark black -3). In this table, only scale from 0 to 2 are shown, as none of the water policies have gender transformative provisions.

‘women’ only twice, offering no specific allusions to gender and equity. The policy contains a provision for compulsory representation of members from agriculture, water, rural development, and energy sectors in the sub-district (Upazila) irrigation committees and district irrigation committees (strategy 5.14) (MoA, 2017, p. 14). However, there is no clause on the representation of women or civil society representatives in the committees. A brief mention of the inclusion of women and landless people in participatory irrigation management at the water user group level (strategy 5.23, p. 23) is found, but it lacks provisions enabling their meaningful participation in irrigation decision-making (Karim et al., 2018).

Unlike Bangladesh, Nepal’s 2013 Irrigation Policy [MoI (Ministry of Irrigation), 2013] and the second Irrigation Master Plan 2019 [DWRI (Department of Water Resources and Irrigation), 2019] acknowledge the need for research on women’s roles in planning and decision-making among the water user groups (indicator 3.2: Structure–GESI knowledge and capacity). Except these, other water policies reviewed in Nepal have no provisions specific to promoting inclusion, women’s agency, and decision-making. Similarly, provisions to promote gender equality outcomes of water management and water governance (indicator 2.1: Relations—inclusion), address systemic barriers for change (indicator 1.2: Agency—address systemic barriers), and promote social science knowledge and perspectives of water management (indicator 3.2: Structure—knowledge and capacity) are non-existent. Unlike the 2020 National Water Resources Policy (MoEWRI, 2020), the 2013 Irrigation Policy [MoI (Ministry of Irrigation), 2013] prepared prior to federalism was more progressive, scoring 2 in indicators 1.1, 2.1, and 3.1 (Structure—equality, justice, participation). The 2020 National Water Resources Policy aims to provide frameworks for water conservation, management, multiple uses, and regulation in three levels of government to achieve the national vision of prosperity while securing water for the next generation. Yet, none of the 7 objectives, 11 strategies, and 104 action areas mention the words ‘women’, ‘social equity’, or ‘inclusion.’

Similarly, the Draft Water Resources Bill 2020 (GoN, 2020c) adopts a community-based approach to water resources management (Article 10). It acknowledges equity, participation, and indigenous knowledge of local communities in water management and irrigation development. Yet, none of the articles in the Bill include aspects of gender and social inclusion in water and irrigation access, decision-making, and related skills development. The Bill also assumes that participatory irrigation management systems would benefit all farmers, irrespective of social and gender power relations influencing the access to and control over water decisions and planning at the local

level (Khadka et al., 2021a). The Drinking Water and Sanitation Act 2022 (GoN, 2022) recognizes the right of every citizen to drinking water and sanitation. It has provisions of equity consideration in fees for identified marginalized groups or individuals affected by calamities, as well as women’s representation in inter-governmental coordination committees. However, this Act also lacks provisions to tackle systemic issues of gender and social inclusion in the water, sanitation, and hygiene sectors.

Similarly, Nepal’s 2019 National Irrigation Master Plan (IMP) [DWRI (Department of Water Resources and Irrigation), 2019] provides 25 years of strategic direction for irrigation planning and investment. It aims to contribute to achieving the national development vision of economic prosperity through irrigated agricultural development. The plan acknowledges some structural barriers impeding the meaningful participation of women in agriculture and water user groups (indicator 1.2). The strategies conceptualized to address these barriers are training rural women as extension workers and improving their access to extension services. Notably, no specific targets have been developed to achieve this strategy. The plan undermines the need to identify strategies to address social norms and unequal gendered power relations of agricultural and irrigation services and decision-making. The plan also lacks perspectives on inclusion and social justice—it mentions the word ‘smallholders’ merely once. In relation to solar energy and SIP, the plan aims to ‘develop non-conventional irrigation through electric and solar pumping wherever suitable’ [DWRI (Department of Water Resources and Irrigation), 2019, p. 47] but lacks perspectives on the social dimension of SIPs.

In summary, water policies in Bangladesh and Nepal are GESI-aware and demonstrate some understanding of the GESI dimensions of water and irrigation management. The policies view decentralized water management as an approach to water conservation and use. Nonetheless, it is evident that the understanding of GESI as an approach to achieving sustainable and inclusive water resources management is poor. An intersectional approach to gender is also absent from the water policies.

## 4.2 GESI considerations in energy policies in Bangladesh and Nepal

Bangladesh and Nepal have made considerable progress in developing policies for promoting clean energy technologies and services, including solar energy, to improve agriculture production

and enhance socioeconomic development. GESI consideration in energy policies, however, scores below 1 for Nepal and 0 in the case of Bangladesh (see Figure 4). All the ten policies reviewed (see Annex 5) in Bangladesh and two of the eight energy policies in Nepal are gender-unaware with no consideration of GESI perspectives in energy development and institutional mechanism of energy services. This confirms the findings of the gender assessment in renewable energy policies [ADB (Asian Development Bank), 2017, p. 67].

While Bangladesh's 2008 Renewable Energy Policy [MoPEMR (Ministry of Power, Energy and Mineral Resources), 2008] mentions clean and environment-friendly use of renewable energy technology (RETs), none of the objectives and provisions consider GESI. Similarly, the 2012 Sustainable and Renewable Energy Development Authority (SREDA) Act [MoLJPA (Ministry of Law, Justice and Parliamentary Affairs), 2012] is responsible for renewable energy promotion, commercialization, increasing awareness, motivation for the uptake of renewable energy

technology, and research and development. Yet, it does not provide any guidance on the inclusive benefits of renewable energy for women and the poor. The SREDA further developed 'Guidelines to Implement Solar Power Development Program, 2013' (MoPEMR, 2013); Chapter 5 focuses on the implementation of SIPs. Among the 11 stated objectives, there is no mention of a provision or guidance on GESI. While the document emphasizes the formation of a technical committee for SIP implementation, it notably comprises only technical experts. It does not recognize the need for involving social scientists and gender specialists, of which both are considered as crucial aspects for addressing and integrating gender in energy policies (Clancy and Mohlakoana, 2020).

The guidelines on the selection of SIP sites also exhibit a lack of GESI consideration. The majority of poor and women farmers rely on homestead lands and plots located in marginalized areas (e.g., *Khas* lands) for their livelihoods (Theis et al., 2019). These are not considered appropriate for the installation of SIPs, given the

Indicators of gender transformative change provisions in energy policies	Bangladesh										Nepal								
	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9	EP10	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9
1.1: Agency- equitable access to resources																			
1.2: Agency- addressing systemic barriers																			
2.1: Relations - inclusion & voice																			
3.1: Structure - equality, justice and participation																			
3.2: Structure- GESI knowledge and learning																			

FIGURE 4  
GESI considerations in energy policies in Bangladesh and Nepal. Authors' analysis. Light to darker shades of black colour denotes the GESI consideration in energy policies of Bangladesh and Nepal. The gender continuum scale ranges from gender-unaware (light black -0), gender-aware (1), gender-responsive (2), and gender-transformative (dark black -3). In this table, only scale from 0 to 2 are shown, as none of the energy policies have gender transformative provisions.

Score of GESI indicators in energy policies in Nepal  
(gender unaware=0, gender aware=1, gender responsive=2, gender transformative=3)

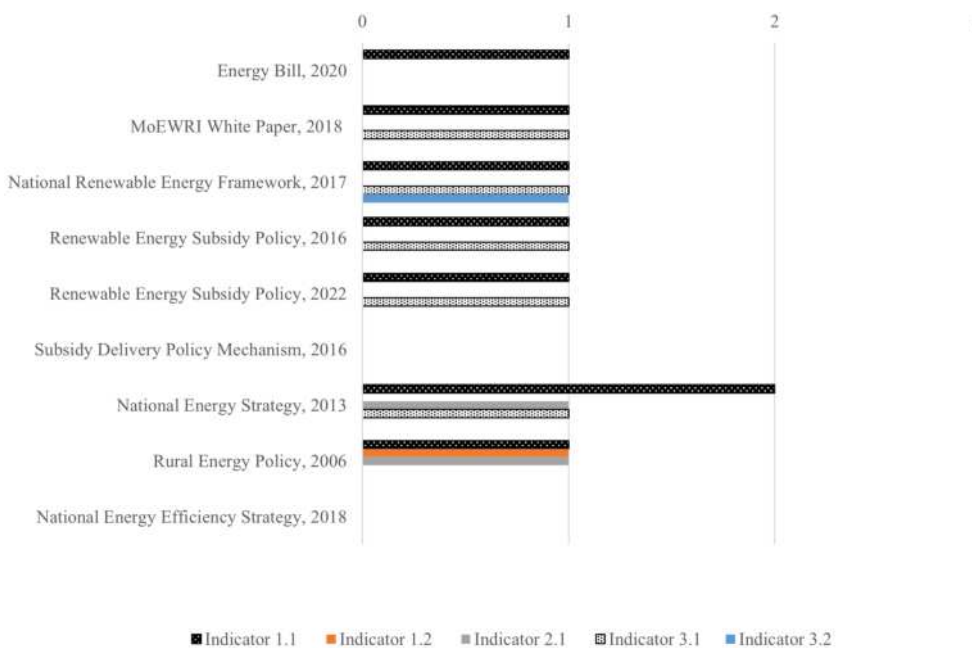


FIGURE 5  
GESI indicators wise provisions in energy policies in Nepal. Authors' analysis.

predominant focus on commercially viable SIP models providing irrigation services against payment of fees, as opposed to models that encourage individual ownership by smallholder farmers (Mitra et al., 2021).

Energy policies often use a technocratic lens, as also evident in the SREDA Energy Efficiency and Conservation Master Plan up to 2030 [SREDA (Sustainable and Renewable Energy Development Authority), 2015]. In the plan, the Ministry of Agriculture is entrusted with the modernization and mechanization of agriculture by introducing renewable energy-based irrigation systems. Similarly, local governments are entrusted with roles to formulate and implement their own Energy Efficiency and Conservation (EE&C) policies, considering the local social and natural conditions. The plan requires non-state actors (e.g., NGOs) to be responsible for ensuring the social aspects of their projects related to energy efficiency and conservation activities, absolving government agencies of this responsibility.

The energy policies in Nepal are gender-aware, with limited understanding and strategies on GESI application. Six out of the eight reviewed policies demonstrate recognition of a few GESI elements (Figure 6). The Draft Electricity Bill 2020 [GoN (Government of Nepal), 2020a] aims to ensure 'access to energy by all' and mandates the provision of one woman in the high-level policy committee on hydropower development; it further affords priority to locals for jobs in hydropower projects affecting them on a competitive basis. Nonetheless, the Bill has no explicit provisions on equity, gender, justice, women's empowerment, and inclusion [GoN (Government of Nepal), 2020a].

The MoEWRI's white paper (MoEWRI, 2018b) is gender-aware, with some considerations of GESI in indicators 1.1 (Agency—equitable access) and 3.1 (Structure—equality, justice and participation). Concerning solar irrigation, the document outlines a project named 'River Banks, Always Green' (strategy 35), with the aim to identify potential farmlands near rivers in hilly areas to pilot solar-lift irrigation systems. This project aims to address and support marginalized farmers. Under the policy roadmap for energy (strategy 17), special energy programs such as free energy meters for target groups (predominantly the marginalized) to enhance their living standards and promote social justice using renewable energy are emphasized. The policy displays some GESI awareness but has limited mentions of subsequent integration of GESI into the several renewable energy projects mentioned, such as the 'One Province, One Mega Project (strategy 56) or 'Every Settlement, Energy Settlement' (strategy 86), where all local governments will be supported for solar projects of 100 to 500 kw by the provincial governments through a challenge fund. Here, 50% of the project cost would be reimbursed to enable irrigation, drinking water, and street lighting projects. There is, however, no mention of how every settlement (including DAGs) can access the benefits accrued.

Similarly, the 2017 National Renewable Energy Framework (AEPC, 2017) has some gender elements in its framework principles (Article 3.2), highlighting gender-responsive and -inclusive energy access. It also embeds gender as a cross-cutting issue and notes that a renewable energy framework coordination committee with a gender-inclusive membership may be required. However, the policy does not go far to shed light on intersectionality and disparities in energy access by varied groups—it mentions the words 'women,' 'poor,' and 'equitable' once, thrice, and once, respectively.

Subsidy provisions on RETs, including SIPs to enable farmers' access to energy being promoted by energy policies, are gender-aware,

with limited GESI strategies. Strategy 8.2 of the 2016 Renewable Energy Subsidy Policy (AEPC, 2016b) intends to improve livelihood for disadvantaged communities. Strategy 9.3 aims to promote RETs to reduce the burden of work for rural women and positively impact their health (AEPC, 2016b, p. 6). A maximum 60% subsidy of the total system cost not exceeding NPR 2,000,000 (approximately USD\$ 15,400) per system would be provided for solar PV pumping systems for irrigation of agricultural land, managed by a community or private company (strategy 11.2.5). A similar 60% subsidy provision exists for solar drinking water systems where additional benefits of NPR 4,000 (approximately USD\$ 30) per household are allocated for target beneficiary groups. For other RETs, districts in the country are categorized into the following three categories to determine subsidy amounts: A (very remote), B (remote), and C (accessible). An additional subsidy is also provisioned in some cases to targeted beneficiary groups that include 'women-led households with dependent children, Dalits, and endangered indigenous community identified by GoN' (AEPC, 2016b, p. 6), which is gender-aware, though not gender-responsive as the subsidies are non-targeted blanket subsidies, which are prone to elite capture (Kafle et al., 2022). There is currently an updated version of this policy that has replaced the 2016 version. The 2022 Renewable Energy Subsidy Policy is mostly similar to its predecessor, with the provision for a 60% blanket subsidy remaining constant. There is currently, however, a 90% subsidy on solar drinking water projects managed by local agencies and consumer groups, as opposed to the 60% previously granted to the community or private sector. Both strategies aim to slowly phase out the subsidy and promote loans for renewable technology. There are no new considerations of gender in the policy.

According to the existing 2016 Renewable Energy Subsidy Delivery Mechanism, while there is interest in forming community groups to access energy, inclusivity parameters are missing when conceptualizing the roles of local institutions for community solar projects. The group members listed in Article 5.2.1 of the Subsidy Delivery Mechanism [AEPC (Alternative Energy Promotion Center), 2016a], for example, would also need to own irrigable lands and have proof of said land ownership, which effectively eliminates the participation of landless farmers. As a companion act of the 2016 Renewable Energy Subsidy Policy (AEPC, 2016b), it reinforces the understanding that technology access is impacted by lack of financial support alone.

The 2013 National Energy Strategy [WECS (Water and Energy Commission Secretariat), 2013] overall scores well on at least 3 of the 5 indicators (1.1, Agency—equitable access, 2.1: Agency—address systemic barriers; and 3.1: Structure—equality, justice, and participation). It recognizes the need for better energy access and options to reduce the drudgery, hardship, and health challenges (e.g., indoor air pollution) associated with using firewood faced by rural women and children. The strategy recognizes the absence of women and minority groups such as Dalits in the decision-making structures of the grassroots energy institutions, causing a gap in ownership by these groups. It also highlights the under-representation of women professionals in the energy sector institutions and decision-making [WECS (Water and Energy Commission Secretariat), 2013]. The actions specified in the strategy are, however, limited to the 'instrumental approach' to GESI, offering two interventions such as the provision of training opportunities for the poor population and participation of women in planning, management, and development of new RETs. Both are devoid of an intersectional lens and do not



specify GESI measures for achieving these objectives. The Rural Energy Policy 2006 [MoE (Ministry of Environment), 2006] outlines three main objectives—increasing cost-effective clean energy access, increasing productivity and employment, and improving the living standards of people. Nonetheless, it lacks explicit objectives in addressing GESI concerns. Similarly, the 2018 National Energy Efficiency Strategy [MoEWRI (Ministry of Energy, Water Resources and Irrigation), 2018a] is GESI-unaware, lacking any reference to gender and equity (see Annex 6 for details).

### 4.3 GESI considerations in agriculture and food policies in Bangladesh and Nepal

Compared to water and energy policies, the agricultural policies reviewed are observed to be relatively progressive, where Nepal’s agriculture policies score 2, while Bangladesh scores 1 (see Figure 6). In the case of Bangladesh, gender consideration in the national agriculture policies (NAPs) has evolved toward being gender-aware over the past two decades. While the progression is visible in indicators 1.1 (Agency: equitable access), 2.1 (Relations: inclusion), and 3.1 (Structure: equality, justice, and participation), the policies are silent on indicators 1.2 (Agency: address systemic barriers) and 3.2 (Structure: knowledge and capacity), i.e., working through systemic barriers and integrating GESI in planning, monitoring, evaluation, and learning (PMEL).

In Bangladesh, women’s participation in the three policies that we reviewed, 1999, 2013, and 2018 National Agriculture Policy (NAP) is predominantly limited to post-harvest activities (e.g., agro-processing, storage, agro-business) and activities such as seed production and preservation, nursery, and beekeeping (see Annex 7). Women’s participation is also envisioned for vegetable and homestead gardens. These provisions do not recognize women’s roles in agricultural value chains, decision-making, and financial services. Second, a noticeable difference in NAPs between 1999 and 2013 is the inclusion of new categories of farmers, such as landless, marginal, small, medium, and large farmers, with particular emphasis on women and youth in the 2013 NAP (MoA, 2013), which was absent in the first NAP of 1999 [MoA (Ministry of Agriculture), 1999]. However, the 2013 NAP remains silent on other socioeconomic differences between women and men, which is a barrier to gender equality outcomes (Clement et al., 2019). Third, the 2018 NAP (MoA, 2018) has dedicated sections on women empowerment and youth in

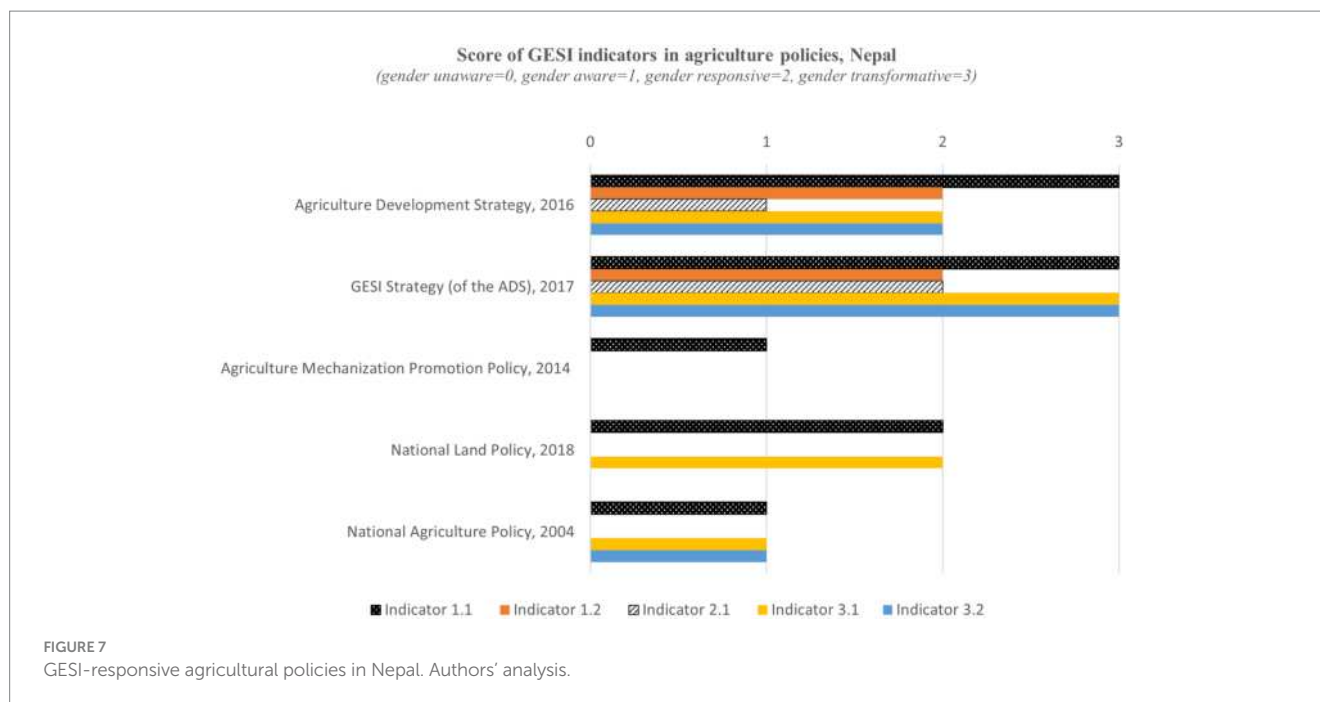
agriculture. It explicitly focuses on agricultural cooperative models to achieve food security and economic growth as well as mandatory participation of women in the local government, sub-district, district, and national agricultural credit committees. However, a strategy to understand and challenge social norms, gender, and social discrimination related to access to and control over agricultural inputs, including formal credits, skills, and technologies, is observed to be missing. Overall, the agricultural policies see gender equality and women empowerment as something to be achieved at the grassroots level, without due consideration and strategies to challenge gendered power relations at the household, community, and organizational level and increase women’s say in agriculture-related decision-making and activities.

Agricultural development policies in Nepal that we reviewed are GESI-responsive, with an overall score of 1.4 in the gender continuum (see Figure 7). The Agriculture Development Strategy (ADS) 2015–2035 and its associated 2017 GESI Strategy secured a high score under our methodology. International actors have supported the preparation of ADS (MoAD, 2016, p. 1), while UN Women supported the GESI strategy as part of the ADS framework (MoAD, 2016, p. 79). This could be one of the reasons why gender is highly reflected in these policies (see Annex 8).

The ADS is gender-responsive and scores 2 on all domains of the gender-transformative indicators, except 1.2 (Agency: address systemic barriers), where it scores 1. The policy acknowledges poverty, exclusion, food security, and gender issues in Nepal and details GESI-specific activities in different indicators (see Figure 7). Further, it has an inbuilt overall GESI component as part of its output 1.5 (Mechanisms Established for GESI). However, it lacks strategies to challenge social norms and power relations (indicator 1.2: Agency—address systemic barriers). The GESI Strategy (2017) for the Agriculture Development Strategy, as the name suggests, is a GESI-responsive document and scores above 2 across all indicators. Developed by UN WOMEN, it offers strategies for gender-transformative changes, e.g., the inclusion of GESI courses in agricultural training, equitable access to and control over resources and technologies by women and disadvantaged groups, and building technical capacity for women farmers and smallholder farmers. The GESI strategy recognizes women and smallholders as indispensable to Nepalese agriculture while acknowledging their marginalization from productive resources and assets. In fact, it specifies parameters within the agency (skills, knowledge, self-esteem, aspirations), structure (laws, policies, norms, institutional practices), and relations

Indicators of gender transformative change provisions in agriculture policies	Bangladesh			Nepal				
	FS1	FS2	FS3	FS1	FS2	FS3	FS4	FS5
1.1: Agency- equitable access to resources	Light	Light	Light	Light	Light	Light	Light	Light
1.2: Agency- addressing systemic barriers	Light	Light	Light	Light	Light	Light	Light	Light
2.1: Relations - inclusion & voice	Light	Light	Light	Light	Light	Light	Light	Light
3.1: Structure - equality, justice and participation	Light	Light	Light	Light	Light	Light	Light	Light
3.2: Structure- GESI knowledge and learning	Light	Light	Light	Light	Light	Light	Light	Light

FIGURE 6  
GESI provisions in agriculture policies, Bangladesh and Nepal. Light to darker shades of black color denote the extent of GESI consideration in the agriculture policies of Bangladesh and Nepal. The gender continuum scale ranges from gender-unaware (light back-0), gender-aware (1), gender-responsive (2), and gender-transformative (dark black-3).



(power dynamics within households) to enable empowerment (MoAD, 2017, p. 7). The policy proposes solutions such as having 33% women technicians recruited for the 'One Municipality, One Rural Technician' program.

The 2004 National Agriculture Policy [MoAD (Ministry of Agriculture Development), 2004] is gender-aware with the provision of 50% women's inclusion in agricultural programs and training. The policy has a dedicated section on notable priorities for smallholders, Dalits, and marginal farmers in accessing land, loans, and irrigation infrastructure. It also calls for the provision of land tax exemption, safety nets to cope with extreme weather events, and agro-forestry promotion targeted at them [MoAD (Ministry of Agriculture Development), 2004, p. 5–6].

The 2014 Agriculture Mechanization Promotion Policy (MoAD, 2014) scores poorly on the gender continuum across almost all indicators. Apart from promoting environmental and women-friendly agricultural mechanization and equipment to address the drudgery of women's work (Objective 3), there is no other gender interest reflected in the document (MoAD, 2014).

Robust GESI awareness, on the other hand, is reflected in the 2018 National Land Policy. It scores 2 on indicators 1.1 (Agency: equitable access) and 3.1 (Structure: equality, justice, and participation) related to ameliorating the access for women, the landless, tenants, and the marginalized groups, possessing a dedicated vision to make land access equitable for women. The measures provisioned to achieve women's access and ownership of land include some exemption in registration tax when land is registered in women's name and a minimum fee when land is registered in the name of the spouse [MoLMCPR (Ministry of Land Management, Cooperative and Poverty Reduction), 2018, p. 13–14]. The Policy further details low-interest loans for landless and smallholder farmers for purchasing or leasing agricultural lands for farming [MoLMCPR (Ministry of Land Management, Cooperative and Poverty Reduction), 2018]. These gender- and social-responsive land policies—in addition to the Constitutional provisions of offering support to women—can be used as value propositions for additional discounts to women farmers on

SIP subsidy, given that the land is transferred to their names (Mukherji et al., 2017).

#### 4.4 GESI considerations in SIP financing policies in Bangladesh and Nepal

There is no separate SIP subsidy policy in Bangladesh, despite SIP installations effectively being supported by various types of grants and subsidies. For example, with the support of development partners, national energy authorities such as BREB, BMDA, and Rural Development Authority (RDA) and financial agencies such as IDCOL are implementing different modalities for SIP financing. However, the modalities are not targeted at women farmers specifically, although some of the models (e.g., BMDA) do target small and marginal farmers. SIP financing models include (i) the 'fee for water' service model—the dominant model of IDCOL and (ii) the 'ownership' model that includes individuals and groups of farmers as a target group of SIPs—the dominant models of BREB, BMDA, and BWDB. Under the 'fee for service' model, IDCOL provides 50% of the total SIP cost to intermediaries (NGOs, private sector, also known as sponsors), 35% is financed by IDCOL as a loan, and the sponsor makes a down payment of the remaining 15%. This loan is supposed to be repaid within 10 years at 6% interest. In such a case, the sponsor owns and operates the SIP. They supply water to small-, medium- and large-sized land-holding farmers for fees such as US\$ 52/ha<sup>3</sup> during the Boro rice season. While SIPs are owned by private companies and NGOs, there is no provision for individual ownership; a study shows that at least a third of those served by these SIPs are sharecroppers and marginal farmers (Mitra et al., 2021).

Under the group ownership model, a group of farmers—either self-organized or through irrigation committees—invest, own, and operate the SIP. Government departments such as BREB, BMDA, BADC, and RDA provide financial assistance to these groups for procuring the SIP equipment. The model prioritizes small and marginalized farmers who do not have the capacity to invest, and therefore, most of the group ownership models operate under a 100%

grant basis, except under BADC, where farmers are responsible for 35% of the total cost. As part of the individual ownership model implemented by BREB, individual farmers get 55% of the total cost as a grant from the Asian Development Bank and pay 45% (of which 10% is upfront payment), while the rest is a loan to be repaid over 10 years. The implementation of all such models is at present at an early stage; actual participation or target groups, as well as the effects, are not well understood (Mitra et al., 2021).

Nepal has a SIP subsidy policy with a 60% subsidy or grant to individual farmers. The SIP recipient farmers must bear 40% of the cost; in some communities, local governments provided additional subsidies, in effect making SIPs virtually free for farmers (Kafle et al., 2022). Despite the subsidy policy provision, this cost remains relatively high for women and disadvantaged groups, as the maximum retail price for even a 1 HP pump stood at NPR 250,407 (approx. USD\$ 2,500) in 2020 (Kafle et al., 2022).

In Nepal, the AEPC, which is the nodal agency, prioritized granting SIPs to farmers with smaller land holdings, but the applicant pool itself was not very diverse (Kafle et al., 2022). This was likely due to the process being private sector-led; the information may not have reached the small, marginal, and women farmers. SIP financing, like most other development interventions, suffers from an ‘elite-capture’ problem where the smallholders and women farmers rarely know about SIPs and the application processes, despite the AEPC preferring women applicants for granting the SIPs. Common prerequisites such as the need to submit a copy of the land certificate, citizenship, and recommendations from local governments when applying for SIP subsidy are also factors that exclude women, tenants, and marginal farmers from applying for SIP subsidy. Further, tenant farmers relying on oral contracts are rendered self-excluded in the criteria (Sugden, 2014). Table 2 summarizes the strengths and weaknesses of the various financing modalities from GESI perspectives.

TABLE 2 Strengths and challenges of SIP financing models from GESI perspectives.

SIP financing models	Characteristics	Strengths	Challenges
Subsidy or grant model	A certain percentage is given as a subsidy or grant for the SIP technology, and the rest is financed by farmers. An individual farmer or a group of farmers can own the SIP in this model (Mitra et al., 2021).	The subsidy allows greater access to smallholder farmers and disadvantaged groups to use the technology. It is also useful, particularly when promoting SIP on the ground for greater uptake (Khadka et al., 2021a). Women farmers can benefit from it if the subsidy or grant is targeted at them with affirmative policy provisions on subsidy and subsidy delivery mechanisms. It facilitates the multiple-use water services meeting the water needs for irrigation, drinking, livestock, health, homestead production, etc.	Subsidy often suffers from elite capture and may not reach intended marginalized groups (Kafle et al., 2022) because of their limited social networks. The current subsidy on SIPs deployed by AEPC also mandates land ownership papers to be eligible for the subsidy. Hence, policy advocacy is required to make the subsidy criteria women-friendly. Men and advantaged groups might influence decisions over SIP operation and water allocation if the SIP interventions are not implemented in a GESI-responsive manner. Women, tenants, and marginalized farmers might not get the services unless subsidy policies and subsidy delivery mechanisms favor them.
Rent-to-own model	Renters pay a fixed monthly or quarterly fee to rent the pump until all cost is cleared, after which the renter owns the equipment.	There is no up-front cost for farmers, suggesting that smallholders would also be able to rent the technology. Farmers are also able to access O&M services from the private vendor (Shrestha and Uprety, 2021). Women could benefit from the model to access water for domestic and productive uses in homesteads and small plots that they have control over.	Rental costs may still be high, and having to pay for them over a long time may discourage smallholders, especially when pumps mostly have only seasonal requirements. No or limited access to extension services for women could undermine their ability to effectively use SIPs for productive purposes.
Grant-loan	Combines a certain percentage of grant or subsidy added to a loan; there may also be some small upfront equity amount to be borne by the farmer (Shrestha and Uprety, 2021).	It is useful for farmers who would otherwise not be able to afford the upfront cost of the technology. The model can be customized based on farmers' profiles. With this model, a SIP can be accessible for women and tenant farmers with low-interest rate loan provisions by development banks with witnesses either from local government or agricultural cooperatives.	Farmers could be adversely affected if loan repayment schemes are not flexible. Banks might not be willing to provide women and tenant farmers loans with the guarantee of cooperatives due to a fear of the repayment ability of the latter.
Solar irrigation service provider (Pump rental model)	An entrepreneur owns, operates, and maintains a SIP and provides irrigation water services to farmers for a fee. The model can be considered as a ‘fee for service model’ (Mitra et al., 2021). Pump rental markets are found in Nepal (Terai) and Bangladesh.	Typically, it involves farmers renting equipment based on per hour of pumping (Urfels et al., 2020). Greater benefit for smallholders who would then be able to access water without having to own the pump. With the help of low-cost loans, partial grants, or financial incentives, women can be developed as water entrepreneurs.	Pumping timelines could overlap among farmers and cause delays in accessing the equipment. There could also be liquidity delays when farmers do not have the cash upfront to pay for the rental (Urfels et al., 2020). Structural barriers, unless irrigation or energy programs address them, disable women to be local water entrepreneurs.

Authors' compilation.

## 5 Discussion

Our main conclusion suggests that WEF sector policies in Bangladesh and Nepal are GESI-aware but lack GESI-transformative strategies despite gender-transformative change being embedded in the highest laws of both countries (i.e., their Constitutions) (Khadka et al., 2021b). Our review of WEF sectoral policies in Bangladesh and Nepal reveals that, except for energy policies in Bangladesh, most other WEF policies are gender-aware, with an average score of 0.6 in the gender continuum. Agriculture policies in both countries are relatively progressive and score high across the GESI indicators. Yet, they lack provisions for tackling unequal power relations and improving GESI-transformative knowledge and capacity to achieve positive development outcomes. Agriculture mammoths, such as the Agriculture Development Strategy, have been developed in consultation with several development partners, as noted previously, therefore showcasing the language of gender and social inclusion very well. UN Women facilitated the accompanying GESI strategy of the ADS. These policies are also more aware of the changing social reality and the need to accommodate the growing women workforce in agriculture, compared to the technology-focused energy policies. Overall, agriculture policies are aware that they are dealing with people and their varied needs, while energy policies focus on infrastructure and technology, often seeing people as secondary.

Gender policy failure is often linked to how language is used in the policy itself. Guijt and Kaul Shah (1998) found that generalization and using slogans instead of highlighting the complexity of an issue often resulted in policy failure. For instance, ‘gender’ and ‘community’ continue to appear in conjunction in policies, and decision-making (poorly defined or not defined at all) is often centered on this community of receivers of ‘action plans.’ Social norms, hierarchies, and forms of differentiation are barely touched upon, if at all (Guijt and Kaul Shah, 1998), resulting in a basic approach to gender and, ultimately, policy failure. Slogans, which are again popular in gender and development, are useful in selling ideas and imagery in simplistic language (Cornwall et al., 2008), which would likely ensure greater

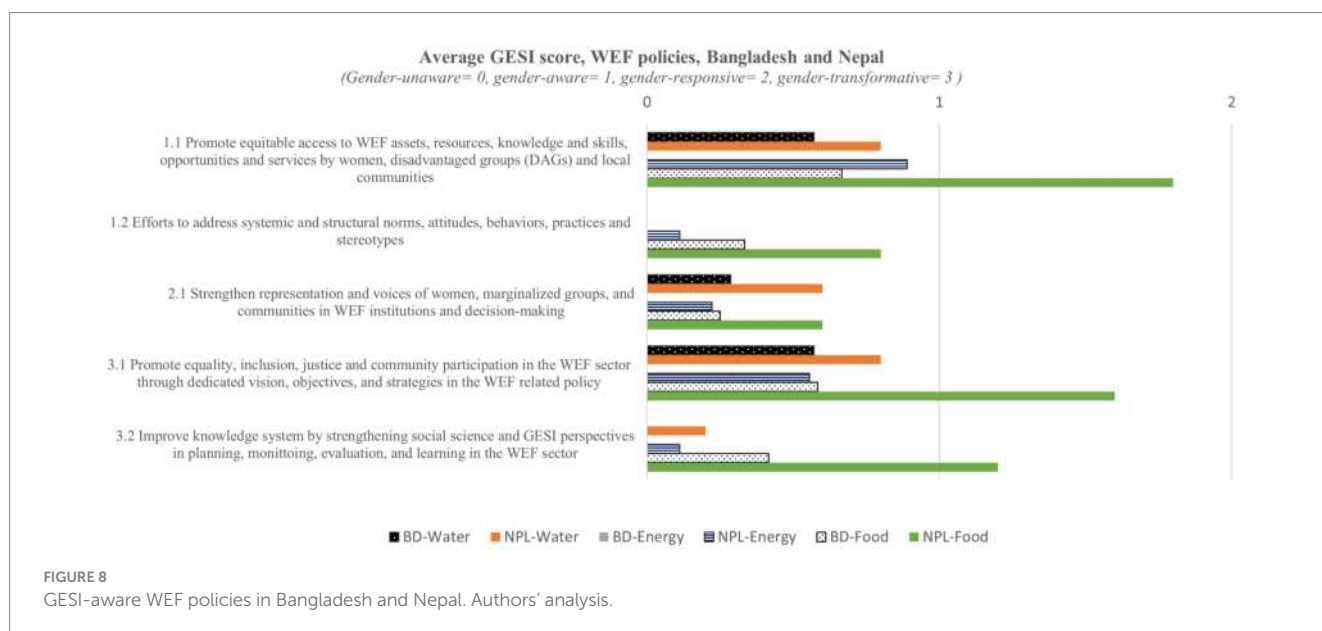
buy-in from the larger development industry and the receivers of the message. Here again, ideas are reduced from their complexity in order to soften problems and motivate some potential action (Cornwall et al., 2008). This ultimately reduces the scope and impact of policy. This problem is also pertinent in the way policies in the WEF sector are built in Bangladesh and Nepal.

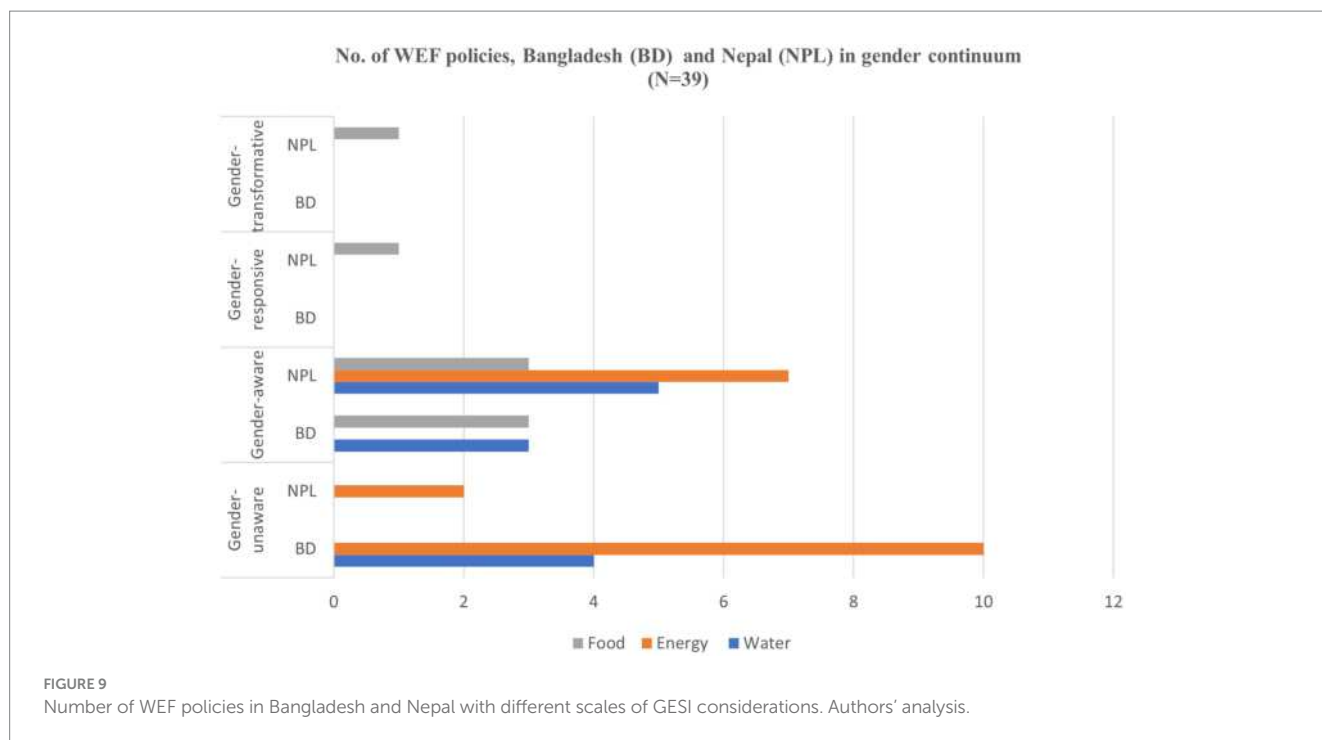
Both countries have gender-transformative constitutions and national development policy frameworks committed to gender equality and women’s advancement in policies in all sectors and institutions [DoE (Department of Environment), 2016; Khadka et al., 2021a]. Yet, progressive provisions do not entirely translate to the WEF sector policies.

Over 54% of the 39 WEF policies reviewed are ‘gender-aware,’ with limited provisions on GESI perspectives and specific strategies to empower women and marginalized groups to achieve sustainable WEF management. While 41% of WEF policies are gender-unaware, only 3% are observed to be gender-responsive and gender-transformative oriented, respectively (see Figure 8).

GESI-understanding of the reviewed WEF sectoral policies appeared to be varying. While Bangladesh’s water policies have some provisions to ensure access to resources, opportunities, and representation by women, Nepal’s water policies lack this dimension, except for the ones centered on irrigation. Similarly, Nepal’s energy policies are gender-aware in comparison to the gender-unaware energy policies of Bangladesh (see Figure 9).

The policy narratives for addressing issues of sustainability, inclusion, inequalities, poverty, and WEF resource access remain centrally focused on physical, economic, and technological aspects of the resources (e.g., efficiency, training for women, subsidy for farmers, modern energy technology). Even if a few WEF policies do include some GESI provisions, these policies are limited to addressing immediate needs (e.g., training and representation in irrigation user groups or energy user groups) of women and disadvantaged groups. GESI is mostly defined as ‘women’ alone and as something that must be achieved at the grassroots (refer to Supplementary material for the narratives in WEF policies we reviewed). Research by Buchy and





Shakya (2023) also confirms this finding. Overall, the policies are weak to conceptualize GESI as a complex and political approach to tackle unequal power relations, discrimination, and inequalities persisting in the social, political, and institutional systems of Bangladesh and Nepal (Bhusan Udas, 2014; Karim et al., 2018).

The policies also display limited interests in conceptualizing and challenging gender, caste, ethnicity, and class-based social relationships that influence access to and control over WEF resources, including SIP technologies, information and knowledge, and decision-making by women and men of different identities. The WEF policies have limited focus on generating and promoting social science data, knowledge, information, and GESI capacity in the WEF sector actors.

The way gender is addressed in policies is mostly relegated to a narrow economic or financial approach; for instance, the understanding is that technology is not being adopted due to financial reasons alone. Therefore, the response to this is also financial—using subsidies or grants. In addition to this, a blanket approach is often used. For instance, the 60% subsidy on SIPs, which, when non-targeted, fails to address real access issues for the most marginal. This is understandable as it is easier for governments to award money and technology than to attempt and change gender norms and relations. However, if there is no understanding of what underpins the adoption of technology (rights, power), then technology and subsidy deployment will have little effect.

Our review concluded that WEF policies do not promote gender-transformative change in the WEF sectors in the study areas. Most policies reflect an awareness of the need to consider gender, equity, and inclusion in water, energy, and agriculture development, but they offer few, if any, strategies and actions specifically toward realizing GESI objectives. The WEF policies, while reflecting awareness of GESI and social equity, are unable to challenge structural barriers such as existing policies, social norms of gender, and unequal power relations hindering the participation of women and marginalized groups in and benefitting from WEF resources, including SIP technologies and related governance. This policy gap in the WEF sectors could be an opportunity for science-policy-action dialogues at various scales to generate 'political action' among policy actors and decision-makers on gender- and social-transformative WEF system interventions.

The study suggests the inclusion of social science and GESI perspectives in policymaking, implementation, and impact assessment processes of the WEF sectors in South Asia. This is essential for ensuring gender transformative perspectives and provisions in the policy and regulatory frameworks, including financial assistance and subsidy mechanisms of the sectors (Rai Paudyal et al., 2019; Patnaik and Jha, 2020). Policy and public awareness are vital in shaping subsidy policies related to WEF, including solar irrigation that will be in favor of women, smallholders, and tenant farmers.

## 6 Conclusion and recommendations

This study aimed to explore the efforts of governments in Bangladesh and Nepal to understand and integrate gender equality and social inclusion perspectives and measures in WEF sector

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

MK contributed to the conception, design, and analysis of the study. GS and LU reviewed and analyzed policies from Bangladesh and Nepal, respectively. AMu reviewed and provided comments for improving the first and subsequent drafts. AMi supported the review of sections in policies from Bangladesh. SS reviewed word counts, updated policies, and revised and proofread the document. All authors contributed to the article and approved the submitted version.

## Funding

The Swiss Agency for Development and Cooperation (SDC)-funded project titled Solar Irrigation for Agricultural Resilience, South Asia (SoLAR-SA) supported this research.

## Acknowledgments

International Water Management Institute (IWMI) researchers carried out the water, energy, and food/agriculture sector policies of Bangladesh and Nepal. The contents of this publication are the sole responsibility of the authors and do not necessarily reflect the views of

## References

- ADB (2020). *Gender equality and social inclusion diagnostic of selected sectors in Nepal*. Kathmandu, Nepal: ADB.
- ADB (Asian Development Bank) (2017). *Bangladesh: Gender equality diagnostic of selected sectors*. Manila: ADB. Available at: <https://www.adb.org/documents/bangladesh-gender-equality-diagnostic-selected-sectors>
- AEPC (2016b). *Renewable energy subsidy policy, 2073*. Kathmandu, Nepal: Alternative energy promotion center (AEPC), Ministry of Population and Environment (MoPE), Government of Nepal.
- AEPC (2017). *National renewable energy framework. Approved by 71st AEPC Board Meeting dated 2074/07/16 (2nd November 2017)*. Kathmandu, Nepal: Alternative Energy Promotion Center.
- AEPC (Alternative Energy Promotion Center) (2016a). *Renewable energy subsidy delivery mechanism, 2073*. Kathmandu, Nepal: AEPC, Ministry of Population and Environment
- Agarwal, B. (1994). *A field of one's own: Gender and land rights in South Asia*. Cambridge, UK: Cambridge University Press.
- Bhatt, R. P. (2017). Chapter five: hydropower development in Nepal - climate change, impacts and implications, *Renewable hydropower technologies*, (Ed.) B. I. Ismail, (InTech).
- Bhusan Udas, P. (2014). *Gendered participation in water Management in Nepal Discourses, policies and practices in the irrigation and drinking water sectors (PhD Thesis)*. Wageningen, the Netherlands: Wageningen University.
- Buchy, M., and Shakya, S. (2023). Understanding the gap between the gender equality and social inclusion policy and implementation in the energy sector: The case of Nepal. *Energy for Sustainable Development* 76, 1–9. doi: 10.1016/j.esd.2023.101297
- BPC (Bangladesh Planning Commission) (2020). *Making vision 2041 a reality: perspective plan of Bangladesh*. Dhaka: Planning commission. General economics division (GED), Ministry of Planning. Government of the People's republic of Bangladesh. Available at: <http://oldweb.lged.gov.bd/uploadeddocument/unitpublication/1/1049/vision%202021-2041.pdf>
- CIAT (International Center for Tropical Agriculture) and World Bank (2017). *Climate-smart agriculture in Bangladesh. CSA country profiles for Asia series*. Washington, D.C., USA: CIAT; World Bank, 28
- Clancy, J. S., and Mohlakoana, N. (2020). Gender audits: an approach to engendering energy policy in Nepal, Kenya and Senegal. *Energy Res. Soc. Sci.* 62:101378. doi: 10.1016/j.erss.2019.101378
- SDC or IWMI. We thank the reviewers. All remaining errors belong to the authors.
- Clement, F., Harcourt, W. J., Joshi, D., and Sato, C. (2019). Feminist political ecologies of the commons and commoning. *Int. J. Commons* 13, 1–15. doi: 10.18352/ijc.972
- Cornwall, A., Harrison, E., and Whitehead, A. (2008) *Gender myths and feminist fables: the struggle for interpretive power in gender and development*, Wiley Blackwell, Oxford.
- DoE (Department of Environment) (2016). *Gender policy*. Dhaka, Bangladesh: DoE, Ministry of Environment and Forests, Government of Bangladesh.
- DWRI (Department of Water Resources and Irrigation) (2019). *Irrigation master plan 2019*. Kathmandu, Nepal: DWRI, Ministry of Energy, Water Resources, and Irrigation, Government of Nepal. Available at: <https://dwri.gov.np/files/document/20210222080845.pdf>
- Elmhirst, R., and Resurreccion, B. P. (2008). Gender, environment and natural resource management: new dimensions, new debates, R. Elmhirst and B. P. Resurreccion, (Eds.) *Gender and natural resources: Livelihood, mobility and interventions*. London, UK: Routledge.
- FAO (Food and Agriculture Organization) (2019). *Country gender assessment of agriculture and the rural sector in Nepal*. Kathmandu, Nepal: FAO.
- FAO. (2023). *The status of women in agrifood systems*. Rome: Food and Agriculture Organization of the United Nations
- GC, R. K. (2020). *Exploring the potential of multiple use water Services for Smallholder Farmers in the Western Middle Hills of Nepal (PhD Dissertation)* Virginia Polytechnic Institute and State University.
- GoB (Government of the People's Republic of Bangladesh) (2021). *Nationally determined contributions (NDCs), 2021*. Dhaka, Bangladesh: GoB.
- GoI (Government of India) (2022). *India's intended nationally determined contribution: Working towards climate justice*. Delhi: Ministry of Environment, Forest and Climate Change, (GoI).
- GoN (2020b). *Second nationally determined contribution (NDC)*. Kathmandu, Nepal: GoN.
- GoN (2020c). *Draft water resources (management and regulation) bill, B.S. 2077*. Kathmandu, Nepal: GoN.
- GoN (2022). *Water supply and sanitation act, 2022 (Nepali)*. Kathmandu, Nepal: GoN.
- GoN (Government of Nepal) (2020a). *Draft electricity bill, 2020*. Kathmandu, Nepal: GoN.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2023.1159867/full#supplementary-material>

- Gonda, N. (2016). Climate change, “technology” and gender: “adapting women” to climate change with cooking stoves and water reservoirs. *Gen. Technol. Dev.* 20, 149–168. doi: 10.1177/0971852416639786
- Government of Bangladesh. (1999). National Water Policy, 1999, Ministry of Water Resources, Government of the People's Republic of Bangladesh. <http://nda.erd.gov.bd/en/c/publication/national-water-policy-1999>
- Government of Bangladesh. (2001). National Water Management Plan, 2004. Volume 2. Government of the People's Republic of Bangladesh. Ministry of Water Resources. Dhaka, Bangladesh: Water Resources Planning Organisation. Approved by National Water Resources Council. [https://old.warpo.gov.bd/nwmp/nwmp\\_vol2.pdf](https://old.warpo.gov.bd/nwmp/nwmp_vol2.pdf)
- Government of Bangladesh. (2003). *The Bangladesh Energy Regulatory Commission Act, 2003*. Bangladesh Gazette, Extraordinary, Bangladesh, Dhaka: Government of the People's Republic of Bangladesh. [https://climate-laws.org/document/the-bangladesh-energy-regulatory-commission-berc-act-2003\\_191f](https://climate-laws.org/document/the-bangladesh-energy-regulatory-commission-berc-act-2003_191f)
- Government of Bangladesh. (2004). Private Sector Power Generation Policy, 1996 (revised in 2004), Ministry of Energy and Mineral Resources, Government of the People's Republic of Bangladesh. <https://mccibd.org/wp-content/uploads/2021/09/Private-Sector-Power-Generation-Policy-of-Bangladesh-1996-and-Revised-2004.pdf>
- Guijt, I., and Kaul Shah, M. (1998) *The myth of community, gender issues in participatory development*. Intermediate Technology Publications, London.
- Hillenbrand, E., Karim, N., Mohanraj, P., and Wu, D. (2015). Measuring gender transformative change: A review of literature and promising practices. CARE USA. Working Paper. Available at: [https://www.care.org/wp-content/uploads/2020/05/working\\_paper\\_aas\\_gt\\_change\\_measurement\\_fa\\_lowres.pdf](https://www.care.org/wp-content/uploads/2020/05/working_paper_aas_gt_change_measurement_fa_lowres.pdf)
- Import Duty Exemptions for Solar and Wind of Bangladesh (Statutory Regulatory Order). (2004). <https://www.iea.org/policies/6128-import-duty-exemptions-for-solar-and-wind-of-bangladesh-statutory-regulatory-order>.
- Jaim, W. M. H., and Hossain, M. (2011). Women's participation in agriculture in Bangladesh: trends, determinants and impact on livelihoods. Paper presented in the pre-conference event on “dynamics of rural livelihoods and poverty in South Asia”, 7th Asian Society of Agricultural Economists (ASAE) international conference Hanoi, Vietnam, October 13–15, 2011.
- Joshi, D. (2011). Caste, gender and the rhetoric of reform in India's drinking water sector. *Econ. Polit. Wkly.* 46, 56–63.
- Kabeer, N. (1999). From feminist insights to an analytical framework. An institutional perspective on gender inequality, N. Kabeer and R. Subrahmanian (Eds.) *Institutions, relations and outcomes*. New Delhi: Kali for Women.
- Kabeer, N. (2005). Gender equality and women's empowerment: a critical analysis of the third millennium development goal. *Gen. Dev.* 13, 13–24. doi: 10.1080/13552070512331332273
- Kafle, K., Uprety, L., Shrestha, G., Pandey, V., and Mukherji, A. (2022). *Solarizing agriculture? Barriers and determinants of solar irrigation adoption in Nepal*. SSRN
- Karim, R., Lindberg, L., Wamala, S., and Emmelin, M. (2018). Men's perceptions of Women's participation in development initiatives in rural Bangladesh. *Am. J. Mens Health* 12, 398–410. doi: 10.1177/1557988317735
- KfW (2006). *Achieving gender equality outcomes in priority sectors for German financial cooperation with Bangladesh. Bangladesh Gender Profile. Discussion Paper*, 42.
- Khadka, M., Uprety, L., Shrestha, G., Minh, T. T., Nepal, S., Raut, M., et al. (2021a). *Understanding barriers and opportunities for scaling sustainable and inclusive farmer-led irrigation development in Nepal*. Kathmandu, Nepal: The Cereal Systems Initiative for South Asia (CSISA).
- Khadka, M., Uprety, L., Shrestha, G., Mitra, A., and Mukherji, A. (2021b). *Do water, energy and food Nexus policies enable gender transformative changes? Evidence from Bangladesh and Nepal. A draft report*. Kathmandu, Nepal: IWMI
- Kooijman-van Dijk, A. (2020). ENERGIAs gender and energy research Programme: findings and experience from research for policy. A. Pueyo. and M. Maestre (Eds.) *Gender and energy: Opportunities for all*. IDS Bulletin, 51
- Leach, M., Mehta, L., and Prabhakaran, P. (2016). Sustainable development: a gendered pathways approach. Melisa L (Ed.) *Gender equality and sustainable development*. London and New York: Routledge.
- Leder, S., Clement, F., and Karki, E. (2019). Reframing women's empowerment in water security programmes in Western Nepal. C. Sweetman and L. Medland (Eds.) *Gender and water, sanitation and hygiene*. Practical Action Publishing.
- Malhotra, M. (2021). *The disconnect between gender-transformative language and action in Global Health. Think piece series 2021*. Tokyo, Japan: Gender and Energy Health Hub.
- Manjula, M. (2021). “Gender gap in agriculture and the ‘south Asian enigma’,” ORF issue brief no. 498. New Delhi, India: Observer Research Foundation.
- McDougall, C., Badstue, L., Mulema, A., Fischer, G., Najjar, D., Pyburn, R. et al. (2021). Towards structural change: gender transformative approaches. In ; and R. Pyburn, and *Advancing gender equality through agricultural and environmental research: Past, present and future*. Washington DC: International Food Policy Research Institute.
- Mercy Corps (2022). *Bhakar's GESI first approach overview*. Portland, USA: Mercy Corps. 15.
- Minh, T. T., Zwart, S., Appoh, R., and Schmitter, P. (2021). *Analyzing the enabling environment to enhance the scaling of irrigation and water management technologies: a tool for implementers*. Colombo, Sri Lanka: IWMI. 18p
- Mitra, A., Alam, M. F., and Yashodha, Y. (2021). *Situational analysis report prepared as part of SDC SoLAR project, September 2021. SoLAR-SA project*. Delhi, India: IWMI
- MoA (2013). *National Agriculture Policy 2013*. Dhaka, Bangladesh: MoA, Government of People's Republic of Bangladesh.
- MoA (2017). *Integrated Micro-irrigation policy 2017*. Dhaka, Bangladesh: MoA, Government of the People's Republic of Bangladesh.
- MoA (2018). *National agriculture policy 2018*. Dhaka, Bangladesh: MoA, Government of the People's Republic of Bangladesh.
- MoA (Ministry of Agriculture) (1999). *National agriculture policy, 1999*. Dhaka, Bangladesh: MoA, Government of People's Republic of Bangladesh.
- MoAD (2014). *Agricultural mechanization promotion policy 2014*. Kathmandu, Nepal: MoAD, Government of Nepal.
- MoAD (2016). *Agriculture development strategy, 2015–2035. Part I*. Kathmandu, Nepal: MoAD.
- MoAD (2017). *Gender equality and social inclusion*. Kathmandu, Nepal: MoAD.
- MoAD (Ministry of Agriculture Development) (2004). *National Agriculture Policy*. Kathmandu, Nepal: MoAD.
- MoE (Ministry of Environment) (2006). *Rural energy policy, 2006*. Kathmandu, Nepal: MoE, Government of Nepal.
- MoEWRI (Ministry of Energy, Water Resources and Irrigation) (2018a). *National Energy Efficiency Strategy 2075*. Kathmandu, Nepal: MoEWRI.
- MoEWRI (2018b). *White paper on the status and future roadmap of energy, water resources and irrigation sector, 2018 (2075)*. Kathmandu, Nepal: MoEWRI.
- MoEWRI (2020). *National Water Resources Policy: 2077*. Kathmandu, Nepal: MoEWRI, Government of Nepal.
- Mohideen, R. (2018). Energy technology innovation in South Asia implications for gender equality and social inclusion. ADB South Asia working paper series, no. 61, 2018. Available at: <https://www.adb.org/sites/default/files/publication/463296/swp-061-energy-technology-innovation-south-asia.pdf>
- MoI (Ministry of Irrigation) (2013). *Irrigation policy*. Kathmandu, Nepal: MoI.
- MoLJPA (Ministry of Law, Justice and Parliamentary Affairs) (2012). *The sustainable and renewable energy development authority (SREDA) act, 2012. (act no. 48 of 2012)*. Dhaka, Bangladesh: Government of the People's republic of Bangladesh, MoLJPA, legislative and parliamentary affairs division
- MoLMCPR (Ministry of Land Management, Cooperative and Poverty Reduction) (2018). National Land Policy 2018. *Approved by the cabinet, government of Nepal on BS 2075.12.07 (Nepali)*. Kathmandu, Nepal: MoLMCPR
- MoPEMR (2013). *Guidelines for the implementation of solar power development program-2013*. Dhaka, Bangladesh: MoPEMR, Government of the People's Republic of Bangladesh.
- MoPEMR (Ministry of Power, Energy and Mineral Resources) (2008). *Renewable energy policy of Bangladesh*. Dhaka, Bangladesh: MoPEMR, Government of the People's Republic of Bangladesh. (Accessed December 18, 2008)
- Mukherji, A., Chowdhury, D., Fishman, R., Lamichhane, N., Khadgi, V., and Bajracharya, S. (2017). *Sustainable financial solutions for the adoption of solar powered irrigation pumps in Nepal's Terai*. Kathmandu, Nepal: ICIMOD.
- Mullinax, M., Hart, J., and Garcia, A. V. (2018). Using research for gender-transformative change: principles and practices. IDRC. Available at: <https://ajws.org/wp-content/uploads/2019/05/Gender-Transformative-Research.pdf>.
- Nightingale, A. (2006). The nature of gender: work, gender, and environment. *Environ Planning D* 24, 165–185. doi: 10.1068/d01k
- NPC (National Planning Commission) (2019). *The 15th plan, 2019–2023 and approach paper*. Kathmandu, Nepal: NPC, Government of Nepal.
- Osmani, S. R., Ahmed, A., Ahmed, T., Hossain, N., Huq, S., and Shahan, A. (2016). *Strategic review of food security and nutrition in Bangladesh*. Rome: World Food Programme. 16.
- Osunmuyiwa, O., and Ahlberg, H. (2019). Inclusiveness by design? Reviewing sustainable electricity access and entrepreneurship from a gender perspective. *Energy Research & Social Science*. 53, 145–158. doi: 10.1016/j.erss.2019.03.010
- Patnaik, S., and Jha, S. (2020). Caste, class and gender in determining access to energy: a critical review of LPG adoption in India. *Energy Res. Soc. Sci.* 67:101530. doi: 10.1016/j.erss.2020.101530
- Pederson, A., Greaves, L., and Poole, N. (2014). Gender transformative health promotion for women: a framework for action. *Health Promot. Int.* 30, 140–150. doi: 10.1093/heapro/dau083
- Quisumbing, A., Ahmed, A., Hoddinot, J., Pereira, A., and Roy, S. (2021). Designing for empowerment impact in agricultural development projects: experimental evidence from the agriculture, nutrition, and gender linkages (ANGeL) project in Bangladesh. *World Dev.* 146:105622. doi: 10.1016/j.worlddev.2021.105622

- Rahman, S. (2000). Women's employment in Bangladesh agriculture: composition, determinants and scope. *J. Rural. Stud.* 16, 497–507. doi: 10.1016/S0743-0167(00)00006-1
- Rai Paudyal, B., Chanana, N., Khatri-Chhetri, A., Sherpa, L., Kadariya, I., and Aggarwal, P. (2019). Gender integration in climate change and agricultural policies: the case of Nepal. *Front. Sustain. Food Syst.* 3:66. doi: 10.3389/fsufs.2019.00066
- Sayeed, M. S., Foster, R. E., and Rahman, M. M. (2020). Sustainable solar water pumping. *Proceedings 49th National Solar Conference: Solar 20/20. American solar energy society, 1st virtual conference, June 24, 2020.*
- Shah, T., Rajan, A., Rai, G. P., Shilp, V., and Durga, N. (2018). Solar pumps and South Asia's energy-groundwater nexus: exploring implications and reimagining its future. *Environ. Resour. Lett.* 13:AAE53F. doi: 10.1088/1748-9326/aae53f
- Shrestha, S., and Uprety, L. (2021). *Solar irrigation in Nepal. A situation analysis report.* Kathmandu, Nepal: IWMI.
- Skutsch, M. M. (1998). The gender issue in energy project planning welfare, empowerment or efficiency? *Energy Policy* 26, 945–955. doi: 10.1016/S0301-4215(98)00037-8
- SREDA (Sustainable and Renewable Energy Development Authority) (2015). Energy efficiency and conservation master plan up to 2030. Dhaka, Bangladesh: SREDA, Power Division, Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh Available at: [https://policy.asiapacificenergy.org/sites/default/files/EEC\\_Master\\_Plan\\_SREDA\\_2.pdf](https://policy.asiapacificenergy.org/sites/default/files/EEC_Master_Plan_SREDA_2.pdf)
- Sugden, F. (2014). *Landlordism, tenants and the groundwater sector: Lessons from Tarai-Madhesh, Nepal, IWMI research report 162, 33p.* Colombo, Sri Lanka: IWMI
- Sugden, F., Agarwal, B., Leder, S., Saikia, P., Raut, M., Kumar, A., et al. (2020). Experiments in farmers' collectives in eastern India and Nepal: process, benefits, and challenges. *J. Agrar. Change* 21, 90–121. doi: 10.1111/joac.12369
- Theis, S., Krupnik, T. J., Sultana, N., Rahman, S.-U., Seymour, G., and Abedin, N. (2019). *Gender and agricultural mechanization: A mixed-methods exploration of the impacts of multi-crop reaper-harvester service provision in Bangladesh IFPRI Discussion Paper 01837.* Washington, D.C., USA: The International Food Policy Research Institute (IFPRI).
- Urfels, A., McDonald, A. J., Krupnik, T. J., and van Oel, P. R. (2020). Drivers of groundwater utilization in water-limited rice production systems in Nepal. *Water Int.* 45, 39–59. doi: 10.1080/02508060.2019.1708172
- WECS (Water and Energy Commission Secretariat) (2013). *National Energy Strategy of Nepal.* Kathmandu, Nepal: WECS, Government of Nepal.
- Winther, T., Ulsrud, K., and Saini, A. (2018). Solar powered electricity access: implications for women's empowerment in rural Kenya. *Energy Res. Soc. Sci.* 44, 61–74. doi: 10.1016/j.erss.2018.04.017
- World Bank (2020). *Global Economic Prospects.* Washington, DC: World Bank, Available at: <https://openknowledge.worldbank.org/handle/10986/33748> License: CC BY 3.0 IGO.