

GESI REVIEW OF POLICY ENVIRONMENT OF SOLAR IRRIGATION PUMPS (WATER, ENERGY, AND FOOD NEXUS POLICIES) IN INDIA

Do Water, Energy and Food Nexus Policies Enable Gender Transformative Changes in India?

SaciWATERs

SHREYA CHAKRABORTY
SREENITA MONDAL

CONTENT

1. SIGNIFICANCE AND CONTEXT OF STUDY
2. OBJECTIVES AND METHODOLOGY
3. SOLAR ENERGY ROADMAP AND SIPs STATUS IN INDIA
4. GESI CONTEXT OF AGRICULTURE IN INDIA
5. NATIONAL FRAMEWORKS FOR GESI TRANSFORMATION WFE POLICIES
6. GESI IN WFE SECTOR POLICIES (CENTRAL) IN INDIA
7. GESI IN STATE-LEVEL RENEWABLE ENERGY AND SIPs SECTOR POLICIES IN INDIA
9. DISCUSSIONS: OPPORTUNITIES AND GAPS FOR GESI OUTCOMES OF WEF POLICIES, PROGRAMS
10. CONCLUSIONS: HIGHLIGHTS OF THE STUDY
11. RECOMMENDATIONS

SIGNIFICANCE AND CONTEXT OF STUDY

Solar energy has been a key component of India's renewable energy program since the 6th Five Year Plan (FYP) in 1980s. This focus on solar energy emerged from the need for extending rural electrification and regional development, particularly in marginal and backward areas in the country. Over the past decade, since the 11th Five Year Plan solar energy development has become an essential component of India's national climate change action plan, as a key strategy for replacing fossil fuel based energy sources and reducing carbon emissions (Kapoor et.al 2014)¹. In 2014 agriculture was found to be the second highest source of GHG emissions in India (19.6% of the total emissions) while the energy sector (electricity and heat generation) accounted for 49% of total emissions (USAID 2018)². 22% of total electricity and 15% of total diesel supply in India is consumed by agriculture (IEA 2015)³. Solar irrigation has thus emerged as a new focus area under India's solar development strategy that is seen as a positive intervention with multiple benefits. It simultaneously plays a role in reducing emissions from the agriculture sector, improving water availability and livelihood for farmers, and reducing burdens on coal-based production and highly subsidized supply of electricity for agriculture (Yashodha et.al 2021, Shah et.al 2018)⁴⁵.

As new policies, financial instruments, and technologies are developed to promote increased uptake of solar irrigation in India, there is an emerging opportunity to incorporate strategies to ensure social and gender inclusiveness in this initiative. Irrigation development in India has been highly disparate and gendered. This is true of both centralized large canal irrigation systems as well as the informal and spontaneous decentralized development of capital-intensive tubewell irrigation (Dubash 2002, van Koppen 1998)⁶⁷. Access to land and capital have determined this differential distribution and access to irrigation. Underlying social structures of gender, class, caste, and their intersections have interacted with technology, resource distribution, and governance to generate these disparities (Naz 2015, Sarkar 2012, Kulkarni 2016)⁸⁹¹⁰. Small and marginal farmers are highly dependent on buying water or renting pumps from large farmers for irrigation and can therefore benefit from the opportunities presented by the alternate energy source provided by solar irrigation pumps (Shah 2010, Raymond and Jain, 2018)¹¹¹². As solar irrigation in India is still at nascent stages of development and implementation, a deliberate focus on social and gender inclusion in policies recognizing and responding to these underlying social structures can be transformative in overcoming structural barriers.

Literature has documented several ways in which better access to solar irrigation can have direct and co-benefits for women. For instance, through their potential as multiple use sources, they have been used to supplement drinking water requirements for households and livestock rearing in water scarce regions and regions with low levels of rural electrification (Sambodhi and Dalberg 2018, van Koppen et.al 2018)¹³¹⁴. Use of solar pumps for domestic water purposes can reduce the water collection burdens on women and release more time for women's productive labour (IRENA 2016)¹⁵. Particular designs of solar irrigation pilot projects have improved women's incomes through its use for homestead horticulture gardens, use in collective agriculture by women's groups, and women's entrepreneurship in solar-pump rental business (Wong 2019, Sugden 2016, Shirsath 2020, Burney et.al 2017)¹⁶¹⁷¹⁸¹⁹. However, unless underlying unequal gender relations and their structural roots are addressed, these positive initiatives can end up reproducing existing hierarchies (Wong 2019, Leder et.al 2019)²⁰. The policy environment of solar irrigation needs to play an essential role in ensuring this gender-supportive environment and structural transformation.

Further, the agriculture sector contributes the majority of female workers in India (Ghosh and Ghosh 2014, Pattnaik et.al 2017, Bhattacharya and Rani 1995)²¹²²²³. Increasing male migration out of agriculture, both physically away from rural areas and sectorally to non-agricultural work, has left behind women to tend to much

of the agricultural activities. As much of this 'feminization' of India's agriculture labour has been an outcome of agrarian distress, poverty, lack of women's mobility and financial capacity (Pattnaik et.al 2017, Dewan 2016)²⁴, solar irrigation has the potential to simultaneously contribute to agricultural development (Sambodhi and Dalberg 2018) and thereby improve returns from women's labour in this sector. As India's agricultural labour becomes increasingly feminized, policies for agriculture development need to reflect women's roles and specific needs.

Women and smallholders (marginal and small farmers) predominate the agricultural labour force. Yet, unless this group's contribution to the sector is overtly recognized and targeted focus is provided to these groups, policies and benefits of schemes tend to get concentrated among or appropriated by the elite and large farmers (Hussain 2007, Koppen and Hussain 2007, Chakraborty et.al 2017, Bhattacharya and Rani 1995)^{25,26,27}. Barriers of low access to resources and capital, low education levels and access to knowledge, lack of social and physical mobility, and overlapping marginalities of caste and gender reduce the ability of women and smallholders to access and benefit from policy. Policy therefore needs to have a deliberate orientation towards responding to and removing structural and systemic barriers to ensure gender and social inclusion in development interventions.

Much of the evolving literature on solar irrigation in India has focused on financial mechanisms, comparative cost efficiency with other energy sources, technological development and energy efficiency assessments, effective institutional frameworks and policy evolution (Garg 2018, Yashodha et.al 2021, Shah et.al 2018, Agrawal and Jain 2018, Bassi 2015, KPMG 2014, Raymond and Jain 2018, Hartung and Pluschke 2018)^{28,29,30,31,32}. While social inclusion aspects have been considered in some cases and policies through financial mechanisms to incentivize and benefit small and marginal farmers (Shah et.al 2018), gender inclusion and gender analysis in solar irrigation has largely been missing from this body of literature. A gender analysis of the policy framework of solar irrigation can provide valuable insight into the potential opportunities and barriers it presents for gender transformation. Whether solar irrigation can indeed provide transformative social impacts would emanate from the larger contexts of agriculture, water, and energy nexus within which it is embedded. This study therefore analyses water, food, energy (WFE) related policies as well specific renewable energy and solar policies in India as the policy environment for solar irrigation pumps (SIPs) to assess their levels of gender awareness, responsiveness, and transformative capacity.

The report presents policy analysis at three levels – i) National planning and constitutional frameworks, ii) Central level WFE sectoral policies, iii) state level renewable energy and solar policies. The policy analysis is buttressed by insights from the gender-equity-water/agriculture/energy literature from India to identify documented aspects of inequality and structural barriers that ideally policies should acknowledge and respond to. Ultimately the goal of the study is to capture the opportunities and barriers that existing policy frameworks present for manifesting the potential of SIPs to enable gender transformative changes.

OBJECTIVES AND METHODOLOGY

The main objective of this study is to better understand the extent of consideration of GESI in national constitutions, development policy frameworks, and WEF policies and programs, including SIPs in India.

The following sets of questions will guide the policy analysis:

- What is the GESI context in agriculture development, and status of energy development, including SIPs in India?

- How has GESI been conceptualized and strategized in national development policy frameworks, and the WEF nexus sector's policies in the country? Is there a link between the national development framework and the WEF nexus sector policies in terms of GESI application?
- How have renewable energy, particularly solar energy programs considered GESI?
- What are GESI opportunities and gaps in these policies and programs?

The methodology for this analysis has been drawn from a similar study carried out for Nepal and Bangladesh (Khadka et.al 2021)³³ and therefore has not been reiterated here elaborately. In brief, the study uses a gender transformative approach (GTA) which takes a structural understanding instead of individual causalities of gender inequality and targets root causes in measures to strengthen agency and decision-making capacity of women from the household, communities, markets, and state level (Kabeer 1999, Nightingale 2005, Leach et al 2016). Aligned with this approach the analysis uses a gender continuum scale ranging from gender-blind (0) to gender-aware (1), gender-responsive (2) and gender-transformative (3) (Hillenbrand et al., 2015, Mullinax et al., 2018) as an analytical framework to assess the GESI consideration in the WEF, including SIPs policies and programs in India.

Khadka et.al 2021 have used an integrated framework adapted from Kabeer (1999)³⁴ bringing together the gender continuum and three domains of gender inequality and changes – agency, relation, and structure. Here agency refers to building individual or collective abilities (knowledge and skills), assets, attitudes and actions for enabling inclusion. The domain of 'relation' refers to changing the dynamics and power relations between people at different levels and spaces of interaction (from household levels to communities, markets, and organizations) to enable equality at individual and structural levels. The domain of 'structure' refers to changing and/or building informal and formal institutions that shape actions to support and facilitate gender transformations (Martinez and Wu D. 2009, Morgan 2014 cited in Hillenbrand et al., 2015, p. 10). Khadka et.al 2021 have also developed specific indicators, criteria and provisions under this integrated framework to guide the analysis and justify ranking of policies in accordance with the gender-continuum. This study closely follows the indicators and criteria thus provided.

The policy environment of SIPs is constituted not only by solar energy policies but are also embedded in the food, water, and energy sector nexus of the country and are therefore impacted by agriculture, water, and larger energy and renewable energy policies (Beaton et.al 2019)³⁵. The Indian policy environment is structured at the central and state levels. In addition, the constitution defines and specifies allocation of powers and functions segregating different sectors of influence and policy making among the Union, State, and Concurrent lists. Consequently, the policy environment of SIPs in India is vast and complex. The scope for this review at the national (and central level) has thus been limited to the most recent and active policies, planning period documents, and essential valid Acts related to the WFE sectors. Among these, direct relevance to SIPs has been considered for inclusion in the study (for eg. policies on seed development and agroforestry have been excluded). Specific WFE sectoral schemes have not been included in the review. At the state level the focus of policy inclusion has been more directly on renewable and solar energy policies of selected states. A total of 7 national framework documents, 17 WFE sectoral central policies, and 16 state level renewable energy policies were reviewed for this study (Annexure 1). In addition one important national level solar irrigation scheme (PM KUSUM) was also reviewed given its core relevance to the theme of this study.

In addition, secondary literature has been reviewed with purposive selection criteria using key themes of gender, agriculture, water, energy, solar irrigation, equity, social inclusion, small and marginal farmers, India. This literature has served the purpose of enabling us to identify the varied aspects of the WFE sector in India in which

social and gender inequalities have been found to create unequal outcomes, exclusion, and marginalities. This has guided the policy analysis to identify not only explicit acknowledgements and references to gender and social inequalities in policy but also other indirect implications the same.

SOLAR ENERGY ROADMAP AND SIPs STATUS IN INDIA

Development of solar energy in India can be traced back to the 6thFYP (1980-85). Its primary focus then was on rural electrification and providing decentralised energy supply for household lighting and cooking, as well as industrial uses (Kapoor et.al 2014). In 1993 the Ministry of Non-Conventional Energy Sources (MNES) (now Ministry of New and Renewable Energy, MNRE) initiated a program for off-Grid and decentralized Solar PV Applications including a target for installing 50,000 solar irrigation pumps. Till 2014 the program was able to install only 13,964 pumps (MNRE 2014, as cited in Yashodha et.al 2021)³⁶. During the 10thFYP (2002-2007) the MNES took on pilot projects for providing total energy security to villages under the 'Village Energy Security Program'. Under this initiative incentives for installation of 900-3000Wp capacity pumps for horticulture were piloted. In addition, multiple solar energy infrastructure and installations were promoted across 4000 villages – including SPV pumps, solar lanterns, SPV generators, solar water heating systems, decentralised rooftop SPV installations, and solar cookers (Kapoor et.al 2014). The Electricity Act was passed in 2003. It promoted the development of renewable sources of energy, and included provisions for minimum purchase obligations for state governments from renewable energy sources through specifications set by a State Electricity Regulatory Commission (SERC). However, despite government efforts, due to high capital costs, solar capacity remained at 6 MW till March 2010 (Rao and Agarwal 2021)³⁷.

Since 2010 solar energy received a major push from the launch of the Jawaharlal Nehru National Solar Mission (JNNSM) as one of eight missions under the National Action Plan for Climate Change (NAPCC). In 2015, under India's Nationally Determined Contributions (NDCs) the government of India committed to a target of installing 175 GW renewable energy capacity by 2022 and 450 GW by 2030, reaching 40% share power from renewable energy. Solar power comprises a major component of this target. Under JNNSM the government set a solar power target of 20 GW by 2022. This target has later been upgraded to 100 GW. The Off-Grid and Decentralized Solar PV Applications Programme made significant progress. JNNSM was implemented in two phases: 2010-2013 and 2014-2017. Phase 1 focussed on large solar power plants, mandating purchase obligations for states, and grid-connected rooftop systems. Phase 2 offered a greater focus on rural installations and solar powered pumps for irrigation and rural drinking water supply with subsidy structure of upto 30% central and 30% state contributions. The subsidy framework targeted small and marginal farmers by placing the subsidy cap up to 5 hp and corresponding PV array capacity to up to 5000kWp. The scheme targeted 100,000 solar pumps for 2014-15 and at least 1 million solar pumps to be deployed by 2020-21 for irrigation and drinking water.

This focus on solar pumps through JNNSM after 2017 was continued through central scheme Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM KUSUM) 2019. PM KUSUM Scheme consists of three components: a). Component-A: 10,000 MW of Decentralized Ground Mounted Grid Connected Solar Power Plants, b). Component-B: Installation of 20 lakh standalone Solar Powered Agriculture Pumps, c). Component-C: Solarisation of 15 Lakh existing Grid-connected Agriculture Pumps. Under component A, a target of 10GW has been set to be achieved through renewable power plants of capacity 500 KW to 2 MW to be setup by individual farmers/ cooperatives/panchayats /farmer producer organisations (FPO) on their barren or cultivable lands. Under component B, individual farmers are supported to install standalone solar pumps of capacity up to 7.5 HP, with a total target of 20 lakh pumps by 2022. Under component C individual farmers are supported to solarise grid-connected pumps of capacity up to 7.5 HP with added capacity to enable selling of excess available energy to

DISCOM for added farm income. 15lakh such pump installations have been targeted under component C of PM KUSUM scheme. Under component B and C, the finance structure includes capital subsidy of 30% is provided by the centre, 30% by the state, 40% is to borne by the farmer (bank finance may be availed by 30% cost). Table 1 below shows the physical and financial targets set under PM KUSUM:

Table 1: Physical and financial targets under PM KUSUM (revised 2020-21)

Component	Approved capacity	Creation of RE Capacity targeted (GW)	CFA including service charges (₹ Cr)
Component-A	10 GW	10	3,325
Component-B	20,00,000 pumps	9.6	15,912
Component-C	15,00,000 pumps	11.2	14,798

Source: MNRE 2021

CFA: Central financial assistance

Current status: Under the Off-Grid and Decentralized Solar PV Applications Programme a cumulative total of 272,700 off-grid solar pumps have been installed in the country by the end of 2020. Implementation under the various components of PM KUSUM achieved by the end of 2020 – 4789 MW under component A; 372,999 standalone solar pumps under component B; 77068 individual pump solarised and 167,500 feeder level solarisation under component C (MNRE 2021)³⁸. Table 2 below details the state-wise implementation of decentralized solar pumps till December 2020. In India, the implementation of these schemes is being carried out at the state level with central ministry level financial support. Component A and C are implemented by State Renewable Energy Department and DISCOMs. State departments of renewable energy, agriculture, or horticulture are involved in implementation of component B in different states.

Table 2: Statewise cumulative implementation of solar pumps (as of Dec 2020)

States	Solar Pumps installed/sanctioned (till 2020-21) under		
	Off-Grid and Decentralized Solar PV Applications Prog.	PM KUSUM component B: standalone SIPs	PM KUSUM Component C: Individual grid-connected pump solarisation
Chhattisgarh	61970	20,000	
Rajasthan	53423	75,000	37,500
Andhra Pradesh	34045		
Uttar Pradesh	29600	23,000	
Madhya Pradesh	23156	60,000	
Gujarat	11522	2,199	7,000
Maharashtra	11315	1,00,000	
Odisha	9599	6,000	
Karnataka	7435	10,500	1,000
Tamil Nadu	6289	6,500	20,000
Haryana	5014	37,000	468
Jharkhand	4800	11,000	500
Punjab	4663	9,500	
Bihar	2813		
Kerala	818	100	100

West Bengal	653		700
Telangana	424		
Tripura	151	3,900	2,600
Other states and UTs	998	8300	7200
NABARD (2015 onwards)	4012		
Total	272700	372999	77068

Compiled from: MNRE 2021

In addition, state level schemes (Table 3) have been initiated by state governments to contribute to the national commitments and targets. State policies and their GESI scope have been discussed later in the report.

Table 3: State level schemes solar pump schemes in India

S.No	State	Ministry/Lead Department	Policy/Scheme Name	Year
1	Rajasthan	Directorate of Horticulture	Hi-tech Technology/For Agriculture Solar Powered Pump Scheme	2018
		Dept of Finance, Dept of Energy, Dept of Agriculture with MNRE	Solar Pump Subsidy Scheme	2011-12
2	Andhra Pradesh	New & Renewable Energy Development Corporation of Andhra Pradesh	Andhra Pradesh Solar P V Water Pumping Programme	2014
3	Bihar	Bihar Renewable Energy Development Agency	Bihar Saur Pump Yojana	2015
			Bihar Saur Kranti & Sinchai Yojna	2012
4	Chhattisgarh	Chhattisgarh Renewable Energy Development	Saur Sujala Yojana Scheme	2018
5	Gujarat	Gujarat Urja Vikas Nigam Limited	Suryashakti Kisan Yojana	2018
6	Haryana	Haryana Department of Renewable Energy	Solar Water Pumping Scheme	2016
7	Himachal Pradesh	Directorate of Agriculture	Saur Sinchae Yojana	2018
8	Jharkhand	Jharkhand Renewable Energy Development Agency	Solar water Pumping Scheme Programme	2016
9	Karnataka	Karnataka Renewable Energy Development Agency	Surya Raitha Scheme	2014
10	Madhya Pradesh	Department of Horticulture	Mukhyamantri Solar Pump Yojana	
11	Maharashtra	Maharashtra State Electricity Distribution Company Limited	Mukhyamantri Solar Pump Yojana Maharashtra	2019
		Maharashtra Energy Development Agency (MEDA)	Atal Solar Krushi Yojana-2	2018
12	Odisha	Odisha Renewable Energy Development Agency	Soura Jananidhi	2018
15	Uttar Pradesh	Agriculture Department and UP NEDA	Uttar Pradesh Solar Pump Yojana	2016
16	West Bengal	Water Resource Investigation and Development Department	West Bengal Accelerated Development of Minor Irrigation Project	

Source: Compiled by IWMI 2021: <https://www.indiawaterportal.org/articles/solar-irrigation-policies-india>

Also several pilot programmes have been supported by international donors, NGOs, and government to assess feasibility, scalability, and farmer's response (Shirsath 2020). Varied models of financing and beneficiary involvement have been piloted in India - Subsidy-saving model, Developer-centred farmer-dedicated solar plant, Developer-centered distributed generation model, Solar irrigation service provider (S-ISP) model, and Solar power as a remunerative crop (SPaRC) model (Shah et.al 2018). Each model is found to fulfill a different set a SIP promotion objectives showing tradeoffs between various objectives under different methods of implementation. However, while equity among farmers and focus on small holder farmers has been focused in many models, focus on women beneficiaries is seen in only few cases (eg. implementation of SIPs through women SHGs in Madhya Pradesh, with Self Employed Women's Association SEWA in Gujarat, and with women cooperative-led farming collectives in Bihar).

GESI CONTEXT OF AGRICULTURE IN INDIA

In order to study the gender and social inclusion context of solar irrigation in India, it is essential to embed this analysis within the larger contexts of gender and social inequality structures and their manifestations in agrarian outcomes of India. While there are regional variations, overarching pattern of access to resources, participation in labour force, decision-making power, and distribution of benefits from agriculture is highly unequal in India. 68.45% of India's operational holdings are marginal holdings (below 1ha) and these marginal farmers operate only 24.03% of operated agricultural area. Another 17.62% are small holdings (1-2ha). On the other hand only 4.37% holdings are medium and large holdings (medium: 4-10ha / large: 10ha and above); yet they operate a total of 29.23% of operated agricultural area (MoAFW 2019)³⁹. Amongst the scheduled castes an even higher percentage of holdings are marginal (78.19%). Further, only 12.72% of operational holdings are under women operating only 11.15% of agriculture area. Nearly 60% of these holdings are marginal holdings. Men on the other hand control over 87% holdings covering almost 89% of total agriculture area (MoAFW 2019). There is thus a class-caste-gender intersection and overlapping marginalities that dictate inequality in the agriculture sector in India. These structural inequalities manifest in varied aspects of agriculture, water, and energy access.

The agricultural sector in India accounts for 60.8 per cent of the total labour force (PLFS 2020-21) and 20.2 per cent of the Gross Value Added (GVA) in the country. It is also found that as an impact of the global COVID-19 pandemic, the pressure on the Indian agricultural sector has further increased. According to the PLFS report (2020-21)⁴⁰, nearly 75% of the total female workforce is engaged in agriculture compared to only 54% of the male workforce. While both men and women are involved in agriculture, men's and women's roles differ widely across regions. Along with the domestic chores and caregiving activities within the households, women play varied roles in agriculture as agriculture labourers, unpaid family labourers, de jure land owners, cultivators, and managers and they are the invisible backbones of the Indian agriculture sector (Sen et.al 2019, Ahmed 2004)^{41,42}. During a peak cropping season, women farmers in India work about 3,300 hours, double the 1,860 hours their male counterparts put into farming (Kamdar and Das 2019)⁴³.

Yet, women's contributions are often overlooked in national statistics like- the census, NSSO, etc. One of the main reasons for the under-representation of women in Indian agriculture is the concept of work participation is often shaped by the patriarchal social norms and hence is partially blind to the nature of work done by women. For example, the status of working on own farms without pay could often go unrecognized, as it may be treated by either or both the male head of the household as well as the woman worker as an extension of housework. This problem is compounded if the work in the family concern is either interspersed with domestic and care work or carried out in the domestic spaces (Sen et.al 2019).

With structural changes and neoliberal globalization, there is evidence of an increase in women's role in agriculture. A relatively impoverished agriculture sector has increased the rate of out-migration among the male members to the urban centres and resulted in increasing women's role in agriculture (Kelkar 2010, Patnaik and Lahiri-Dutt 2017)^{44,45}. Yet women own only a meagre percentage of the agricultural land (Mehta 2022)⁴⁶. Women constitute only 14% of landowners in rural India, owning 11% of agricultural land (Agarwal et al. 2021)⁴⁷. As per a report by OXFAM, one-third of female farmers in India are unpaid laborers on family farms owned by their parents, husbands or in-laws (Dubochet 2013)⁴⁸. The lack of land ownership is one of the reasons why women are undervalued in agriculture.

The lack of land ownership rights also results in a barrier to access to institutional credit and bank loans, various government schemes for the agricultural benefit and a weakening of their decision-making powers. In an agrarian state like Uttar Pradesh only 4% of female farmers have access to institutional credit (Oxfam 2022)⁴⁹. Another UN Women study reported that merely 5% of women have been issued Kisan Credit Cards in India (Seethalakshmi, 2017)⁵⁰. Another impediment that exists in Indian agriculture is the lack of training and extension in sustainable agricultural practices, especially among women farmers. For instance, under India's Agricultural Technology Management Agency (ATMA) Scheme, only one-fourth of participants in exposure visits, trainings, demonstrations, farm schools and Kisan Melas, were women (MoAFW 2019 as cited in Alvi et al 2021)^{51,52}. Women's mobility constraints emanating from patriarchal structures and limiting their spatial scope to the household and domestic arena inhibit their ability to join exposure visits and trainings conducted. Male dominated extension services tend to design programmes, training spaces, and ease of communication to suit men (Paul, 2017)⁵³. Limited access to institutional credit and lack of training leads to low levels of awareness about new technologies (e.g. use of solar pumps) is another important issue faced by women in agriculture.

There also found gender inequalities in access to agricultural input, especially when it comes to technological choices. There is evidence that the mechanisation of Indian agriculture has led to insensitivity towards gender, increasing unemployment among rural women post the Green Revolution (Singh et al 2013)⁵⁴. The lack of training programmes also creates a knowledge gap about modern technologies and prevents women from benefiting equitably from new innovations.

The gender gap that exists in access to productive resources, inputs, and services is often ingrained in social norms and cultural settings in a given geographical setting (Gupta et al 2017)⁵⁵. This results in women's lower agricultural productivity, lower income, and weakening of decision-making power. It is estimated that if women have the same access to productive resources as men, they would increase the yields on their farms by 20-30% and this would end up adding at least 2.5-4% to the total agricultural output in developing countries (FAO 2011)⁵⁶. Similar gender inequalities exist in access to formal markets and price realisation, women often realise less prices for their produce than their men counterparts. The Indian agricultural market is highly male-dominated due to women's restricted mobility rooted in social and cultural norms and therefore a free market may further increase the gender inequality in agriculture (Kamdar and Das 2019).

Women not only have limited decision-making power at the farm level, but their representation, participation, and involvement at the institutional level are even low and many times the concerns raised by the women are usually not taken into account. While women's view varies considerably from men's regarding farming and water management needs, women's independent views are usually not taken into consideration, however, in some cases, women are involved in farming and water management decisions jointly with men (Khandker et al 2020)⁵⁷.

NATIONAL FRAMEWORKS FOR GESI TRANSFORMATION WFE POLICIES

The GESI context of Indian agriculture sector has identified many underlying gender and socioeconomic structural inequalities that must be overcome in order for new interventions to be gender transformative. The next few sections of the study will assess national frameworks and WFE policies to see if they acknowledge and respond to these structural inequalities. We will enquire as to whether these frameworks and policies are able to offer opportunities that may be mobilised by the promotion of solar irrigation in India. The overarching framework for sectoral policies in India is provided by the Constitution and periodic long-term national plans. India followed a five year planning process under the Planning Commission after independence and continued the same till 2017 (1st FYP – 12th FYP. After 2017 the government has prepared three vision and planning documents – 3 Year Action Plan, 7 Year Strategy, and Vision 2030. The Vision 2030 document has not yet been published in the public realm and therefore for this section only the 3-year and 7-year strategy documents will be reviewed along with the Constitution for understanding the national frameworks for GESI.

Constitutional Mandates towards GESI

For social inclusion the very preamble of the Constitution expresses the central vision of law around - JUSTICE, social, economic and political; EQUALITY of status and of opportunity. In line with this vision the Constitution provides the Right to Equality as a fundamental right under which equality before law (Art. 14) and equal protection of the laws must be practiced for all persons, and prohibits against any citizen on grounds of religion, race, caste, sex, or place of birth (Art. 15). The Right provides equality of opportunity in public employment while permitting special provisions for women and children, advancement of socially and educationally backward classes, and economically weaker sections (Art. 16). Directive Principles provide for promotion of educational and economic interests of Scheduled Castes, Scheduled Tribes and other weaker sections (Art. 46); provision for just and humane conditions of work and maternity relief (Art. 42).

The Directive Principles, which are non-binding but direct the government in policy making, include important provisions highly relevant for economic sectors and resource access. Under this it is stated that the “State shall, in particular, strive to minimise the inequalities in income, and endeavour to eliminate inequalities in status, facilities and opportunities, not only amongst individuals but also amongst groups of people residing in different areas or engaged in different vocations” (Art. 38). It further directs policies to secure right to an adequate means of livelihood and equal pay for equal work for men and women equally (Art. 39). It further directs policy to secure distribution of ownership and control of material resources for the common good and prevent economic systems from concentrating wealth and means of production (Art. 39). These provide important frameworks for GESI opportunities for policy making in India.

The 73rd Amendment Act 1992 provided for devolution of governance to local governance (Panchayats and Municipalities), making those important actors in planning and implementation of economic development and social justice under the larger centralized federal structure. Under Schedule 11 which outlines Panchayat mandates, one can find most of the sectors of planning and implementation that are highly relevant for solar irrigation – non-conventional energy sources, agriculture, minor irrigation, water management and watershed development, rural electrification, Poverty alleviation, Women and Child development. Therefore, while central and state level policies dictate development and sectoral interventions, local governance systems have a significant role in scaling down policies to specific contexts through village/municipality level planning, budget allocations, and implementation. However, since electricity grids continue to be under the ambit of central and state level control, local governance can have an important role in decentralized interventions.

The Constitution of India also promotes political inclusion for backward groups (scheduled castes and tribes) through reservations in governance (panchayats, municipal councils, judicial councils, cooperative societies) to ensure proportional representation. For women there is one-third reservation at devolved governance levels. An important element of GESI is the acknowledgement of intersectional gender marginalities by creating reservation of women from Scheduled Castes or the Scheduled Tribes. This offers important frameworks for women's participation in local collectives and resource governance.

National Planning Frameworks

The planning frameworks in India, reflected in the recently published 3-year Action Plan and 7 year strategy of Niti Aayog, have a dedicated vision for gender and social inclusion. Gender inequalities have been primarily acknowledged under focus areas of economic participation, women's safety and gender-disaggregated data, identifying their invisibility and socio-physical constraints of mobility, time, and domestic burdens (Niti Aayog 2017, Niti Aayog 2018)⁵⁸. Therefore the planning framework has outlined gender objectives of creating an enabling environment, overcoming institutional and structural barriers and enhancing the female labour force participation rate to at least 30 per cent by 2022-23 (Niti Aayog 2018)⁵⁹. In response to these inequalities and objectives the planning documents highlight the need for generating gender aggregated data and integrating gender budgets with outcome budgets to make Gender Responsive Budgeting more effective. Further it indicates the need to encourage women's economic participation through more vocational and skill training for women, linking more women with formal financial systems, development of Equal Opportunity policies, and legislations for enabling gender-sensitive provisions in the informal sector. For creating enabling conditions for women in agriculture it indicates ways forward through improving asset ownership and securing women's rights over common property resources including irrigation systems, water, fishing grounds and forests (Niti Aayog 2018). It also indicates plans to ensure 50% women's membership in FPOs, and targeting women farmers in agricultural extension.

The Planning frameworks also include dedicated focus on social inclusion through a focus on minorities, scheduled castes, and scheduled tribes. The major focus in this aspect relates to promoting education, enabling economic development through promotion of entrepreneurship, and better monitoring and targeting of existing schemes (Niti Aayog 2017, Niti Aayog 2018). The economic backwardness of these groups has been acknowledged in the plan documents. However, the sociocultural and historical roots of this backwardness and prevailing discriminatory practices have found no mention in the plan documents. As a result while the plans are responsive to this social inequality, they are unable to provide socially transformative frameworks for policy-making.

While several positive frameworks and directions are offered under the short-term and long-term plan documents, gender and social inclusion are considered separately as dedicated sections/chapters and not integrated into the sectoral plans. Gender Responsive Budgeting (from 2005 in India) and special schemes developed for minorities and tribal communities continue to lack efficacy and adequate targeting due to this lack of integration. Sectoral components of the planning framework have tended to take more all-encompassing terminologies such as 'farmers', 'households', 'per capita', 'citizens', 'Indians', 'users', 'buyers', 'people's participation', and 'family' that do not reflect gender and social inequalities in water, agriculture, and energy sectors. Gender responses in the planning frameworks have tended to reduce 'gender' to 'women', thereby often failing to acknowledge structural and relational roots of gender inequalities manifested in agency, resource access, safety, and economic participation. Many of the proposed responses and ways forward for policy offered by the planning framework therefore focus on enabling improved access to resources, knowledge, skills, assets, and services. Yet in doing so they continue to remain within the boundaries of gender stereotypes, traditional

gender division of work, and women's domestic and social (mobility, safety, childcare, time) constraints instead of aiming to overcome them.

Other National GESI Frameworks

In addition to the constitutional and national planning frameworks, GESI contexts in India also emerge from some additional sources. These include international conventions that India is signatory to, land laws, and National Policy of Women. India is a signatory of various international conventions for gender justice. For political and economic rights there are the Convention on the Political Rights of Women, 1954, International Covenant on Economic, Social and Cultural Rights, 1966 and the Convention on Elimination of all forms of Discrimination against Women (CEDAW). Under the International Covenant on Economic, Social and Cultural Rights, 1966, Art. 7 obligates state parties to: "recognize the right of everyone to the enjoyment of just and favourable conditions of work..". This includes, equal remuneration for equal work without any distinction, women being guaranteed equal conditions of work, safe and healthy working conditions, and equal opportunity (UN 1966)⁶⁰. CEDAW Art 11(1) further provides for obligations for States parties to take appropriate measures to eliminate discrimination against women in the field of employment in order to ensure on the basis of equality of men and women (UN 1979)⁶¹.

India's land laws emanate from their traditional roots in religious personal laws. Notably for the majority Hindu population of the country land inheritance laws are guided by the Hindu Succession (Amendment) Act 2005. Among Muslims in India land inheritance and distribution is dictated by The Muslim Personal Law (Shariat) Act, 1937. The Hindu Succession Act 1956 gave rights to inherit land to both daughters and sons. It also gave women the absolute right over their land ownership and freedom to sell or transfer their land. However, only son's had coparcenary rights (at birth) while women were only successors to receive share of land after partition from brothers. It also only considered unmarried daughters. The Hindu Succession (Amendment) Act 2005, overcame this structural inequality by providing daughters (married and unmarried) coparcenary rights in joint family property. Yet, passing of the Act has not guaranteed its implementation and intended outcome. Even after decades of passing of the original Act women owned land in only 16% households. As women move to and are then seen to be rooted to marital homes, paternal families are less inclined to accept daughter's rights over land (Agarwal et.al 2021). The Muslim laws of inheritance also accords inheritance rights to both sons and daughters. However, female heirs receive only half the quantum of share that male heirs receive. Indian Succession Act, 1925 governs land inheritance through wills and intestate succession where religious personal laws aren't valid.

In addition to the above frameworks, India has a dedicated policy of women - National Policy for the Empowerment of Women (2001) and the recent Draft National Policy for Women 2016. The 2001 policy aimed to bring about the advancement, development and empowerment of women through a myriad of provisions. Most relevant of these to our current analysis include - equal power sharing and active participation in decision-making, and institutionalizing women's participation and perspectives in designing and implementing macro-economic and social policies. With regard to their economic participation the policy envisioned for poverty eradication among poor women, enhancing women's access to credit, and concentrated efforts to ensure proportionate benefits of training, extension, and various programmes. The policy places women at the centre of environment conservation and spreading the use of non-conventional energy sources including solar energy, biogas, smokeless chulahs and other rural application. The 2016 policy brings in an added focus on climate change and positions women at the core of mitigation, adaptation, energy planning and policy-making, and resource management.

While the 2001 policy focused more on women and their individual/collective agency, the recent draft Policy 2016 has strengthened the relational aspects of gender inequality and response. Its core vision sees women as participating as “equal partners” in all spheres. The mission statement of the policy aims to ensure equal rights and opportunities for women at different levels of social relations such as family, community, workplace, and governance. Further an objective of the policy aims at “transforming discriminatory societal attitudes, mindsets with community involvement and engagement with men and boys”. Under governance and decision-making it not only aims at increasing participation but also the quality of representation through greater capacity building. This draft policy can thus provide a framework for responding to relational impediments behind gender inequality.

In summary, the national frameworks for GESI in India offer several opportunities for inclusion in policy. The frameworks are progressive in identifying and acknowledging the prevalent inequalities in social and economic sectors and responding with measures to improve access resources, knowledge, and skills. It offers frameworks for more decentralization and devolution of powers to enable for context specificity and participation at local grassroots levels for social change. It also envisions gender and social equality as well as greater equality in participation in governance, planning, and implementation. Intersectional understanding of women across caste class and age groups, rather than as a homogenous category, is an important contribution of these frameworks. Additionally a transformative view of gender relation acknowledging and challenging systemic barriers of norms and attitudes is emerging in the frameworks which is progressive and can strengthen the level of gender inclusion in sectoral policies. There are also some gaps that emerge in the national GESI frameworks. There is a lack of structural understanding of inequality and responses targeting root causes of patriarchal structures and gender discrimination. Land laws, which in India act as the key capital access determining access to many other resources and policy benefits, are almost entirely structured under religious personal laws thereby influenced by traditionally held socio-structural inequalities and practices. There is also a lack of integration of gender and social inclusion within sectoral development. There is a tendency to look at it as a separate independent objective and focus, divorced from sectoral plans.

GESI IN WFE SECTOR POLICIES (CENTRAL) IN INDIA

Having discussed indepth national frameworks that provide a base for policy-making, we try to enquire whether these opportunities are reflected and realized in specific sectoral policies forming the policy environment for SIPs in India.

Water Sector Policies

4 key central water sector policies have been considered for assessment. Some recent draft policies have also been considered since they can reflect new concerns and ongoing engagement with equity and gender issues.

National Water Policy 2012: The policy acknowledges skewed access to water between different people and “unique needs and aspirations of Scheduled castes, Scheduled Tribes, women, and other weaker sections” (p.9). It recognizes that groundwater, being perceived as an individual property, is exploited inequitably. However the policy does not include any measures for promoting equality. It does state the provision of differential water pricing mechanism for priority allocations for ensuring drinking water, food, and livelihood security for the poor. However, this is not mentioned with the positive intent to promoting equality, rather to reduce the negative impacts of introducing water pricing on the poor, especially for basic water requirements. This assumes that without water pricing water access to equitable. Yet it ignores other barriers of access such as the access to land, capital, technology, knowledge, and social relations which can create inequality in water access even without water pricing (Joshi 2011, Moench 1992, Dubash 2002, van Koppen 1998)⁶²⁶³. Further, It has no mention of

'gender' and does not acknowledge gender inequalities in water access outside of the very broad reference to 'incorporating considerations of unique needs and aspirations' of women. The policy does not have any mention of systemic barriers creating unequal access or unique needs. Under representation and participation in institutions and decision-making there is only mention of broad categories of 'community' based water management, 'stakeholder' and community participation, *participatory* mapping involving *local communities*, with absolutely no mention of unequal representation therein. Training and quality improvement of 'water planners and managers' are considered with no GESI considerations. The highly masculine nature of irrigation and water planners and managers has been well recognized and established in literature (Zwarteveen 2008)⁶⁴, and therefore a lack of recognition of the same in policy will tend to promote status quo. The policy does however incorporate principle of equity and social justice as a basic principle of the policy but has no mention of provisions to ensure the same. It also does not identify water as a basic human right and promotes pricing mechanisms market led water allocation and distribution. The policy has identified a lack of interdisciplinary holistic approach to water planning and promotes a crucial focus on considering social and environmental aspects, integrated water resource management, and creating multi-disciplinary structures in departments/organisations. Yet the data collection and research focus of the policy is entirely on hydroclimatic and techno-managerial in nature with no provision for social, let alone gender-disaggregated data.

<u>WATER SECTOR POLICIES</u>	National Water Policy 2012	Draft National Water Framework Bill 2016	Draft Model Bill for Conservation, Protection, and Regulation of Groundwater, 2016	National Water Mission
GESI CRITERIA				
1.1 Promote equitable access to WFE assets, resources, knowledge and skills, opportunities and services by women and DAGs	1	1	2	2
1.2 Efforts to addressing systemic barriers for change [e.g. structure, social norms, attitude, behaviour, practices, and gender stereotypes]	0	0	0	0
2.1 Strengthen representation and voices of women, marginalized groups, and communities in WFE institutions and decision-making	0	0	2	1
3.1 Promote GESI, justice, and community participation in the WFE sector through dedicated vision, objectives, and strategies in the WEF policy	1	1	1	0
3.2 Improve knowledge system by strengthening social science and GESI perspectives in planning, monitoring, evaluation and learning (PMEL)	1	0	0	0

Draft National Water Framework Bill 2016: Since water is state subject in India, this draft bill is towards an Act for only a national legal framework for protection, conservation, regulation, and management of water. The bill identifies the basic right to sufficient quantity of safe water within easy reach of households regardless of caste, creed, religion, community, class, gender, age, disability, economic status, land ownership and place of residence. Water as a basic right has been reiterated multiple times. It also incorporates the basic principle of water as a 'common heritage of the people of India, held in public trust'. The bill provides for water security plan that is to ensure equitable use of irrigation water. It also provides for a groundwater protection bill to ensure protection against gender discrimination and socioeconomic inequalities in access to groundwater. There are no

measures provided as to how these would be achieved. It mandates water pricing, and considers differential pricing as a pro-poor mechanism. Yet with regard to participation in only mentions water user associations, community, farmers, and people-centred management.

Draft Model Bill for Conservation, Protection, and Regulation of Groundwater, 2016: This bill is towards an Act for providing a legal framework for groundwater protection, conservation, and regulation in India. The bill identifies a fundamental right to basic water access for a healthy and dignified life. Non discrimination and equity has been included as a mandatory principle wherein every person is to be provided access to water without discrimination of caste, creed, economic status, land ownership, birth place, race, religion, and sex. It further incorporates protection against gender discrimination and inequalities in water access as one of the core objectives of the law. It however does not identify measures to achieve this nor respond to the roots and relations of inequality. As measures it calls for an appropriate authority for ensuring equitable distribution. A groundwater security plan is required to be prepared to provide for groundwater conservation, augmentation, regulation, and socially equitable use. It also mandates adequate representation to scheduled castes, tribes, and women at different levels of groundwater governance - Gram Panchayat/Block panchayat Groundwater committees and District groundwater councils. However this inclusion is more tokenistic as it does not identify the importance of intersectional gender and social identities, nor social relations that undermine the quality of participation. Focus on data for monitoring and planning focus only on technical, and hydro-climatic aspects with no mention of multidisciplinary, social and gender-disaggregated data.

National Water Mission: The National Water Mission, which is a part of India's National Action Plan for Climate Change is weak on GESI considerations. Any mention of gender or women, backward castes, and minorities is missing from this mission document. There is however some focus on ensuring equality in access to irrigation for large and small farmers through promoting technical measures such as promoting micro-irrigation, rotational water distribution systems, volumetric ceilings and rational pricing. There is an inclusion of participatory water management and water use associations but have no mention of representation within these, except for a cursory mention of including women. It naively assumes that participatory community based management would directly lead to equity.

Agriculture Policies

In India primarily five year plans have provided agriculture policy frameworks. The lack of a national Agriculture policy is a glaring gap in the sectoral policy structure for a country with accounts for 20.2% of the GDP and over 60% of its labour force. However, other policies have contributed to the agriculture policy framework which are analysed in this section.

National Policy on Farmers 2007: One of the major objectives of the policy is mainstreaming gender dimensions in all farm policies and programmes. It identifies skewed ownership of land, access to credit, technology and implements for women. In response it includes measures for enabling equitable access to land and credit through joint pattas and speedy issuance of Kisan credit cards to women. It provides for support services such as crèches, child care centres, nutrition, health and training for women empowerment. There is also special focus on women's involvement in livestock and fishing activities. These ofcourse do stereotype the limited and support roles for women in agriculture. For smallholders it focuses on supporting measures such as livestock improvement, aquarian reforms to provide them access to village ponds, provision of social security, and promotion of cooperative/group farming and farmers estates and companies. There are also dedicated sections with recognition and measures for tribal farmers, small holders and youth in agriculture. Systemic barriers of norms,

attitudes and stereotypes have not been considered in the policy. It has some references to water users association, inclusion of women as water users and water managers, involvement of stakeholders in participatory decision-making. But it does not extend aspects of participation beyond passing mention to include measures of ensuring inclusion. There is a special focus on improving knowledge systems through pro-small farmer, gender sensitive and socially relevant research strategy to ensure social inclusion in access to new technologies. As a response it proposes restructuring of agricultural curriculum and pedagogical methods to make agricultural education gender sensitive.

AGRICULTURE SECTOR POLICIES	National Policy on Farmers 2007	National Mission for Sustainable Agriculture	Doubling Farmers' Income	National Food Security Act 2013	Draft National Land Utilisation Policy
GESI CRITERIA					
1.1 Promote equitable access to WFE assets, resources, knowledge and skills, opportunities and services by women and DAGs	2	1	1	2	2
1.2 Efforts to addressing systemic barriers for change [e.g. structure, social norms, attitude, behaviour, practices, and gender stereotypes]	0	0	0	2	0
2.1 Strengthen representation and voices of women, marginalized groups, and communities in WFE institutions and decision-making	0	0	0	2	0
3.1 Promote GESI, justice, and community participation in the WFE sector through dedicated vision, objectives, and strategies in the WEF policy	2	0	0	2	2
3.2 Improve knowledge system by strengthening social science and GESI perspectives in planning, monitoring, evaluation and learning (PMEL)	2	0	0	0	0

National Mission for Sustainable Agriculture: Under this mission document, which is a part of National Action Plan for Climate Change is, extremely poor in terms of GESI considerations. It has no mention of gender or women. It has some technical provisions for improving access to credit, crop insurance, and livelihood diversification. Some examples of these include promotion of microfinance, developing and strengthening low tunnel / poly house farming, building vertical linkages between small producers and food processors via contract farming, supply chain management etc, and horticulture extension. However the operational manual for the policy does mandate at least 50% of the allocation for small, marginal farmers of which at least 30% are women beneficiaries/ farmers (MoAFW)⁶⁵. There is no reference to caste, tribal, and minority groups let alone intersectionalities. There is no recognition of GESI in institutions and decision making. All focus on research and data is entirely directed at technological interventions and physical resource and climatic factors. There is no underlying vision or objective on GESI; it has only been included as technical provisions for improving access without any acknowledgement of underlying inequality and its causes.

Doubling Farmer's Income: After the 12th Five year plan ended in 2017, Doubling Farmer's Income has become the key agricultural policy strategy, which is also reflected in the chapter on agriculture in India's Year Action Plan and the 7-year strategy document. While the 12th FYP brought out importance of and multiple initiatives for

women farmers and smallholders with references to *women, dalit, tribal farmers*, the recent policy direction in agriculture has no mention of *gender, women, caste groups, minorities, or indigenous* farmers. The entire policy mentions only '*farmers*'. Small farmers are mentioned only with regard to scaling of benefits by promoting collective farming and Farmers Producer Organisations. There is no mention of systemic or structural constraints of capital and resources faced by smallholders and any measures to overcome those. Research and data priorities focus entirely on technological innovation with no social component acknowledged or promoted. Equity aspects do not show up in goals and objectives of the policy and neither is it mentioned anywhere in the policy documents. There is no focus of involving farmers in decision-making institutions, let alone recognising gender and social disparities in representation. This is shift from the five year plan period (11th and 12th plan) to the new agricultural policy focus is concerning from GESI considerations.

Draft National Land Utilisation Policy 2013: This draft policy aims to offer a policy framework to ensure optimal utilization of land resource including agriculture land through appropriate land use planning and management. One of its guiding principles includes addressing inclusive growth, poverty eradication and gender equality in all policies and programmes. In line with this principle one of the key objectives of the policy "to identify and protect lands that are required to promote and support social development, particularly of tribal communities and poor section of society for their livelihood". Accordingly it provides for the categorisation of socially important areas such as tribal lands under 'Protected Lands'. It further calls for protection of rights of tribes and poorer sections on common lands. However with regard to gender or women's access and rights to land there is no mention in the policy. With regard to participation in decision making there is mention of participatory planning with stakeholders, communities, individuals, citizen's groups, neighbourhood groups, business groups, consumer groups, and such other groups, including NGOs and CBOs. There is no acknowledgement of social exclusion and special measures for GESI.

National Food Security Act 2013: While this is not directly an agriculture policy, agricultural revitalisation is a major underlying mandate for improving access to food in the country. Therefore although considered primarily as a social sector policy, it has been considered within the ambit of policies of agri-systems in India. The act is aimed at mobilising the right to food through specific entitlements to subsidised food grains and nutrition support. This policy has a focus on women and poor as key beneficiaries of the act. Provisions for their inclusion includes their identification under the Targeted Public Distribution System, defining women as the head of household for the purpose of issuing ration cards, and a special focus on specific nutritional requirements for pregnant and lactating mothers, and children. There is also a focus on vulnerable groups affected by remoteness including tribal areas. While defining women as head of household is a transformative response to the patriarchal household headed by men, the focus on women in the policy in some ways emerges from their traditional reproductive roles and responsibilities for domestic nutrition. Therefore the indicator 1,2 has been ranked as only gender-responsive in terms of gendered norms and practices, In terms of representation in decision-making the act is strong. The act mandates the constitution of a State Food Commission wherein among six members at least two women are mandated and one person each from the Scheduled castes and Scheduled Tribes.

The act directs the government to advance food and nutritional security through various measures including revitalisation of agriculture. Securing interests of small and marginal farmers is key among these measures. The National Food Security Mission, a centrally sponsored scheme for strengthening agricultural production, has 33% budgetary allocation for women, small, and marginal farmers as well as proportionate allocation for SC/ST farmers. Specific allocations are also maintained for Special Component Plan (SCP) for Scheduled Castes and Tribal Sub-Plan (TSP) for Scheduled Tribes (DoACFW 2018)⁶⁶.

Energy Policies

Energy policies in India has evolved from a focus on electrification, to multiple energy sources including renewable energy, thereby evolving focus from electricity policies to the broader umbrella of energy policies.

ENERGY SECTOR POLICIES	Draft National Energy Policy 2017	Draft National Electricity Policy 2021	National Electricity Policy 2005	National Rural Electrification Policy, 2006	National Solar Mission	Electricity Act 2003	National Mission on Enhanced Energy Efficiency Framework	Electricity Act 2003
GESI CRITERIA								
1.1 Promote equitable access to WFE assets, resources, knowledge and skills, opportunities and services by women and DAGs	2	1	2	2	2	1	0	0
1.2 Efforts to addressing systemic barriers for change [e.g. structure, social norms, attitude, behaviour, practices, and gender stereotypes]	0	0	0	0	0	0	0	0
2.1 Strengthen representation and voices of women, marginalized groups, and communities in WFE institutions and decision-making	0	0	0	1	0	0	0	0
3.1 Promote GESI, justice, and community participation in the WFE sector through dedicated vision, objectives, and strategies in the WEF policy	0	0	2	2	0	0	0	0
3.2 Improve knowledge system by strengthening social science and GESI perspectives in planning, monitoring, evaluation and learning (PMEL)	0	0	0	0	0	0	0	0

Draft National Energy Policy 2017: This combined energy policy of India is still in draft stages. However, it does provide directions of visions, objectives, and policy agenda and lenses of the energy sector. One of the major objectives of the policy is to ensure energy access at affordable prices to ensure electricity for all households and with a focus on poverty alleviation. Specifically for “vulnerable sections” it provides for financial support (through subsidies with direct cash transfers) and eventual driving of affordability through competitive markets and pricing. It also identifies electricity as a social good and therefore requiring provision of security in its access for all. Energy is however not considered as a right with GESI considerations for decision-making and inclusion as stakeholders in the sector – but merely as beneficiaries. There is, further, no specification of the constitution of these “vulnerable sections” and has no mention to women, backward castes or tribes, minorities, or smallholders. *Women* are mentioned only briefly in a section on clean cooking access providing subsidized LPG connections to rural women. Clearly, a gender agenda is missing from this policy and women’s inclusion is marginal and stereotyped to their role in the domestic space. The GESI component of the policy, therefore, while existing in terms of income poverty at levels of vision and objectives, is weak at deeper levels wherein social exclusion and

vulnerability is understood relationally and structurally. At institutional levels and decision making there is no mention of community involvement or representation aspects.

National Electricity Policy 2005: The National electricity policy does have a focus on ensuring access to electricity to the poor and marginal sections, consumers below poverty line, and particular attention to dalit bastis, tribal areas and other weaker sections. Financial subsidies are offered to ensure affordability of electricity access. Further it states the highest priority of over public finances would be provided to public service obligations like increasing electricity access among small and marginal farmers and rural households. However, there is no mention of women or gender considerations in the policy. 'Households' are considered without any recognition of differential access and engagement with energy within households (Choudhuri and Desai 2020)⁶⁷. Yet for indicator 3.1 it has been considered for a rank 2 given its joint focus on electricity for all, financial mechanisms to promote the same, and particular attention to different social sections as beneficiaries. While there are provisions for community participation in success of policy interventions, they have not been given space for inclusion in decision-making bodies and committees. While representation is mandated from multiple sectors including agriculture, there is no specification of the identity and level of this representation. All reference to skills and capacity, research, and data refers to technological aspects of energy with no inclusion of the social.

Draft National Electricity Policy 2021: Though still in a draft stage, the 2021 Electricity policy has a stark gap in engagement with the social and equity aspects of the energy sector. This has been primarily owed to the fact that India has already reported 100% rural electrification. The quality of electricity supply has been a shift of focus in this policy in terms of rural electrification, but there is no mention of gendered considerations of the same. It reflects the general assumption of the energy sector, particularly in terms of rural electrification, that household electrification is the last mile of energy provision and that the household reflects common benefits and burdens for men and women in the household. There is been a drastic shift to focus on renewable sources of electricity. However in this regard there has been absolutely no mention of access issues, inequality therein. Gender, women, smallholders, backward sections, marginalized groups, find no mention in the policy. Some mention has been made to economically poor households under last mile reach of rural electrification, but no specific measures to understand their backwardness in energy access. There is no mention of community involvement in decision making and all research and data aspects of the sector focus entirely on technical skills and information. There has been an increased focus on market systems, pricing mechanisms, and inclusion of the private sector without any mention of their potential and documented implications for inclusion for the economically backward sections.

Rural Electrification Policy 2006: This policy focused on the rural electrification mechanisms and institutional structures. It provides a focus on Below Poverty line households with provision for 100% capital subsidy. The policy recognizes women as the most impacted by lack of commercial energy or electricity access and therefore mandates their inclusion in the District Committee formed under the Electricity Act for regulation and implementation of rural electrification. However it does not specify their roles, participation levels, and reservations in the committee. There is a strong focus on community involvement through user associations, cooperatives, and community based organisations in management of local distribution. There is a strong focus on involvement and powers of the village level panchayat governance in decision-making and managements which is quite different from the larger focus on central and state level management and regulation in current emerging policies.

National Solar Mission: A sub-mission under the National Action Plan for Climate Change, the national solar mission aims at creating the policy conditions for its diffusion of solar energy across the country. The primary focus is on solar energy penetration, and empowering the grassroots levels through energy security thus created, particularly through decentralised initiatives. There is a component of GESI with a focus on decentralised off-grid opportunities for the power-poor, most of which are remote tribal areas. As a response there is a provision for 90% capital subsidy to enable better access. Subsidy policies and low interest bank credit support have been incorporated to enable market penetration and affordability of these high investment technologies enabling more equitable access than open market frameworks. Yet equity isn't mentioned in the document. Gender justice, rights, vulnerable sections such as smallholders and backward caste groups are not acknowledged or targeted. The regulation, planning and implementation institutions are not decentralised, and mission steering group, mission executive committee, solar research council have no mention of community involvement. All research and human resource development focus of the policy is focussed on scientists and engineers, technical institutes, technological innovation, and financial models for market diffusion.

Other policy documents in the energy sector reviewed were **National Energy Conservation Act 2001**, **Electricity Act 2003**, and the **National Mission for Enhanced Energy Efficiency** mission document. All three documents have no component of social inclusion, gender, or indeed any incorporation of the social beyond broad categories of "consumers", "users", "households", "stakeholders", and "persons". The documents are strongly oriented towards the technical, procedural, financial, and institutional (with no GESI component for participation or representation) frameworks. The Electricity Act 2003 does have some provisions that state non-discrimination against/preference for a consumer or class of consumer in terms of setting of tariffs and charges, and supply of electricity to all areas. However there is a broad underpinning of provisions as "consumers" and provide no specific measures for the same.

Finally, we reviewed the **PM KUSUM scheme guidelines**. Though this study has not included a systematic inclusion of specific government schemes, we have included this scheme as it is the primary program for solar pumps implementation in India and most crucially relevant for SIPs theme of analysis. The scheme has incorporated GESI considerations with regard to small and marginal farmers, but has no inclusion of women, scheduled castes/tribes, and minority groups. Measures to ensure this has been a cap on the Horsepower of the pump and corresponding solar capacity which is eligible for central financial assistance (subsidy) to the farmer. This is considered to be a promising disincentive for large farmers to apply for assistance (Shah et.al 2014). However, there is a clause that attaches the provisioning of the subsidy with the use of micro-irrigation systems to reduce water extraction from the low cost energy availability. Unfortunately this does not consider the fact that micro-irrigation technologies, being capital intensive themselves, are mostly used by large farmers and therefore may exclude many smallholders from access to solar irrigation (Bassi 2015)⁶⁸.

GESI in state-level renewable energy and SIPs sector policies in India

The Ministry of New and Renewable Energy (MNRE) has put in place several schemes/ programmes for developing and promoting clean energy services and technologies, including solar energy to advance economic development, improve energy security, improve access to energy, and mitigate climate change. In line with the schemes and targets of MNRE, different states have also set their targets and released schemes for Renewable Energy. A brief analysis of the state-level renewable energy policies finds that there is limited recognition of

differentiated energy needs across different social groups especially differential needs of energy for women and men. Gender equality issues are almost absent in the policies. We reviewed the 16 such renewable policies from 9 states using five indicators of gender transformative change. The renewable energy policies score as gender-blind on the gender continuum scale. While it seems most of the RE policies lack gender perspective and strategies, RE schemes and programs however are progressing towards gender-responsive.

Andhra Pradesh

In order to increase the deployment of solar energy projects and create a favourable environment in the state, the Andhra Pradesh government announced a **Solar Power Policy in 2018**. The recent energy program documents are gender-aware and incorporated some gender and equity perspectives. For instance, the solar power policy of Andhra Pradesh (2018) scores at 0.2 in the overall gender continuum, as it has considered GESI in only one indicator (1.1.) out of the five GESI indicators. The indicator 1.1. scores at 1. The policy document focuses on Solar-powered agricultural pump sets to meet the power requirement of the farmers during the daytime (Pg 2 and Pg 3). Though it has not provided the definition of farmers, however, as it has identified that farmers face different challenges and unequal opportunities in accessing and benefiting from irrigation technologies. It is indirectly designed keeping women's needs in mind so that women are able to use and benefit from the technologies in order to get dispensable irrigation facilities. It is mentioned in different studies that access to irrigation is a gendered issue. It is especially difficult for the women farmers to access irrigation facilities as many times electricity supply for irrigation is available only post-midnight. Getting access to irrigation during the daytime might help the women farmers in crop diversification, increase productivity, increase income and ultimately lead to women's economic empowerment. The policy document also mentions increasing dependency on solar pump sets for irrigation without any additional financial burden on the farmers. This policy aims to address and support marginalized farmers from remote areas to create better economic opportunities for them. The policy emphasizes both employment generation and economic sustainability. For example, it is mentioned in the policy that "the Government will encourage Grid Connected Solar Pump sets to benefit the farmer community by way of sale of surplus energy to the DISCOMs." Similarly, it also mentioned in the objective that it will promote local manufacturing facilities which will generate employment in the State.

The **Wind Power Policy (2015)** mentions meeting the growing demand for power in an environmentally and economically sustainable manner and promoting investments for setting up manufacturing facilities in the State, which can generate gainful local employment, however, none of the objectives and provisions stated in the document entails clauses on GESI. Similar to Wind Power Policy, the **Wind-Solar Hybrid Power Policy (2018)** also focuses on employment generation (pg 5), however, does not focus on the GESI framework.

Bihar

Bihar's RE policy (2017) was found to be GESI-aware. Overall, the score stands at .8 on the gender continuum Scale. The policy proposed that BREDA should explore programs like- Bihar Rural Livelihoods Project (JEEVIKA) to provide support for entrepreneurship to women and youth at the grassroots level and improve socio-economic conditions. In a rural context, for example, providing opportunities to women in productive activities can contribute to local economies while also promoting women's economic empowerment and poverty alleviation (Wodon and De La Briere 2018). In line with MNRE initiative, Bihar's RE policy has also emphasized the deployment of Solar pumps for irrigation and drinking water purposes and also kept provisions for additional subsidies. While the policy mentions that poor access to irrigation facilities poses an economic risk to the small and marginal farmers, the **Bihar Saurya Karnti Sinchai Scheme (2015)** mentions that farmers with land holdings between 1 acre to 5 acres will only be eligible for this scheme (75 percent subsidy). However, it is often

found that restrictive gender norms limit women's ownership of productive assets and recognition as farmers (Mokyr 2017; Kelkar and Krishnaraj 2013). The scheme lacks GESI strategies to address these challenges and empower women in the SIPs.

Gujarat

While **Gujarat's Small Hydel Policy - 2016** mentions promoting investment, employment generation, skill enhancement, and creating environmental consciousness among the citizens, none of the objectives and provisions stated in the document entails clauses on GESI.

The **Solar Power Policy 2015** focuses on the deployment of SIPs and stand-alone PV systems and home lighting systems. From gender and social inclusion point of view, guideline 9.8 shows that the state policy has given special emphasis to home lighting systems for isolated and scattered houses in extremely remote areas where the grid connection is not currently feasible (Pg 16).

Karnataka

In the **RE policy 2021-2026** the Government of Karnataka mentions promoting the Solarization of the existing grid-connected Irrigation pumps through feeder Solarization. The feeder solarization provides an opportunity for use of solar energy to supply electricity to agricultural feeders, especially during the daytime (Pg 25). This strategy indicates towards social inclusion.

Maharashtra

The **Unconventional Energy Generation Policy-2020** of Maharashtra moves toward social inclusion as it mentions that transmission connected solar pumps will be used for public water supply schemes for pumping and supplying drinking water to villages / wadas / pades / hamlets/gram panchayats which do not have electricity supply in rural and remote areas (Pg 10 and pg 17). It also mentions that SIP beneficiaries (farmers) need to share 10 percent of the installation cost, which is even lesser for the beneficiaries belonging to the SC and ST groups (Pg 17). The policy further aims to provide solar-based home-based lamps and fans to the remote villages/wadis in the state where electricity will not be reached through traditional energy systems on 100 percent financial assistance (Pg 18). It is important to mention here that women and men have differential energy needs given the prescribed gender roles in both household and productive spheres. Lack of access to clean energy within the households has an impact on women more than men as women spend more time in the private domain than men. Though this policy does not mention directly gender equality, equity, and women's empowerment, however, the policy strategies might impact women in a positive way.

Odisha

The **RE policy, 2016** of Odisha is gender-aware, although GESI strategies in the policy are limited. The policy states that the government will continue to encourage and support decentralized RE applications for on-grid/ off-grid / hybrid modes to address the energy needs of poorer and deprived communities to make efficient use of RE resources to promote efficient demand-side management. For instance, it mentions the use of an improved biomass cookstove that burns biomass efficiently with reduced emissions and offers cleaner cooking energy solutions. In traditional patriarchal societies, it is mainly women who are assigned the responsibility of cooking and therefore, are exposed to detrimental health conditions in absence of clean energy sources. In the light of this problem, increasing the use of improved cookstoves is expected to have a positive impact on women's health.

Punjab

The **New and Renewable Sources of Energy (NRSE) Policy – 2019** is **gender blind**. While it focuses on increasing the income of the farmers through solarisation of the grid-connected agricultural pumps to meet the irrigation needs and sell excess available energy to PSPCL/ LICENSEE, the policy document addresses farmers as 'him'. It indicates that this policy simply overlooks the differential gender roles and energy needs in agriculture.

Tamil Nadu

Tamil Nadu's solar energy policy 2019 is **gender-blind**, however, it has the provision of ensuring access to affordable, reliable, and quality energy for all (Pg 2 and 3). The policy mostly focuses on environmental protection and the welfare of the households. It indicates the policy assumes that individuals are part of households and that the benefits from any household-directed welfare should trickle down equally to the individuals in the household. But this ignores the intra-households gender differences in access to resources, different social roles, and agency when it comes to decisions around energy. If a policy isn't sensitive to these differences, then it may not achieve the impact it intended. Similarly, this policy aims to create green jobs through solar energy development, however, it is not mentioned in the document how to ensure that both women and men equally participate and benefit from the opportunities the green economy presents. The solar energy policy also mentions that suitable incentives will be designed to promote solar energy generation in the agriculture sector for the farmers, but what and how benefits can be availed is not mentioned in the policy document (Pg 9).

West Bengal

The **policy on co-generation and generation of electricity from renewable sources of energy, 2012** of West Bengal aims for accelerating development initiatives for the promotion of alternate energy sources in the State. While it mentions that RE project developers should try to generate local employment opportunities, however, does not provide any strategies for the same. In the entire document, there is no mention of the word 'women', 'gender', equality, equity, and inclusion.

Discussions: Opportunities and Gaps for GESI outcomes of WEF Policies, Programs

This assessment of the policy environment for SIPs provides some promising opportunities that provide frameworks for incorporating GESI more strongly in SIP programmes in India. We also recognize gaps in the GESI frameworks that could inform potential improvements for making more inclusive solar energy policies and SIP programmes.

1. National frameworks for policy-making can offer progressive transformative components for policies:

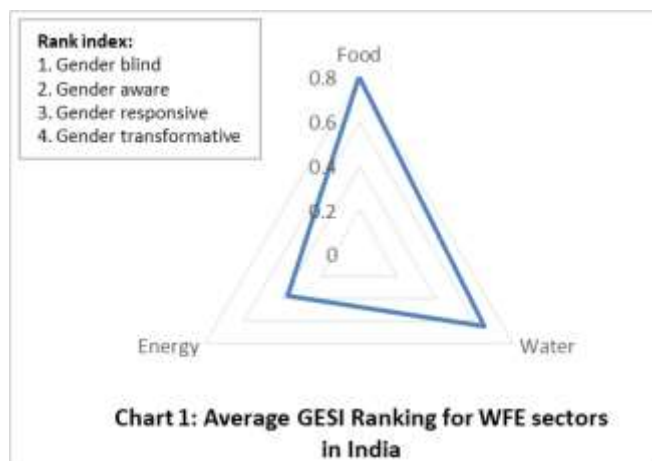
The national frameworks for policy making in India are progressive on many aspects with regard to GESI considerations. The acknowledgement of unequal access to resources and unequal outcomes in the development process is strong. Intersectional understanding of women across caste class and age groups, rather than as a homogenous category, is an important contribution of these frameworks. Further, commitments towards gender equality and dedicated policy for women and their empowerment at systemic levels affecting norms and underlying gender stereotyping is a strong addition to these frameworks. This is particularly with regard to devolution of powers decentralizing decision-making and governance to the grassroots levels, and participation therein. This offers an important opportunity for GESI inclusion at multiple scales and recognition of structural inequalities at the roots of society. If incorporated within WFE policies in India, they would make for a stronger and more inclusive policy framework for SIPs development in India.

However in recent policies there appears to be a trend of dilution of these GESI structures and decentralization in sectoral policies. While some implementation and managerial aspects decentralized and covered under broad terminologies of 'community participation', their involvement in planning and decision-making has been lower. More focus has emerged for growth and development founded on technological innovation, privatized market systems with a focus on financial feasibility with little focus on the social.

2. Learning from gaps in national frameworks:

Some tendencies in national frameworks which present gaps in the GESI considerations can inform WFE policies ensuring the emerging policies can be designed minding these gaps. One of the key gaps in this regard is the separation of gender and social inclusion as distinct sectors of interventions, not integrated as essential for just development in all sectors. Even a separate policy for women, while is a strength reflecting dedicated commitment to gender issues in the country, reproduces this idea that gender and women need to be considered as separate from other development sectors. There is a strong gender component in planning of certain sectors such as

nutrition, sanitation, and health. In economic sectors this component is either very weak or non-existent. This gets reflected in many policies considering inclusion of gender and marginalized sections as an afterthought, and completely missing from sectors that are considered more technical and not 'social' sectors. This appears to be particularly true for the energy sector policies and climate change related policies. Comparatively the agriculture sector policies have better incorporation of GESI in India. However, even in this sector this integration of GESI is significantly diluted in recent policies.

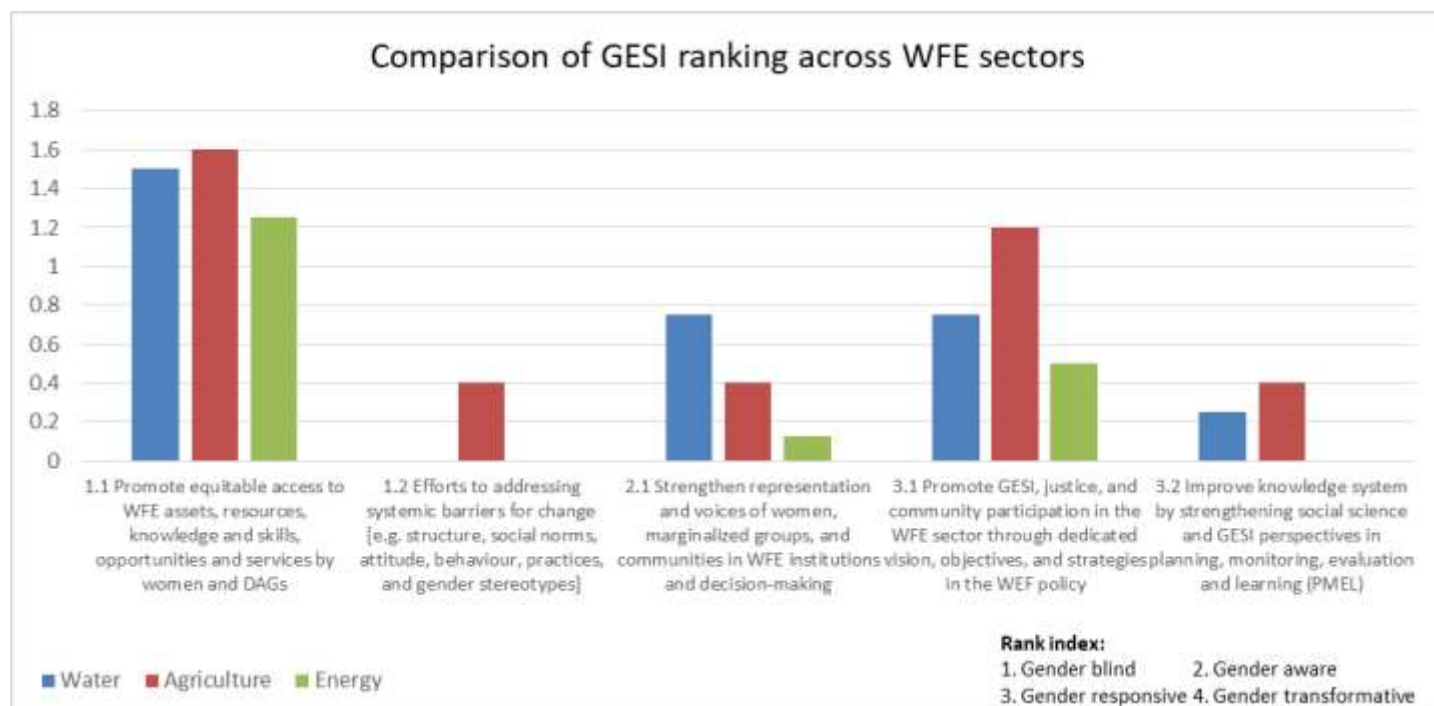


Secondly, while the national planning framework acknowledges unequal gender outcomes of development, there is a lack of recognition of underlying socio-structural roots of the same. As a result the responses are more a response to proximate inequalities in resource access but fail to target the roots that create unequal access to policy benefits in the first place (Chakraborty et.al 2018). This is also evident in the WFE policies in India.

3. Gender-blind to Gender-aware national WFE sector policies:

The sectoral analysis of WFE analysis reveals that on an average, taken all together, the sectoral policies are largely gender blind, with some policies being gender aware. Of the 17 central policy documents reviewed only 4 policies have attained an average rank of 1 or above. With regard to specific indicators indicator 1.1 ranks as gender aware. This is line with the focus on proximate inequalities in resource access on national frameworks rather than on systemic and structural roots of inequalities. Relational and structural indicators have fared significantly worse in the policies.

There are ofcourse variations among sectors. The agriculture sector shows a higher rank averaging 0.8, with gender aware ranking to two indicators, as opposed to the water and energy sectors. Different policies under this sector has different focus areas on different marginalized groups. The national policy on farmers brings focus to varied social sections including women, small and marginal farmers, tribal farmers, landless, and the youth. Food security policy focuses on women strongly and other policies have a recognition of vulnerability of small and marginal farmers. The water sector has brought focus to the right to water as a basic right to life, but despite immense focus on literature on the inequalities in water access (Paul 2017, van Koppen 2007, Zwarteveen 2008), has almost no measures that go beyond the recognition of the right to ensure its implementation.



The energy sector is stark in its absence of inclusion of the social in its policy purview. The focus on GESI ended with the reported completion of rural household electrification. Therefore while older policies had a focus on women and tribal communities for ensuring access and participation in committees, more recent policy documents have lost even the social focus, let alone GESI considerations. With the shift of discourse towards

climate change mitigation and renewable energy, energy policies have turned their focus entirely to techno-financial considerations. Further, inclusion of the 'social' in knowledge generation, research, and data generation is overwhelmingly in technology, technical skills, scientific R&D, and hydro-climatic and spatial datasets. Only the National Water Policy and the National Policy on Farmers has mention of interdisciplinary knowledge (water policy) and gender-sensitive curriculum (policy on farmers). The progressive intersectional gender inclusive participation at different levels of decision-making framed in the constitution are largely missing from the sectoral policies except in two policies. The energy sector performing particularly poorly in this regard. In this sector, the centralization of policy making has almost excluded community involvement in decision-making platform reducing the grassroots to mere beneficiaries of services.

4. Missing recognition and responses for systemic barriers and transformative directions

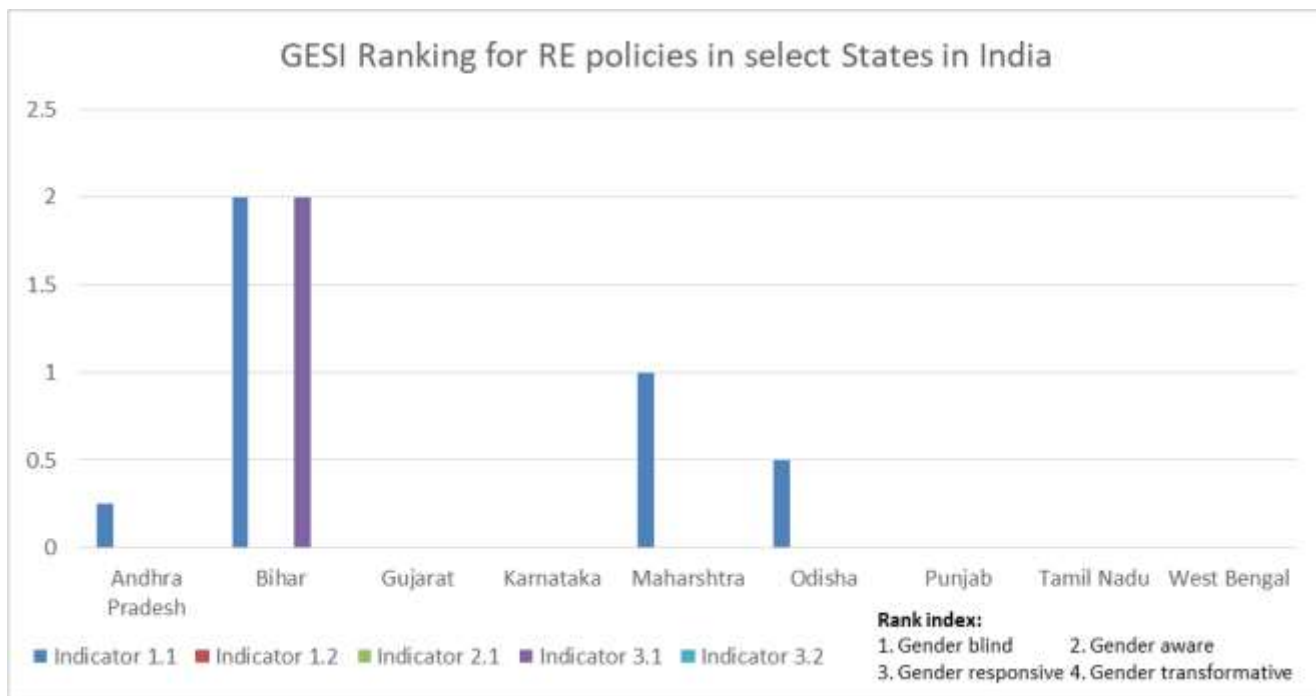
The most marked in its absence is the recognition and response to systemic barriers emanating from gendered norms, practices, and social stereotypes. This is concerning as success of policy implementation and equal distribution of policy benefits first and foremost emanates from access to these policies. Systemic barriers to these policies can diminish the efficacy of policies. Therefore even the gender-responsive measures taken up by policy will end up being poorly manifested in actual results. This may be seen even in the case of participation where the little focus there is on representation is limited by any recognition of systemic constraints women face in male dominated decision-making groups and therefore offer no specific measure to challenge these barriers. The lack of focus on the 'social' in knowledge creation and research only stands to widen this gap in policy. It is also notable that none of the indicators have been ranked as gender-transformative in the analysis. The lack of focus on systemic indicators also seeps into a general lack of transformative lenses to viewing the problem and consequently the prescription for other relational and structural indicators. These include intersectionality in agency and participation, underlying visions and objectives of justice, recognition and realization of rights, and socially inclusive knowledge generation. All of these emerge essentially from a firm understanding of systemic roots of discrimination and inequalities.

The introduction of a relational understanding of gender, including men into the purview of its interventions in the recent Draft National Policy for Women 2016 offers a promising framework for policy for strengthening the systemic undertaking of policy responses. However the lack of integration between gender/social inclusion with other economic sectors in planning could potentially hinder the translation of this progressive addition to sectoral policies of WFE.

5. Gender-blind energy sector policies:

As mentioned earlier, among the three sectors, the energy sector is the most glaring in its omission of GESI consideration, especially in recent policy focus. The shifting focus of energy policies away from rural electrification to promoting the renewable energy sector has led to an intensification of the techno-financial focus of the policy. The devolution of decision-making and governance to the grassroots has shifted to a centralized scheme of decision-making with the increased inclusion of the private sector in this policy environment. While there is a continued commitment to rural electrification for "all", the recognition of inequalities in energy access, burdens and benefits within the household is missing (Clancy et.al 2003)⁶⁹. Also this social inclusion component in policy does not move beyond household electrification and cooking fuel and does not extend to irrigation and other rural energy uses such as street lighting, transportation, community buildings, which literature reveals also has significant gender implications (Oparaocha and Dutta 2011, Boomsma and Steg 2014, Wong 2019)⁷⁰⁷¹. Women are only mentioned in sections discussing cooking fuel and stereotypes women to their domestic roles in the social structure.

This gender blindness of the national energy policy framework translates to gender blind renewable energy policies at the state level. The policies are oriented towards technical aspects of energy (its generation, transmission, distribution, efficiency, regulation etc) completely missing out on its social component, let alone aspects of equity. However some of the solar schemes initiated by the government has brought in measures to benefit small and marginal farmers, but no gender component and no focus on other social groups such as backward caste, tribal, and minority groups. Provision of subsidy is a major component of these schemes are stated to promote affordability of the technology. However the priority and agenda for this subsidy is focused more on fast tracking market penetration than a promotion of equity. However some other measures such as applying a cap on land ownership and pump horsepower are focused on an equity objective. Integration of these subsidies with other conditions such as land ownership, tubewell ownership, micro-irrigation ownership play a role in diminishing the intended impact for equity (Bassi 2018). The gender blindness of renewable energy policies at the state level are discouraging for gender inclusion in SIPs unless brought in with a mandated focus in specific policies. As of now, the policy frameworks for the schemes do not incorporate GESI provisions. While the new National Energy Policy 2017 continues to be in draft phase, it is yet to be seen if the final version of policy bridges this gap.



6. Limited conceptualization of inequality and inclusion:

Despite the scattered inclusion of women in some of the policies analysed here, it is worthwhile to note that these policies do not take a relational understanding of women’s backwardness and lack of economic participation. As a result there is an overall reduction of ‘gender’ inequality to women and women empowerment. Inequality is understood only through its proximate manifestations of unequal access to resources, skills, and services (agency). The focus on women is disproportionately high in sectors of health, nutrition, and sanitation. Their inclusion in agriculture sector is mostly through their high involvement in allied activities. The typecasting of women’s role in the domestic realm and unpaid informal employment is evident. The sociopolitical structures creating these manifestations are not recognized and acknowledged. This gap may emerge both from knowledge gaps as well as political underpinnings. Socio-structural aspects of gender are closely intersected by structures of

class, caste, and religion (Joshi 2011, Rao 2018)⁷². These social structures are often rigid and well integrated into political structures of power and governance in India. As seen in this review, even now land ownership and inheritance rights emerge from religious personal laws in India which only strengthens the claims of caste and religious structures roles in determining gender relations. The stark omission of a focus on interdisciplinary research and data in the sectoral policies will add further to this lack of understanding of the systemic and structural in the continued marginalization and exclusion of women from policy benefits even after 70 years of post-independence planning. This has a long term degenerative impact on policy's ability to ensure gender inclusion at transformative levels. Tokenistic GESI can only go so far in ensuring true inclusion and will only continue to reproduce inequalities despite policy efforts.

The overarching objective of this study is to understand the conceptualisation, framework, recognition, and measures of social inclusion provided for in the policy environment of SIPs to enable more inclusive promotion of SIPs. The national policy frameworks have offered progressive conceptualizations and measures that can enable strong policy practices. But recent trends of centralization and dilution of the 'social' is concerning and special care must be taken to ensure that these trends do not seep into schemes and their implementation. The lack of appreciation of systemic barriers for marginalized sections of society also reduce efficacy of policies. Supporting policies and scheme designs with strong research, pilot studies, and evidence generation would go a long way in informing transformative scheme design and structure. The fact that solar schemes in the country have shown GESI considerations despite the lack of same in the policies, shows that designing of new schemes do present opportunities for inclusion of new emerging conceptualisations and evidence-based research.

Conclusion – Highlights of the study

The review analysis conducted here offers the following highlights:

- National frameworks for policy-making in India - including the constitution, planning documents, international commitments, land laws, and policies for women – offer progressive frameworks for GESI. It envisions gender and social equality in participation in governance, planning, and implementation. Intersectional understanding of women across caste class and age groups, rather than as a homogenous category, is an important contribution of these frameworks. Additionally a transformative view of gender relation acknowledging and challenging systemic barriers of norms and attitudes is emerging in the frameworks which is progressive and can strengthen the level of gender inclusion in sectoral policies.
- National frameworks also offer provisions for devolution of governance to panchayats with mandates for representation and reservations for marginalised communities. This is an important provision allowing for GESI at the grassroot levels decision-making. Mandates for planning and implementation for the agricultural, water, electricity and non-conventional energy (among WFE sectors) are provided to this devolved level of governance. This provides opportunities for incorporating context specificity and locational specific social relations in policy planning and implementation frameworks.
- National frameworks also suffer from some gaps in relation to integration of gender and social inclusion interventions and planning in economic and other growth oriented development sectors. While a dedicated treatment of gender and social inclusion is a much needed approach to overcome broad umbrella treatment of society and community assuming inherent homogeneity, it's absence from planning sections of other sectors is concerning. The dedicated treatment of GESI should not lead to its perception as a separate divorced "social sector" and thereby be bypassed while dealing with other sectors of economic growth.

- A total of 7 national framework documents, 17 WFE sectoral central policies, and 16 state level renewable energy policies were reviewed for this study. In addition one important national level solar irrigation scheme (PM KUSUM) was also reviewed given its core relevance to the theme of this study. We find that sectoral WFE policies on an average rank gender-blind with agriculture sector (0.8 rank) faring relatively better than water and energy sectors. Only 4 sectoral policies could get ranking of gender-aware averaging across all indicators. All state level renewable policies were ranked as strongly gender-blind.
- However there are variations in specific indicators. Indicator 1.1 related to “Promoting equitable access to WFE assets, resources, knowledge and skills, opportunities and services by women and Disadvantaged Groups” ranked the highest as gender-aware across all three sectors. 9 of the sectoral policies were found to be gender-responsive in this indicator. Indicator 1.2 which reflected “efforts to address systemic barriers for change” received the lowest average rank with only one policy being gender responsive in this category. All other policies were not even gender-aware in this regard. This is a critical finding showing that GESI in policy in India has been focused mostly on proximate inequalities in resource access but fail to target the roots that create unequal access to policy benefits in the first place.
- The energy sector’s omission of GESI is stark in policy with an almost exclusive focus on techno-financial and managerial focus of policy. This tendency is found to have further intensified in recent policies with shifting focus solely from rural electrification coverage to renewable energy promotion. Increasing tendency of centralization of its institutional framework is observed with lesser involvement of decentralized governance and community participation in decision-making. The private sector involvement has received a notable push in recent policies. Subsidy policies, though promoting affordability of renewable energy investments, are targeted at fast tracking of market penetration to drive down costs from scale. However there has been some GESI consideration in solar schemes through caps on land ownership or pump capacity to target small and marginal farmers. Gender considerations and any other socially marginalized categories are not considered in the scheme.
- This gender-blindness of national energy policies is also reflected widely in state level renewable energy policies. While some schemes at the state level have taken up considerations of GESI through targeting subsidy beneficiaries, the policy documents themselves are mostly gender blind. Only 3 policies are ranked gender aware and only one policy is gender aware on indicator 1.1. And only one policy has ranked gender responsive on indicator 3.1. All other indicators under 16 reviewed policies are gender blind.
- While there are some crucial opportunities provided by national frameworks, the trends emerging in sectoral policies are concerning for GESI as a policy environment for SIPs. Therefore with little support from larger sectoral policy environment, SIP policy designs will need to be structured with dedicated GESI focus. Given the gender-blindness of sectoral policies these GESI considerations for SIP schemes will not emerge strongly from its policy scaffolding.

Recommendations

Based on this review we identify here some gaps and opportunities that would help strengthen GESI

1. Exhaustive wide scope policy review:

The policy environment in India is vast and complex emerging from varied sectors and across different states. An exhaustive wide scope review of policies including state policies and operational specifications of schemes would

provide a stronger understanding of GESI frameworks in policies as there are considerations in schemes that are not necessarily specified or mandated in wider policy documents. Specific government schemes and programmes tend to emerge and evolve faster than changing policy visions across shifting governance regimes. Therefore while wider policies give significant insight into conceptualisations and sectoral priorities, they may not reflect all GESI considerations included in specific schemes.

2. Stronger research base on social aspects of renewable energy, particularly solar energy in India:

Much of the gender awareness in planning frameworks emerge from existing social research and assessments developed and consolidated over a long period. Strengthening social research in energy, particularly in solar energy, can therefore provide support of evidence for GESI in the sector. A strong social research base in the sector with evidence for GESI can offer a foundation for gender aware and gender responsive sectoral planning. Scheme impact assessments, pilots, action research, and transdisciplinary knowledge co-production with multiple stakeholders can be important methods of social research to offer adequate evidence for policy. Learning from emerging cases and studies globally and regionally could also offer a strong database for research.

Involvement of interdisciplinary teams within and beyond social sciences can provide a linkage with the sector's current techno-managerial focus and social considerations. In doing so robust social research methods can also translate knowledge on systemic barriers and structural roots of inequalities to actionable transformative policy measures.

3. Evidence based research and advocacy for gender inclusion in SIP schemes and pilots:

Since there is no focus on social research and gender-aggregated data development in sectoral policies currently, strong advocacy would be necessary to complement the strong social research base. Participatory action research involving co-production of knowledge with multiple stakeholders can provide a starting point for advocacy (Swilling 2014)⁷³ initiating early dialogue on GESI in the sector, particularly in SIP scheme designs.

4. Mobilise progressive provisions of the national framework in energy policies:

The national frameworks in India offer some progressive provisions for participation, decentralized governance and decision-making, and focus on equality. However their incorporation in sectoral policies have either not translated or diminished over time. Mobilising these provisions in emerging draft policies and schemes can offer strong GESI considerations in energy policies and schemes.

5. Recognise co-benefits and impacts of SIPs across the WFE nexus:

In order contribute to effective GESI considerations for SIP policies it is essential to understand SIPs in their larger context of the WFE nexus rather than assessing them only for their energy access components. If developments and scheme designs in solar irrigation do not consider co-benefits or externalities in other sectors in the nexus, apparently beneficial provisions for one sector could be undone through negative impacts in other sectors (Shah et.al 2018, Beaton et.al 2019). These externalities would also be relevant for GESI considerations in other sectors.

REFERENCES:

- Agrawal, S., & Jain, A. (2019). Sustainable deployment of solar irrigation pumps: Key determinants and strategies. *Wiley Interdisciplinary Reviews: Energy and Environment*, 8(2), e325.

- Ahmed, S (2004) Gender Issues in Agriculture and Rural Livelihoods Volume 1. Chennai: M. S. Swaminathan Research Foundation and Thrissur: Kerala Agricultural University
- Alvi, M., Barooah, P., Gupta, S., & Saini, S. (2021). Women's access to agriculture extension amidst COVID-19: Insights from Gujarat, India and Dang, Nepal. *Agricultural Systems*, 188, 103035.
- Anupama Mehta. 2022, "Gender Gap in Land Ownership," accessed July 10, 2022, https://www.ncaer.org/news_details.php?nID=252&nID=252.
- B. van Koppen, G, Rai, and R.Rathod (2018) *Gender and social analysis of the Dhundi Solar Cooperative, Gujarat*. Findings from the field visits 3-4 March 2018 , IWMI , IWMI
- Bansari Kamdar and Shreyasee Das, "Women Grow as Much as 80% of India's Food – but Its New Farm Laws Overlook Their Struggles," *The Conversation*, accessed July 10, 2022, <http://theconversation.com/women-grow-as-much-as-80-of-indias-food-but-its-new-farm-laws-overlook-their-struggles-155083>.
- Bassi, N. (2015). Irrigation and energy nexus: Solar pumps are not viable. *Economic and political weekly*, 63-66.
- Bassi, N. (2015). Irrigation and energy nexus: Solar pumps are not viable. *Economic and political weekly*, 63-66.
- Beaton, C., Jain, P., Govindan, M., Garg, V., Murali, R., Roy, D., ...& Pallaske, G. (2019). *Mapping Policy for Solar Irrigation Across the Water-Energy-Food (WEF) Nexus in India*. Winnipeg, Manitoba, Canada: International Institute for Sustainable Development.
- Bhattacharya, B., & Rani, G. J. (1995). Gender in agriculture: An Asian perspective. *Asia-Pacific Journal of Rural Development*, 5(1), 27-48.
- Bina Agarwal, Pervesh Anthwal, and Malvika Mahesh (2021), "How Many and Which Women Own Land in India? Inter-Gender and Intra-Gender Gaps," *The Journal of Development Studies* 57, no. 11 (November 2, 2021): 1807–29,
- Boomsma, C., & Steg, L. (2014). Feeling safe in the dark: Examining the effect of entrapment, lighting levels, and gender on feelings of safety and lighting policy acceptability. *Environment and Behavior*, 46(2), 193-212.
- Burney, J., Alaofè, H., Naylor, R., & Taren, D. (2017). Impact of a rural solar electrification project on the level and structure of women's empowerment. *Environmental Research Letters*, 12(9), 095007.
- Chakraborty, S., Goyal, M., Rao, A., Sen, S., Jain, S., & Manoj, J. (2018). Drought Preparedness of Vulnerable Sections in Rural Telangana. *SaciWATERs*.
- Choudhuri, P., & Desai, S. (2020). Gender inequalities and household fuel choice in India. *Journal of cleaner production*, 265, 121487.
- Clancy, J. S., Skutsch, M., & Batchelor, S. (2003). The Gender-Energy-Poverty Nexus: Finding the energy to address gender concerns in development. *DFID project CNTR998521*.
- Dewan, R. (2016). Contextualising and visibilising gender and work in Rural India: Economic contribution of women in agriculture. *Indian Journal of Agricultural Economics*, 71(1), 49-58.
- DoAFW. (2018). Re-Vamped National Food Security Mission (Nfsm) Operational Guidelines (2018-19 to 2019-20). Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India ([NFSM12102018.pdf](#))

- Dubash, N. K. (2002). *Tubewell capitalism: groundwater development and agrarian change in Gujarat*. Oxford University Press.
- FAO. 2011. [The State of Food and Agriculture 2010-2011 \(SOFA\)](#). Food And Agriculture Organization Of The United Nations Rome, 2011
- Garg, V. (2018). India: Vast potential in solar-powered irrigation. *Institute for Energy Economics and Financial Analysis, Cleveland, Ohio*.
- Ghosh, M., & Ghosh, A. (2014). Analysis of women participation in Indian agriculture. *IOSR J. Human. Soc. Sci*, 19(5), 1-6.
- GoI (2020). "Periodic Labour Force Survey" Ministry of Statistics and Programme Implementation, Government of India, June 2020, New Delhi,
- Gupta, S., Pingali, P. L., & Pinstrip-Andersen, P. (2017). Women's empowerment in Indian agriculture: does market orientation of farming systems matter?. *Food security*, 9(6), 1447-1463.
- Hartung, H., & Pluschke, L. (2018). The benefits and risks of solar powered irrigation. *Rome (Italy): Food and Agriculture Organization*.
- Hussain, I. (2007). Understanding gender and diversity dimensions of irrigation management for pro-poor interventions. *Irrigation and Drainage: The journal of the International Commission on Irrigation and Drainage*, 56(2-3), 299-305.
- IEA, 2015, India energy outlook -special report (<https://www.iea.org/reports/india-energy-outlook-2015>)
- IRENA. (2016). *Solar pumping for irrigation: Improving livelihoods and sustainability*. Abu Dhabi: The International Renewable Energy Agency (IRENA).
- Joshi, D. (2011). Caste, gender and the rhetoric of reform in India's drinking water sector. *Economic and Political Weekly*, 56-63.
- Kabeer, N. 1999. From Feminist Insights to an Analytical Framework. An institutional perspective on gender inequality. *In: Kabeer, N. & Subrahmanian, R. (eds.) Institutions, Relations and Outcomes*. New Delhi: Kali for Women
- Kapoor, K., Pandey, K. K., Jain, A. K., & Nandan, A. (2014). Evolution of solar energy in India: A review. *Renewable and Sustainable Energy Reviews*, 40, 475-487.
- Kelkar, G. (2010). "The feminization of agriculture in Asia: Implications for women's agency and productivity". Retrieved June 13, 2022 from <http://www.agnet.org/library/eb/594>.
- Khadka, M., Uprety, L., Shrestha, G., Mukherji, A. & Mitra, A. 2021c. Do Water, Energy and Food Nexus Policies Enable Gender Transformative Changes? Evidence from Bangladesh and Nepal, September, 2021. IWMI-Nepal.
- KPMG. (2014). Feasibility analysis for solar agricultural water pumps in India. Shakti Sustainable Energy Foundation, January 2014.
- Kulkarni, S. (2016). Gender and water in India: A review. *Indian Water Policy at the Crossroads: Resources, Technology and Reforms*, 73-91.
- Leder, S., Sugden, F., Raut, M., Ray, D., & Saikia, P. (2019). Ambivalences of collective farming: Feminist political ecologies from the Eastern Gangetic Plains. *International Journal of the Commons*, 13(1).

- Lucy Dubochet, "When Women Farm India's Land: How to Increase Ownership?," Oxfam Policy Brief no. 8 (2013): 4.
- Ministry of Agriculture and Farmer's Welfare (MoAFW), 2019. Annual Report: 2018- 2019. Department of Agriculture, Cooperation and Farmer's Welfare, New Delhi.
- MNRE 2021. Annual Report. Ministry of New and Renewable Energy, Government of India (https://mnre.gov.in/img/documents/uploads/file_f-1618564141288.pdf)
- MNRE, 2014, Annual report, Ministry of New and Renewable Energy, Government of India
- MoAFW (undated). Farm Women Friendly Hand Book. National Gender Resource Centre, Agriculture Ministry of Agriculture & Farmers Welfare, Government of India
- MoAFW. 2019. Agriculture Census 2015-16 Phase 1 Report. Agriculture Census Division Department of Agriculture, Co-Operation & Farmers Welfare Ministry of Agriculture & Farmers Welfare, Government Of India
- Moench, M. H. (1992). Chasing the watertable: Equity and sustainability in groundwater management. *Economic and Political Weekly*, A171-A177.
- Naz, F. (2015). Water, water lords, and caste: a village study from Gujarat, India. *Capitalism Nature Socialism*, 26(3), 89-101.
- NITI Aayog. (2017). *India three year action agenda 2017-18 to 2019-20*. New Delhi: NITI Aayog.
- NITI Aayog. (2018). *The strategy for New India@75*. New Delhi: NITI Aayog.
- Oparaocha, S., & Dutta, S. (2011). Gender and energy for sustainable development. *Current Opinion in Environmental Sustainability*, 3(4), 265-271.
- Oxfam (2022). "India: Women Farmers Persevere," Oxfam International, May 25, 2022, <https://www.oxfam.org/en/india-women-farmers-persevere>.
- Pattnaik, I., & Lahiri-Dutt, K. (2017). Tracking Women in Agriculture through Recent Census Data in India. Working Paper series (No. 242), Gujarat Institute of Development Research, Gujarat.
- Pattnaik, I., Lahiri-Dutt, K., Lockie, S., & Pritchard, B. (2018). The feminization of agriculture or the feminization of agrarian distress? Tracking the trajectory of women in agriculture in India. *Journal of the Asia Pacific Economy*, 23(1), 138-155.
- Rao, Harsha V., and Disha Agarwal. 2021. How India's Solar and Wind Policies Enabled its Energy Transition: A Decade in Review. New Delhi: Council on Energy, Environment and Water
- Rao, S. (2018). Gender and class relations in rural India. *The Journal of Peasant Studies*, 45(5-6), 950-968.
- Raymond, A., & Jain, A. (2018). Solar for irrigation—A comparative assessment of deployment strategies. *Council on Energy, Environment and Water, Thapar House*, 124.
- Sambodhi, & Dalberg. (2018). Impact assessment of the National Solar Pumps Programme. New Delhi, India: Shakthi Foundation.
- Sarkar, A. (2012). Equity in access to irrigation water: A comparative analysis of tube-well irrigation system and conjunctive irrigation system. *Problems, perspectives and challenges of agricultural water management*, 1-18.

- Seethalakshmi, S. (2017). *Gender Responsive Budgeting: A Focus on Agriculture Sector*, New Delhi, India: United Nations Entity for Gender Equality and the Empowerment of Women (UN Women).
- Shah, T. (2010). *Taming the anarchy: Groundwater governance in South Asia*. Routledge.
- Shah, T., Rajan, A., Rai, G. P., Verma, S., & Durga, N. (2018). Solar pumps and South Asia's energy-groundwater nexus: exploring implications and reimagining its future. *Environmental Research Letters*, 13(11), 115003.
- Shirsath PB, Saini S, Durg N, Senoner D, Ghose N, Verma S, Sikka A. 2020. Compendium on Solar Powered Irrigation Systems in India. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- Singh, K. M., Meena, M. S., Kumar, A., & Singh, R. K. P. (2013). "An Overview of Gender Issues in Agriculture." *SSRN Electronic Journal* 5(34) : 1-9
- Sucharita Sen et al., Summary Report: Understanding Women's Role in Agriculture in the Eastern Gangetic Basin: The Macro and Micro Connections, 2019, <https://doi.org/10.13140/RG.2.2.18212.42880>.
- Sugden, F. (2016). Tenant Collectives in the Eastern Gangetic Plains – A New Model for Bottom Up Irrigation and Land Management for Marginal Women Farmers. 2nd World Irrigation Forum 6-8 November 2016, Chiang Mai, Thailand
- Swilling, M. (2014). Rethinking the science-policy interface in South Africa: experiments in knowledge co-production. *South African Journal of Science*, 110(5-6), 01-07.
- Tanusree, P. (2017). Viewing national water policies through a gendered lens. *Economic and Political Weekly*, 52(48).
- UN (1966). International Covenant on Economic, Social and Cultural Rights. General Assembly resolution 2200A (XXI). United Nations (<https://www.ohchr.org/sites/default/files/cescr.pdf>)
- UN (1979). Convention on the Elimination of All Forms of Discrimination against Women. UN General Assembly (<https://www.un.org/womenwatch/daw/cedaw/text/econvention.htm>)
- USAID (2018). Greenhouse Gas Emissions in India. Factsheet: India. <https://www.climatelinks.org/sites/default/files/asset/document/India%20GHG%20Emissions%20Factsheet%20FINAL.pdf>
- Van Koppen, B. (1998). Water rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development. *Agriculture and Human Values*, 15(4), 361-374.
- Van Koppen, B., & Hussain, I. (2007). Gender and irrigation: overview of issues and options. *Irrigation and Drainage: The journal of the International Commission on Irrigation and Drainage*, 56(2-3), 289-298.
- Varsha Khandker, Vasant P. Gandhi, and Nicky Johnson, (2020) "Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India," *Water* 12, no. 1 (January 2020): 196, <https://doi.org/10.3390/w12010196>.
- Wong, S. (2019). Decentralised, off-grid solar pump irrigation systems in developing countries—Are they pro-poor, pro-environment and pro-women?. In *Climate change-resilient agriculture and agroforestry* (pp. 367-382). Springer, Cham.

- Yashodha, Y.; Sanjay, A.; Mukherji, A. 2021. Solar irrigation in India: a situation analysis report. Colombo, Sri Lanka: International Water Management Institute (IWMI). 29p. doi: <https://doi.org/10.5337/2021.217>
- Zwarteveen, M. (2008). Men, masculinities and water powers in irrigation. *Water Alternatives*, 1(1), 111.

ANNEXURE 1

List of Policies reviewed for study

NATIONAL FRAMEWORKS FOR POLICIES
Constitution of India
Niti Aayog, 3 Year Action Plan
Niti Aayog, Strategy for New India @75 - 7 year strategy
Draft National Policy for Women 2016
National Policy for Empowerment of Women 2001
Hindu Succession (Amendment) Act 2015
Muslim Personal Law (Shariyat) Act 1956

SECTORAL POLICIES: WATER	STATE RENEWABLE ENERGY POLICIES	
National Water Policy 2012	Renewable Energy Export Policy, 2020	Andhra Pradesh
Draft National Water Framework Bill 2016	Solar Power Policy 2018	
Draft Model Bill for Conservation, Protection, and Regulation of Groundwater, 2016	Wind Power Policy 2015	
National Water Mission	Wind Solar Hybrid Power Policy 2018	
SECTORAL POLICIES: AGRICULTURE	Bihar policy for promotion of New and Renewable Energy Sources 2017	Bihar
National Policy on Farmers 2007	Small Hydel Power Policy 2016	Gujarat
National Mission for Sustainable Agriculture	Solar power policy 2021	
Doubling Farmers' Income	Wind Power Policy 2016	
National Food Security Act 2013	Wind-Solar Hybrid power policy 2018	
Draft National Land Utilisation Policy	Draft Renewable Energy Policy 2021-2026	Karnataka
SECTORAL POLICIES: ENERGY	Unconventional Energy Generation Policy 2020	Maharashtra
Draft National Energy Policy 2017	Renewable energy policy 2016	Odisha
Draft National Electricity Policy 2021	Solar Policy 2013	
National Electricity Policy 2005	New and Renewable Sources of Energy Policy 2019	Punjab
National Rural Electrification Policy, 2006	Solar Energy Policy 2019	Tamil Nadu
National Solar Mission	Renewable energy policy 2012	West Bengal
Electricity Act 2003		
National Mission on Enhanced Energy Efficiency Framework		
Electricity Act 2003		

¹Kapoor, K., Pandey, K. K., Jain, A. K., & Nandan, A. (2014). Evolution of solar energy in India: A review. *Renewable and Sustainable Energy Reviews*, 40, 475-487.

² USAID (2018). Greenhouse Gas Emissions in India. Factsheet: India.

<https://www.climatelinks.org/sites/default/files/asset/document/India%20GHG%20Emissions%20Factsheet%20FINAL.pdf>

³IEA, 2015, India energy outlook -special report (<https://www.iea.org/reports/india-energy-outlook-2015>)

⁴Yashodha, Y.; Sanjay, A.; Mukherji, A. 2021. Solar irrigation in India: a situation analysis report. Colombo, Sri Lanka: International Water Management Institute (IWMI). 29p. doi: <https://doi.org/10.5337/2021.217>

⁵Shah, T., Rajan, A., Rai, G. P., Verma, S., & Durga, N. (2018). Solar pumps and South Asia's energy-groundwater nexus: exploring implications and reimagining its future. *Environmental Research Letters*, 13(11), 115003.

⁶Dubash, N. K. (2002). *Tubewell capitalism: groundwater development and agrarian change in Gujarat*. Oxford University Press.

⁷Van Koppen, B. (1998). Water rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development. *Agriculture and Human Values*, 15(4), 361-374.

⁸Naz, F. (2015). Water, water lords, and caste: a village study from Gujarat, India. *Capitalism Nature Socialism*, 26(3), 89-101.

-
- ⁹Sarkar, A. (2012). Equity in access to irrigation water: A comparative analysis of tube-well irrigation system and conjunctive irrigation system. *Problems, perspectives and challenges of agricultural water management*, 1-18.
- ¹⁰Kulkarni, S. (2016). Gender and water in India: A review. *Indian Water Policy at the Crossroads: Resources, Technology and Reforms*, 73-91.
- ¹¹Shah, T. (2010). *Taming the anarchy: Groundwater governance in South Asia*. Routledge.
- ¹²Raymond, A., & Jain, A. (2018). Solar for irrigation—A comparative assessment of deployment strategies. *Council on Energy, Environment and Water, Thapar House*, 124.
- ¹³Sambodhi, & Dalberg. (2018). Impact assessment of the National Solar Pumps Programme. New Delhi, India: Shakthi Foundation.
- ¹⁴B. van Koppen, G, Rai, and R.Rathod (2018) *Gender and social analysis of the Dhundi Solar Cooperative, Gujarat*. Findings from the field visits 3-4 March 2018 , IWMI , IWMI
- ¹⁵IRENA. (2016). Solar pumping for irrigation: Improving livelihoods and sustainability. Abu Dhabi: The International Renewable Energy Agency (IRENA).
- ¹⁶Wong, S. (2019). Decentralised, off-grid solar pump irrigation systems in developing countries—Are they pro-poor, pro-environment and pro-women?. In *Climate change-resilient agriculture and agroforestry* (pp. 367-382). Springer, Cham.
- ¹⁷ Sugden, F. (2016). Tenant Collectives in the Eastern Gangetic Plains – A New Model for Bottom Up Irrigation and Land Management for Marginal Women Farmers. 2ndWorld Irrigation Forum 6-8 November 2016, Chiang Mai, Thailand
- ¹⁸Shirsath PB, Saini S, Durg N, Senoner D, Ghose N, Verma S, Sikka A. 2020. Compendium on Solar Powered Irrigation Systems in India. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- ¹⁹Burney, J., Alaofè, H., Naylor, R., & Taren, D. (2017). Impact of a rural solar electrification project on the level and structure of women's empowerment. *Environmental Research Letters*, 12(9), 095007.
- ²⁰Leder, S., Sugden, F., Raut, M., Ray, D., & Saikia, P. (2019). Ambivalences of collective farming: Feminist political ecologies from the Eastern Gangetic Plains. *International Journal of the Commons*, 13(1).
- ²¹Ghosh, M., & Ghosh, A. (2014). Analysis of women participation in Indian agriculture. *IOSR J. Human. Soc. Sci*, 19(5), 1-6.
- ²²Pattnaik, I., Lahiri-Dutt, K., Lockie, S., & Pritchard, B. (2018). The feminization of agriculture or the feminization of agrarian distress? Tracking the trajectory of women in agriculture in India. *Journal of the Asia Pacific Economy*, 23(1), 138-155.
- ²³Bhattacharya, B., & Rani, G. J. (1995). Gender in agriculture: An Asian perspective. *Asia-Pacific Journal of Rural Development*, 5(1), 27-48.
- ²⁴Dewan, R. (2016). Contextualising and visibilising gender and work in Rural India: Economic contribution of women in agriculture. *Indian Journal of Agricultural Economics*, 71(1), 49-58.
- ²⁵Hussain, I. (2007). Understanding gender and diversity dimensions of irrigation management for pro-poor interventions. *Irrigation and Drainage: The journal of the International Commission on Irrigation and Drainage*, 56(2-3), 299-305.
- ²⁶Van Koppen, B., & Hussain, I. (2007). Gender and irrigation: overview of issues and options. *Irrigation and Drainage: The journal of the International Commission on Irrigation and Drainage*, 56(2-3), 289-298.
- ²⁷Chakraborty, S., Goyal, M., Rao, A., Sen, S., Jain, S., & Manoj, J. (2018). Drought Preparedness of Vulnerable Sections in Rural Telangana. SaciWATERS.
- ²⁸Garg, V. (2018). India: Vast potential in solar-powered irrigation. *Institute for Energy Economics and Financial Analysis, Cleveland, Ohio*.
- ²⁹Agrawal, S., & Jain, A. (2019). Sustainable deployment of solar irrigation pumps: Key determinants and strategies. *Wiley Interdisciplinary Reviews: Energy and Environment*, 8(2), e325.
- ³⁰Bassi, N. (2015). Irrigation and energy nexus: Solar pumps are not viable. *Economic and political weekly*, 63-66.
- ³¹KPMG. (2014). Feasibility analysis for solar agricultural water pumps in India. Shakti Sustainable Energy Foundation, January 2014.
- ³²Hartung, H., & Pluschke, L. (2018). The benefits and risks of solar powered irrigation. *Rome (Italy): Food and Agriculture Organization*.
- ³³Khadka, M., Uprety, L., Shrestha, G., Mukherji, A. & Mitra, A. 2021c. Do Water, Energy and Food Nexus Policies Enable Gender Transformative Changes? Evidence from Bangladesh and Nepal, September, 2021. IWMI-Nepal.
- ³⁴Kabeer, N. 1999. From Feminist Insights to an Analytical Framework. An institutional perspective on gender inequality. In: Kabeer, N. & Subrahmanian, R. (eds.) *Institutions, Relations and Outcomes*. New Delhi: Kali for Women
- ³⁵Beaton, C., Jain, P., Govindan, M., Garg, V., Murali, R., Roy, D., ...& Pallaske, G. (2019). *Mapping Policy for Solar Irrigation Across the Water-Energy-Food (WEF) Nexus in India*. Winnipeg, Manitoba, Canada: International Institute for Sustainable Development.
- ³⁶ MNRE, 2014, Annual report, Ministry of New and Renewable Energy, Government of India
- ³⁷Rao, Harsha V., and Disha Agarwal. 2021. How India's Solar and Wind Policies Enabled its EnergyTransition: A Decade in Review. New Delhi: Council on Energy, Environment and Water

-
- ³⁸ MNRE 2021. Annual Report. Ministry of New and Renewable Energy, Government of India (https://mnre.gov.in/img/documents/uploads/file_f-1618564141288.pdf)
- ³⁹ MoAFW. 2019. Agriculture Census 2015-16 Phase 1 Report. Agriculture Census Division Department of Agriculture, Co-Operation & Farmers Welfare Ministry of Agriculture & Farmers Welfare, Government Of India
- ⁴⁰ "Periodic Labour Force Survey" (New Delhi: Ministry of Statistics and Programme Implementation, Government of India, June 2020),
- ⁴¹ Sucharita Sen et al., Summary Report: Understanding Women's Role in Agriculture in the Eastern Gangetic Basin: The Macro and Micro Connections, 2019, <https://doi.org/10.13140/RG.2.2.18212.42880>.
- ⁴² Ahmed, S (2004) Gender Issues in Agriculture and Rural Livelihoods Volume 1. Chennai: M. S. Swaminathan Research Foundation and Thrissur: Kerala Agricultural University
- ⁴³ Bansari Kamdar and Shreyasee Das, "Women Grow as Much as 80% of India's Food – but Its New Farm Laws Overlook Their Struggles," The Conversation, accessed July 10, 2022, <http://theconversation.com/women-grow-as-much-as-80-of-indias-food-but-its-new-farm-laws-overlook-their-struggles-155083>.
- ⁴⁴ Kelkar, G. (2010). "The feminization of agriculture in Asia: Implications for women's agency and productivity". Retrieved June 13, 2022 from <http://www.agnet.org/library/eb/594>.
- ⁴⁵ Pattnaik, I., & Lahiri-Dutt, K. (2017). Tracking Women in Agriculture through Recent Census Data in India. Working Paper series (No. 242), Gujarat Institute of Development Research, Gujarat.
- ⁴⁶ Anupama Mehta. 2022, "Gender Gap in Land Ownership," accessed July 10, 2022, https://www.ncaer.org/news_details.php?nID=252&nID=252.
- ⁴⁷ Bina Agarwal, Pervesh Anthwal, and Malvika Mahesh (2021), "How Many and Which Women Own Land in India? Inter-Gender and Intra-Gender Gaps," *The Journal of Development Studies* 57, no. 11 (November 2, 2021): 1807–29,
- ⁴⁸ Lucy Dubochet, "When Women Farm India's Land: How to Increase Ownership?," Oxfam Policy Brief no. 8 (2013): 4.
- ⁴⁹ "India: Women Farmers Persevere," Oxfam International, May 25, 2022, <https://www.oxfam.org/en/india-women-farmers-persevere>.
- ⁵⁰ Seethalakshmi, S. (2017). Gender Responsive Budgeting: A Focus on Agriculture Sector, New Delhi, India: United Nations Entity for Gender Equality and the Empowerment of Women (UN Women).
- ⁵¹ Ministry of Agriculture and Farmer's Welfare (MoAFW), 2019. Annual Report: 2018- 2019. Department of Agriculture, Cooperation and Farmer's Welfare, New Delhi.
- ⁵² Alvi, M., Barooah, P., Gupta, S., & Saini, S. (2021). Women's access to agriculture extension amidst COVID-19: Insights from Gujarat, India and Dang, Nepal. *Agricultural Systems*, 188, 103035.
- ⁵³ Tanusree, P. (2017). Viewing national water policies through a gendered lens. *Economic and Political Weekly*, 52(48).
- ⁵⁴ Singh, K. M., Meena, M. S., Kumar, A., & Singh, R. K. P. (2013). "An Overview of Gender Issues in Agriculture." *SSRN Electronic Journal* 5(34) : 1-9
- ⁵⁵ Gupta, S., Pingali, P. L., & Pinstруп-Andersen, P. (2017). Women's empowerment in Indian agriculture: does market orientation of farming systems matter?. *Food security*, 9(6), 1447-1463.
- ⁵⁶ FAO. 2011. [The State of Food and Agriculture 2010-2011 \(SOFA\)](#). Food And Agriculture Organization Of The United Nations Rome, 2011
- ⁵⁷ Varsha Khandker, Vasant P. Gandhi, and Nicky Johnson, (2020) "Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India," *Water* 12, no. 1 (January 2020): 196, <https://doi.org/10.3390/w12010196>.
- ⁵⁸ NITI Aayog. (2017). *India three year action agenda 2017-18 to 2019-20*. New Delhi: NITI Aayog.
- ⁵⁹ NITI Aayog. (2018). *The strategy for New India@75*. New Delhi: NITI Aayog.
- ⁶⁰ UN (1966). International Covenant on Economic, Social and Cultural Rights. General Assembly resolution 2200A (XXI). United Nations (<https://www.ohchr.org/sites/default/files/cescr.pdf>)
- ⁶¹ UN (1979). Convention on the Elimination of All Forms of Discrimination against Women. UN General Assembly (<https://www.un.org/womenwatch/daw/cedaw/text/econvention.htm>)
- ⁶² Joshi, D. (2011). Caste, gender and the rhetoric of reform in India's drinking water sector. *Economic and Political Weekly*, 56-63.
- ⁶³ Moench, M. H. (1992). Chasing the watertable: Equity and sustainability in groundwater management. *Economic and Political Weekly*, A171-A177.
- ⁶⁴ Zwartveen, M. (2008). Men, masculinities and water powers in irrigation. *Water Alternatives*, 1(1), 111.
- ⁶⁵ MoAFW (undated). Farm Women Friendly Hand Book. National Gender Resource Centre, Agriculture Ministry of Agriculture & Farmers Welfare, Government of India
- ⁶⁶ DoAFW. (2018). Re-Vamped National Food Security Mission (Nfsm) Operational Guidelines (2018-19 to 2019-20). Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India ([NFSM12102018.pdf](#))

-
- ⁶⁷Choudhuri, P., & Desai, S. (2020). Gender inequalities and household fuel choice in India. *Journal of cleaner production*, 265, 121487.
- ⁶⁸Bassi, N. (2015). Irrigation and energy nexus: Solar pumps are not viable. *Economic and political weekly*, 63-66.
- ⁶⁹Clancy, J. S., Skutsch, M., & Batchelor, S. (2003). The Gender-Energy-Poverty Nexus: Finding the energy to address gender concerns in development. *DFID project CNTR998521*.
- ⁷⁰Oparaocha, S., & Dutta, S. (2011). Gender and energy for sustainable development. *Current Opinion in Environmental Sustainability*, 3(4), 265-271.
- ⁷¹Boomsma, C., & Steg, L. (2014). Feeling safe in the dark: Examining the effect of entrapment, lighting levels, and gender on feelings of safety and lighting policy acceptability. *Environment and Behavior*, 46(2), 193-212.
- ⁷²Rao, S. (2018). Gender and class relations in rural India. *The Journal of Peasant Studies*, 45(5-6), 950-968.
- ⁷³Swilling, M. (2014). Rethinking the science-policy interface in South Africa: experiments in knowledge co-production. *South African Journal of Science*, 110(5-6), 01-07.