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Bright as night: Illuminating the antinomies of 'gender positive' solar development

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ABSTRACT

India is undergoing a rapid transition to renewable energy; the Gujarat Solar Park typifies this transition. In addition to mitigating climate change, the Gujarat Solar Park boasts female empowerment through social development schemes. This manuscript is inspired by the following research question: *To what extent are 'gender positive' processes and projects associated with solar development in India realized on the ground?* Utilizing mixed methods fieldwork and drawing on literature from feminist political ecology, this paper demonstrates how the modalities of solar park development represent an antinomy of a nature-society relation. New configurations of labor under the political economy of solar have produced a gendered surplus population of landless peasants who are not absorbed into wage-labor employment in the solar park. Further, associated social development schemes actually disempower women, despite mandates of 'gender positive' outcomes by UN-based climate treaties to which this project is beholden. The opportunity to participate in one such scheme for female empowerment was reserved for only women of middle-to-high class status and those of dominant castes, thereby reproducing class and caste-based social power asymmetries. Female (dis)empowerment eclipses 'gender positive' guarantees of the solar park. This study highlights some unintended consequences of sustainable energy transitions in the Global South at the local scale. Designing development interventions related to climate change mitigation that boast 'gender positive' outcomes must be careful not to exacerbate gender disparities and economic exclusion in rural areas.

1. Introduction

> "[The solar park developer] has initiated some significant participatory and non-participatory roles in the areas of upliftment of Women & Child." (Gujarat Power Corporation Limited, 2015)
>
> "How can we eat? We cannot find jobs at the solar park. . .We don't have land. The solar park took our land." (Rabari woman in Charanka village, 12 February 2018)

Throughout the Global South, anthropogenic climate change will have place-specific interactive effects on social systems that mediate people's differential exposure to environmental hazards (Birkenholtz, 2011). Exposure and sensitivity to climate-related impacts depends on one's own positionality in the political economy and within multiple and intersecting axes of social difference (e.g., gender, race, caste, class; see Djoudi et al., 2016; Sultana, 2014; Kaijser & Kronsell, 2014; Carr & Thompson, 2014; Osborne, 2015). Climate change vulnerability is especially pervasive among farming communities in Western India (Stock, Birkenholtz, & Garg, 2019; Birkenholtz, 2014; Jain, Naeem, Orlove, Modi, & DeFries, 2015). However, vulnerable farming populations do not receive adequate state assistance to adapt to climate change (Stock et al., 2019). Policies on climate change in India do not sufficiently address the issue of vulnerable populations and when they do, they often take a homogenous stance, ignoring the heterogeneous experiences of the vulnerable (Stock, Vij, & Ishtiaque, 2020). Further, policies and projects designed to mitigate climate change or assist vulnerable populations with adapting to climate change may also produce differential exposure for certain populations (Nightingale, 2017; Nagoda & Nightingale, 2017) due to their lack of attention to the political economic causality of vulnerability (Ribot, 2014; Taylor, 2015). This study demonstrates how institutional responses to the social dimensions of climate change may contradict mandates of reducing vulnerability and improving adaptive capacity of target populations (i.e. women). In doing so, this paper contributes to discussions of sustainable energy transitions in the Global South that share a normative commitment to gender equity by extending policy relevant analysis of solar interventions to inform development practice.

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1.1. Sustainable energy transitions: Gujarat Solar Park

In order to rapidly mitigate climate change, a global transition to renewable energy technologies is necessary, technically feasible and realizable within a reasonable temporal scale (Jacobson & Delucchi, 2011; Sovacool, 2016). States are building out their renewable energy infrastructures and shifting away from fossil fuels, representing sustainable innovations within socio-technical systems (Geels, 2004, 2011). Globally, the political economy of renewable energy transitions can reproduce asymmetrical power relations (Bridge, Bouzarovski, Bradshaw, & Eyre, 2013; McEwan, 2017; Kennedy, 2018; Lawhon & Murphy, 2012; Newell & Phillips, 2016; Cantoni & Rignall, 2019; Siamanta, 2018). In the Global South, these infrastructures are often built in rural spaces on marginal lands fraught with social inequalities and development challenges (Baka, 2017; Dunlap, 2018). Solar arrays are a pervasive renewable energy technology being implemented worldwide with pernicious social and environmental consequences at the local scale (Mulvaney, 2019; Sareen & Kale, 2018). The Indian state claims that solar development will benefit the "large proportion of poor and energy unserved population in the country" by providing a "substantial number of jobs" for local "people barely living at subsistence levels" (MNRE: 2, 2010; MNRE, 2016; Government of India: 3, 2015; Stock, 2020). Yet transitions to solar energy reconfigure land use and labor geographies to the detriment of local peasants (Stock & Birkenholtz, 2019; Yenneti, Day, & Golubchikov, 2016), contradicting claims of rural development and economic empowerment. This paper elucidates the contradictions of ostensible 'gender positive' outcomes of an Indian solar project.

The Gujarat Solar Park (GSP) is a utility-scale solar energy plant (*solar park*)[2] that generates 640 mega-watts of electricity on 5384 acres of land[3] in the semi-arid Patan region of Gujarat state, India. The government of India's agency for solar development, the Solar Energy Corporation of India (SECI), operates as a development broker for solar (see Levien, 2018). SECI identifies, demarcates, acquires and leases land to public and private institutions that seek to develop the solar park and may host additional companies to generate solar power within the park (Stock & Birkenholtz, 2019). Developed by the public entity Gujarat Power Corporation Limited (GPCL), the GSP was India's first large-scale solar utility and was Asia's largest upon completion in 2012. The impetus for constructing the GSP was to mitigate climate change under India's National Action Plan for Climate Change (Government of India, 2008) and to kickstart the nascent Jawaharlal Nehru National Solar Mission (JNNSM) (Government of India, 2010). The GSP has since been rivaled in geographic size and mega-wattage produced by other solar parks in the nation. The successful implementation of the GSP became the *de facto* model for all consecutive solar parks in India.

Presently, these large-scale solar infrastructures are vital among the Government of India's sustainable energy transition outlined as Nationally Determined Contributions (NDC) to the 2015 Paris Climate Agreement to cap global temperature increases to 2 degrees Celsius (Government of India, 2015). Specifically, the JNNSM solar parks (e.g., GSP) will assist India in achieving 40% of total installed electrical generation from non-fossil fuel sources by 2030 (Government of India, 2015). However, research suggests that land acquisition for the GSP disproportionately impacted smallholders of lower caste and class positionalities (Yenneti et al., 2016), transforming the agrarian political economy of nearby villages and providing relatively few job opportunities (Stock & Birkenholtz, 2019). Developers of the solar park boast corporate social responsibility schemes for rural upliftment that focus on capacity-building of local women (MNRE, 2014; GPCL, 2015). Yet land enclosures restricted women's access to vital firewood resources (Stock & Birkenholtz, 2020). The dispossessive effects of solar parks not only influence local social power, but reproduce relations of power to the state and corporate actors. According to Stock (2020: 6), "...solar parks represent an opportunity to preserve asymmetric power relations and a capitalist political economic order."

This manuscript is motivated by the following research question: *To what extent are 'gender positive' processes and projects associated with solar development in India realized on the ground?* Utilizing an access model of vulnerability (Ribot & Peluso, 2003; Birkenholtz, 2011), this research suggests that the GSP is an infrastructure of the sustainable energy transition that reproduces social power asymmetries along multiple axes of social difference through configurations of land, labor and social development schemes. To analyze this case, I draw from the literatures of feminist political ecology (FPE), energy geography and critical development studies. FPE examines the gender dimensions of power and knowledge concerning environmental change, focusing on livelihood struggles and social difference (Rocheleau, Thomas-Slayter, & Wangari, 1996; Hanson, 2016; Sultana, 2009). Recently, many scholars of FPE take an intersectional approach to examine the mutual constitution and articulation of multiple axes of social difference (e.g., gender, caste, class) and embodied practices that shape social inequalities and power relations in political ecology (Mollett, 2017; Nightingale, 2011; see Crenshaw, 1989). In India, caste is a pervasive and institutionalized form of hierarchized social differentiation that mediates social power, opportunity and advantage (Mosse, 2018). This study examines the intersecting caste, class and gender dimensions within agrarian transformation resulting from a large-scale solar infrastructure and its social development schemes. I do this through interrogating the politics of knowledge within the gender discourses[4] of institutions affiliated with the solar park and reveal the effects of these discourses in local villages.

1.2. Gender dimensions of solar development

Despite the concerted efforts of diverse policymakers to consider the social dimensions of climate change (Dubash & Joseph, 2016), India's Paris Agreement NDC document fails to mention caste or class-based differences in vulnerability to climate change, barring a homogenous classification of poverty and apolitical references to poverty alleviation (Stock et al., 2020). The policy document then goes on to suggest that access to 'clean technologies' (e.g., solar energy) is a major component of poverty alleviation (Government of India, 2015: 29) and that all measures taken under this policy represent challenges to address "gender equality and women empowerment" (Government of India, 2015: 4), reflective of gender mainstreaming within India's national policymaking processes and international development policy writ large (Spary, 2019; UNDP, 2020). Claims of "gender equality and women empowerment" are made without a nuanced exploration of how gender identities are differentially impacted nor how specific policies will promote female empowerment. The GSP was also designed to be a Kyoto Protocol-era UN-affiliated Clean Development Mechanism (CDM), sustainable development projects that

[2] A *solar park* is defined as "a concentrated zone of development of solar power generation projects and provides developers an area that is well characterized, with proper infrastructure and access to amenities and where the risk of the projects can be minimized" (Ministry of New and Renewable Energy, 2016: 2).

[3] The Gujarat Solar Park was built on 5,384 acres of land, of which 2,669 acres was public land. The remaining 2,715 acres acquired were smallholders' farm land from Charanka village.

[4] Gregory et al. (2009: 166) define *discourse* as "a specific series of representations and practices through which meanings are produced, identities constituted, social relations established, and political and ethical outcomes made more possible."

generate certified CO_2 emissions reductions that are valued in emissions trading schemes (UNFCCC, 2016). The United Nations Framework Convention on Climate Change mandated all CDMs to provide 'gender positive' or 'gender neutral' impacts for women (UNFCCC, 2012). Little research has been done on the gender impacts of CDMs. Although CDMs have been shown to reproduce social power configurations (Ervine, 2013; Bachram, 2004), procedural injustices (Bryant, Dabhi, & Bohm, 2015; Newell, Phillips, & Purohit, 2011), and differentiate access to material resources (Newell & Bumpus, 2012). Though the CDM is now defunct in India (personal communication, 16 July 2018), the GSP still registers as a CDM project and is still beholden to the mandate of 'gender positive' impacts. This study empirically demonstrates how gender considerations in development policy and interventions are discursive modalities of power that do not always ameliorate gender-related social frictions or open paths to empowerment.

Discourses related to gender, environment and development are often embedded in colonial logics of modernization and racialization (Stock, 2020; Escobar, 1995; Mollett, 2017), tropes of the vulnerable 'Third World Woman' abound (Mohanty, 1988). The Government of Gujarat's State Action Plan on Climate Change identifies women as a being a vulnerable population, stating that climate change may negatively impact their access to natural resources like fuelwood: "Women who have the responsibility of securing water, food and fuel face the greatest challenges. In addition, unequal access to resources, and to decision-making processes make them more vulnerable" (Government of Gujarat, 2014: 191). Yet the policy document does not differentiate women from larger gender concerns and homogenizes all women as vulnerable (Stock et al., 2020). Importantly, it does not discuss gender-based vulnerability to climate change as linked to the political economy and iteratively articulated through axes of social difference. It is within the context of these various policy documents that enshrine gender-sensitive development and female empowerment that the present research study analyzing the gender politics of a solar park is embedded.

Solar technology is often promoted through development interventions as a means of achieving economic empowerment and improving energy access while mitigating climate change (Joshi, Choudhary, Kumar, Venkateswaran, & Solanki, 2019; Liao & Fei, 2019). Globally, solar developers increasingly design interventions that seek to address local gender inequalities. Herein lies the paradox: the solar park operates under the mandates of UN-based climate treaties (e.g., Paris Agreement) and must abide by 'gender positive' procedures and enable 'gender positive' outcomes to ostensibly empower local women. However, enclosure of land for the GSP has disproportionately impacted resource-dependent smallholding farmers and agro-pastoralists (Stock & Birkenholtz, 2019; Yenneti et al., 2016), women in particular. Women from communities adjacent to the GSP tasked with daily household reproduction are dispossessed of the land they depend upon for firewood collection and fodder, a form of energy dispossession (see Baka, 2017). On average, women are spending an additional 1.5 hours per trip in gathering firewood from further distances (Stock & Birkenholtz, 2020). This follows a global pattern of dispossession for local populations by large-scale solar development (Rignall, 2016; Yenneti et al., 2016; Argenti & Knight, 2015).

Since the liberalization of India's economy in 1991, economic development has largely been defined by jobless growth and an expansion of the informal sector (Dasgupta & Singh, 2005). Solar park developers guaranteed that the project will "create a substantial number of jobs and create demand for skilled workforce contributing to the overall economic growth" (MNRE, 2011: 85). Further, developers suggested that the project will "empower local communities" (Asian Development Bank, 2017: 3), especially local people "barely living at subsistence level" (Government of India, 2015: 3). The acquisition of private lands for the solar park has been a highly contested process, involving eminent domain and variable land pricing (Yenneti et al., 2016). Enclosing erstwhile productive agricultural lands has reduced the agricultural production in the community, thereby limiting employment opportunities for wage labor on others' farms (Stock & Birkenholtz, 2019). GPCL asserted that the solar park has created employment for "more than 1000 people on permanent basis" (GPCL, 2020). Yet the jobs created are highly technical, hiring higher educated and certified people from outside of the region. Of the few jobs created for local people, they were menial (i.e., cutting grass, washing solar arrays), few in number and with poor remuneration (Stock & Birkenholtz, 2019). Instead of economic development for residents, the solar park has produced a new landless agrarian workforce that is not being absorbed by the local solar economy (see Li, 2011).

1.3. Antinomies of gender and solar

To quell dissent over dispossession and exclusion, solar park developers and affiliated companies initiate corporate social responsibility (CSR)[5] schemes that ostensibly lead to community development and skill-building. For the GSP, such CSR schemes have included teacher training, school supplies for children, street lights, and improved cook stoves (MNRE, 2014), modalities of 'rendering technical' the legitimate political claims of affected residents (Li, 2007; Birkenholtz, 2013). As Rajak (2011) explains, CSR schemes are often ways to consolidate corporate power that are legitimized through moralistic discourses of social development. In fact, India's CSR schemes represent a shift from the centralized approach of modernist state projects to a corporatized and decentralized approach to development in the present neoliberal era (see Spary, 2019). In this manuscript, I discuss the gender dimensions of employment and a CSR scheme affiliated with the GSP.

Female empowerment through the present modalities of large-scale solar power projects represents an *antinomy*, defined as a "contradiction between two beliefs or conclusions that are in themselves reasonable; a paradox" (Oxford English Dictionary, 2019). Kant (1998) identified four antinomies that undergird his conception of metaphysics, nature and reason (e.g., spontaneity vs. causal determinism). In recent years, geographers and political ecologists have used this term to examine paradoxes within nature-society relations (see Collard, Harris, Heynen, & Mehta, 2018; Ioris, 2015; Hasbullah & Korf, 2013; Swyngedouw, 2009; Korf, 2007; Watts, 2004). Watts (2004) explores the 'antinomies of community' occurring as oil complexes both constitute and challenge customary community authority and community identities within Nigerian petro-capitalism. As one such antinomy of a nature-society relation, configurations of labor and associated social development schemes of the solar park actually disempower women, despite claims of female empowerment and mandates of 'gender positive' project outcomes.

I extend the concept of antinomy to reveal logical contradictions within India's sustainable energy transition. Building off of Stock and Birkenholtz (2020) study that discovered claims of improving rural energy security were undermined by modalities of land acquisition for the GSP that dispossessed women of access to biomass (i.e., firewood) energy resources crucial to household reproduction, a clear antinomy of gender and solar, this study identifies two additional antinomies of 'gender positive' solar development: 1) Despite claims of rural upliftment for women through economic development, configurations of labor under the solar park's transformation of the agrarian political economy have left

[5] The Companies Act, 2013 mandates all Indian companies with average net profits of $722,850 (5 crore rupees) spend 2% of those profits per year on CSR projects that benefit "society at large" (Ministry of Corporate Affairs, 2016).

women without employment opportunities; 2) Despite claims of female empowerment, social development schemes affiliated with the solar park actually disempower women by reproducing caste and class-based social power.

This manuscript proceeds in four additional sections. Section two elaborates on the methods by which this research study was conducted, including household surveys, semi-structured interviews and discourse analysis. Section three discusses research findings from this study, particularly examining employment at the solar parks and a CSR scheme. Section four puts these research findings in conversation with the history of gender and international development. Finally, this manuscript concludes by summarizing this case and discussing the broader implications of this study.

2. Methods

Fieldwork for this research was conducted in 4 villages adjacent to the GSP in Patan district of Gujarat state in Western India in 2018 (Fig. 1). Study villages include Charanka, Fangli, Jamvada and Dhokavada. The entirety of land enclosed for the GSP, both public and private, was from Charanka. Villages selected for comparison with Charanka were restricted to those with a population of less than 3000 and within 15 km of the solar park to ensure comparability. Fifty household surveys were conducted in each of the 4 villages (n = 200), randomly stratified by caste and class (Table 1). Thereafter, I conducted 42 interviews (n = 42) with residents in Charanka and Fangli villages, policymakers from government institutions related to the solar park (e.g., Solar Energy Corporation of India) in the locations of Gandhinagar and New Delhi, and employees of companies operating in the solar park (e.g., Gujarat Power Corporation Limited) utilizing a snowball sampling method. I then conducted a discourse analysis on 9 technical and policy documents relating to the JNNSM solar parks and climate change as powerful textual artefacts of 'authoritative knowledge' on solar development (Table 2). Following Laclau and Mouffe (2001), I identify the political economic context wherein such discourses were produced and strive to highlight their effects 'on the ground,' corroborated with empirical data gathered from surveys and interviews. Surveys and interviews were conducted in the languages of Gujarati, Hindi or English, per the respondents' preference. Respondents were from diverse caste affiliations, including higher-caste individuals comprising the government-designated 'general castes' of Brahmins (Joshi) and Rajputs (Thakore, Parmar, Darbar, Vaghela, Jadeja). General castes in study villages also tended to have larger landholdings and more household and agriculture-based assets in comparison with those whose positionality is subordinate in the local caste-based hierarchy. The majority of respondents belonged to the government-designated 'Other Backward Castes (OBC)' categorization (Gadhvi, Ahir, Rabari, Koli, Ayar). Although lower-ranked in regional caste hierarchy, some OBCs (i.e., Gadhvi, Ahir) possess more social power within the 4 study villages and enjoy more household and agriculture-based assets. Rabaris are a marginalized OBC group of agro-pastoralists (Yenneti & Day, 2015), historically nomadic but largely sedentary in present day. Muslims and Dalits were also engaged for this research study, although few in number due to their low population within the social composition of study villages.

3. Results

Women in villages adjacent to the GSP, specifically those of lower caste and class, have been disproportionately affected by the development of the Gujarat Solar Park (GSP). Beginning with the first antinomy, I discuss the exclusionary labor arrangements of the solar park and contrast claims of female empowerment by the solar park with lived experiences and perceptions of affected women.

3.1. Upliftment through employment: Jangal ma mangal? (Antinomy 1)

Contrary to guarantees of regional upliftment, the solar park did not positively contribute to rural development but became a tool of socio-economic exclusion, disproportionately affecting lower-caste women. A constant criticism of Gujarat Power Corporation Limited (GPCL) and companies within the solar park is that they do not offer employment to women, as most of the "1000 permanent basis" jobs were given to non-local males with advanced degrees and technical skill-sets (GPCL, 2020). This study confirms the lack of employment generation in the solar park for local women. Sixty-three of the 200 households surveyed had someone employed at the solar park. All but 2 of the 63 households were employed in menial labor jobs (i.e., washing solar panels, cutting grass, labor) or security guards. To quote a poor female Rabari respondent in Charanka, "How can we eat? We cannot find jobs at the solar park...We don't have land. The solar park took our land" (CI.002, 12 February 2018). Not all government officials see the plight of project-adjacent residents so dire, as a project executive at GPCL stationed in Charanka explained to me in English: "The people of Charanka need not any employment here. They are all businessmen, super rich people. They need no jobs. They live merrily over the interests drawn from these crores of rupees" (GPCL.001, 22 March 2018). Invoking colonialist tropes of modernization (Escobar, 1995), a general manager of GPCL stationed in Gandhinagar echoed this man's sentiments: "That is a backwards area with unusable land. There was no development in Charanka before. The solar park has stimulated the local economy. Cash is flowing" (GPCL.004, 4 March 2018). But not all people in Charanka and adjacent villages experience this flow of cash and the care-free life derived from solar profits.

Among the 4 villages surveyed (n = 200), only 6 women worked at the solar park (3 from Charanka, 3 from Dhokavada). Each were employed washing solar panels and cutting grasses that grow underneath the solar arrays, making between INR 200 and 400 ($2.90–5.80) per day, a decent wage in these villages. Of the 6 women employed at the solar park, 4 were of the Ahir caste, 1 was Muslim and 1 was a Dalit. No Rabari women surveyed and interviewed were employed at the solar park. The Ahirs are an OBC group and occupy a higher caste position relative to Muslims and Dalits. The Dalit woman had 8 acres enclosed from the solar park and no longer has land to farm, whereas the Ahir women had large landholdings previous to the solar park and only had 1 acre enclosed each. Comparatively, Ahir women possessed greater household assets (e.g., motorcycle, TV, toilet), agricultural assets (e.g., tractor, borewell), livestock (e.g., cow, water buffalo), land holdings (acres) and agricultural income (yearly estimate in rupees), all of which were used as proxies for class in this study. The assets possessed by these women's households were statistically average for the villages they lived in, indicating the women employed at the solar park tended to be of a relative 'middle income' status. Relative to their counterparts, the women from the adjacent villages who were employed at the solar park for menial jobs (i.e., washing panels, cutting grass) tended to be from a higher caste and class position.

A smallholding Rabari woman from Charanka reflected on the lack of jobs at the GSP: "Women do herding. If employment at the solar park is increased, women can get jobs and their status can improve" (C042, 10 February 2018). Within the village of Charanka, 84% of survey respondents said the GSP did not provide new income opportunities (Fangli: 94%; Jamvada: 92%; Dhokavada:

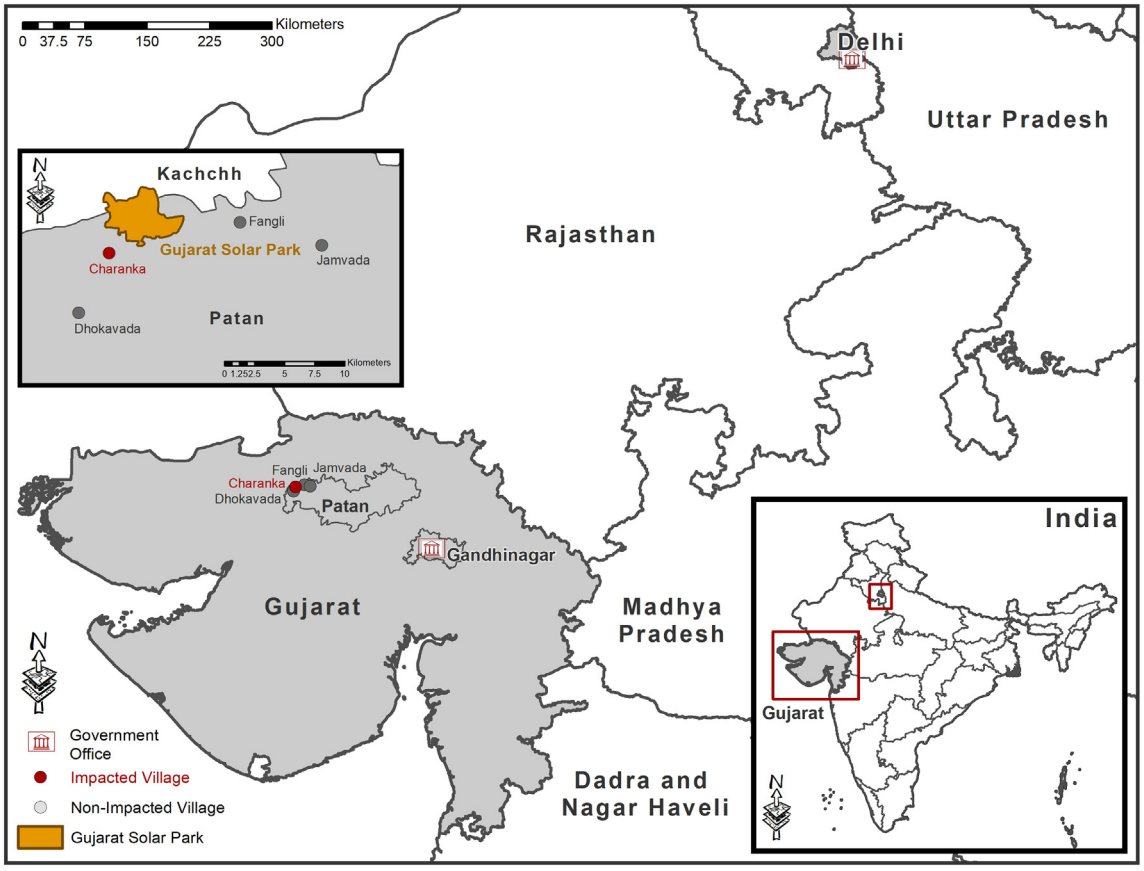

Fig. 1. Map of Gujarat Solar Park and study villages.

Table 1
Summary statistics of respondents (n = 50) in the project-affected village of Charanka. Average income in rupees per year, Rs. 71.4 = US $1. Average landholdings in acres.

Caste Categorization	Percentage of Respondents	Avg. Total Income	Avg. Landholdings
General castes	10%	99,924.49	7.4
Dominant OBCs	22%	55,407.74	8.1
Marginal OBCs	38%	21,346.15	1.9
Scheduled Castes (Dalits)	24%	31,000.00	3.5
Muslims	6%	54,221.96	7.2

98%). An average of 78% of all survey respondents said GSP did not change women's status in the community. These figures stand in stark contrast to the empowerment aspirations by public and private institutions associated with the solar park, as well as the policy documents that undergird solar development in the state. The irony of such overinflated claims of empowerment have not been lost on local residents. A well-respected middle-income Muslim man in the community, who refused to sell his land for the solar park, reflected on the park's influence: "No one knew Charanka before the solar park was built, not even those who live in neighboring villages. Now the entire world knows about our village.

Table 2
Texts utilized to conduct discourse analysis.

No.	Institution	Year	Name	Document Type
1	Government of Gujarat	2014	Gujarat State Action Plan on Climate Change	State Policy
2	Government of India	2008	National Action Plan on Climate Change	National Policy
3	Government of India	2015	India's Intended Nationally Determined Contribution: Working Towards Climate Justice	National Policy
4	Government of India, Ministry of New and Renewable Energy	2010	Jawaharlal Nehru National Solar Mission: Towards Building Solar India	National Policy
5	Government of India, Ministry of New and Renewable Energy	2014	Implementation of a Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects in the country commencing from 2014 to 15 and onwards (i.e. from the year 2014–15 to 2018–19)	National Policy
6	Gujarat Power Corporation Limited (GPCL)	2015	Corporate Social Responsibility (CSR) Policy of Gujarat Power Corporation Limited	State Policy
7	Self-employed Women's Association	2015	Charanka gam—taluko—Santalpur, jillo—Patan, Vikas ane kamgiri report, Gujarat Power Corporation Limited	NGO Project Report
8	United Nations Framework Convention on Climate Change	2012	CDM and Women	International Treaty
9	United Nations Framework Convention on Climate Change	2016	Clean Development Mechanism (CDM)	International Treaty

But it's like *jangal ma mangal!*" (CI.005, 12 February 2018). The phrase "jangal ma mangal" is roughly translated in Gujarati language to "bliss in the jungle", often used sarcastically to ridicule claims of rural development. A landless Dalit male also used the phrase in discussing the solar park: "Earlier it was jungle, now it's *mangal!*" (CI.004, 12 February 2018). Patriarchy may prevent certain willing women from seeking employment at the GSP, but it cannot be argued that there are ample opportunities available.

Sustainable development in the form of solar energy generation has come to this region of Patan, but the distribution of benefits has not been equitable (Yenneti et al., 2016). Numerous peasants were dispossessed of their lands by GSP project developers, undermining revenue and labor opportunities in agrarian livelihoods. Further, Charanka and Fangli households do not benefit from the additional electricity generated by the renewable energy infrastructure (Stock & Birkenholtz, 2019). Claims of development, or even *mangal*, cannot be sustained when local producers are actively underdeveloped in the process. The GSP has produced a gendered landless and jobless workforce through agrarian transformations that disproportionately affect marginalized women (Stock & Birkenholtz, 2020), specifically the lack of wage-labor opportunities. The next section discusses antinomy 2, contrasting the solar park's female empowerment claims with lived experiences of affected women.

3.2. Empowerment: perceptions, realities and 'on paper' (Antinomy 2)

Rural development, gender-sensitive development and female empowerment have all been central concerns identified within policy documents related to climate change adaptation, mitigation and vulnerability in India (Government of India, 2015; Government of Gujarat, 2014; UNFCCC, 2012). The GSP boasts a number of 'social commitments' for rural upliftment and capacity-building as part of their CSR activities, including the temporary employment of unskilled laborers and semi-skilled laborers, a teacher training program, a drinking water facility, installation of solar streetlights in Charanka and adjacent villages, paved roads, renovation of the local primary school and ambulance services for Charanka (MNRE, 2014). Ostensibly, GPCL will also implement a skills development center targeting adolescents and women, wherein they can develop skills related to solar power operations and maintenance for the purpose of improved local employment opportunities (Balan, 2014). According to their website "GPCL has initiated some significant participatory and non-participatory roles in the areas of upliftment of Women & Child" (GPCL, 2015). But despite many claims embedded within solar and climate policy, and the promises of many institutions associated with GSP to promote the empowerment of women (GPCL, 2015; Government of India, 2015; Government of Gujarat, 2014; UNFCCC, 2012), residents of adjacent villages had a largely different perception of progress towards empowerment, standing in contrast to the aims of project developers to secure their support for project goals. The survey instrument asked each household their thoughts on female empowerment, labor roles, status change and livelihoods change (see Table 3, questions 1 and 2, for examples). When asked how the solar park has impacted women's status, the average response of households was 'remained the same' (Table 3, question 3). General caste respondents perceived women's status has changed more than other caste groups, with marginal OBCs the least convinced (Table 4). Contrary to institutional claims of female empowerment, residents of adjacent villages do not feel that the solar park and associated social development programs have changed the status of women.

One of the CSR activities conducted by GPCL to promote female empowerment was a one-off training that focused on "Enhanced skills of women residing in the villages nearby Solar Park, Charanka by providing them training of needle work, patch work etc." (GPCL, 2015). In early 2014 (January-March), GPCL paid the Self-Employed Women's Association (SEWA) INR 1,038,000 (roughly $15,043) to conduct a training for 20 women in Charanka and 20 women in nearby Fangli village (n = 40) to learn artisanal needlework and embroidery techniques for making women's clothing and tapestries of a style endemic to the Patan region under SEWA's flagship *Hansiba* program (SEWA, 2015; Fig. 2). Of the 20 participants in Charanka village, 8 were of the Rajput caste (Thakor, Rathod), 9 were 'Other Backward Castes' (Ayar, Gadhvi) and 3 were Muslims (Table 5). Despite a sizeable Rabari population in Charanka, none of them were participants in this scheme. Eighteen of the 20 participants in Fangli were Ahirs from the 'Other Backward Castes' designation, 1 from the Rajput caste (Jadeja) and 1 Brahmin participant (Joshi). Most of the Ahir women were of middle-class status and one of the Rajput families was of higher-class status. The average class-position of CSR participants was 'middle-to-high,' based upon the attendance list corroborated with my survey data. The project's entire duration was three months, including a one-month training. Women could sell the embroidery work they made, but most of them kept it within the family for when the younger girls get married and join their in-laws' house (personal communication, 10 April 2018). As of writing this manuscript, only a few of the women trained in these techniques still remain affili-

Table 3
Questions asked to survey respondents (n = 200) regarding perceptions of female empowerment. Likert scores represent village averages, on a scale from 1 = diminished greatly, 3 = remained the same, 5 = improved greatly.

Question 1: Has the presence of the solar park in the community changed women's labor roles within their specific livelihoods?

Village	*Yes*	*No*
Charanka	16%	84%
Fangli	10%	90%
Jamvada	0%	100%
Dhokavada	6%	94%

Question 2: Has the presence of the solar park in the community changed women's status in the community?

Village	*Yes*	*No*
Charanka	22%	78%
Fangli	32%	68%
Jamvada	16%	84%
Dhokavada	24%	76%

Question 3: How has the solar park impacted women's status in your village?

Village	*Likert score*
Charanka	3.14
Fangli	3.27
Jamvada	3.12
Dhokavada	3.02

Table 4
Questions asked to survey respondents (n = 50) in Charanka regarding perceptions of female empowerment disaggregated by caste. Responses represented are in the affirmative.

Caste Categorization	*Has the presence of the solar park in the community changed women's labor roles within their specific livelihoods?*	*Has the presence of the solar park in the community changed women's status in the community?*
General castes	33.3%	50%
Dominant OBCs	45.5%	20%
Marginal OBCs	22.7%	14.3%
Scheduled castes (Dalits)	22.2%	22.2%
Muslims	66.7%	33.3%

Fig. 2. An embroidered tapestry created by women trained through SEWA in Patan, India (photo: Ryan Stock R).

ated with SEWA and none of the trained women maintain an affiliation with GPCL's other CSR activities.

However, GPCL's efforts to secure dispossessed women's support for the aims of the solar park through this CSR activity was largely unsuccessful. I met with two employees of SEWA who reside in nearby Dhokavada village, both of relative middle-class status and of the Ahir caste. One of the SEWA women, who lived her entire life in Dhokavada, had no knowledge of the aforementioned CSR projects with SEWA in adjacent villages. When asked about the impact of GPCL's claims of the "upliftment of Women & Child" (GPCL, 2015), she laughingly responded, "There is no female empowerment" (D035, 23 May 2018). After a long pause, she reflected more on the nature of work at the solar park: "People who work at the solar park get a low salary anyway. People like the head or contractor get good money. They are doing corruption. The solar park doesn't give jobs much. The salary is low or sometimes people don't get their salary" (D035, 23 May 2018). Her comments reflect disparate perceptions of what constitutes a decent wage for off-farm employment. Local residents expect that jobs in the new solar economy pay proportionately higher than nascent wage-labor positions, a perception buoyed by the state's claims that the solar park will "create demand for skilled workforce contributing to the overall economic growth" (MNRE, 2011: 85). Another SEWA-employed Ahir woman from Dhokavada applied to GPCL to work at the solar park several times, but they did not respond. She even traveled to GPCL headquarters in the Udhyog Bhavan region of Gandhinagar to seek employment, but agency representatives refused to meet with her. Reflecting on GPCL's claims of female empowerment through one-off CSR activities, she stated, "How can women's status improve? They don't give women jobs at the solar park. I don't support them" (D048, 25 May 2018). In addition to the lack of opportunities for women, corroborating a general consensus among many survey and interview respondents, this woman spoke about the lack of jobs for locals: "People from out of state or a different city get more jobs at the solar park. Local village people do not get many jobs there" (D048, 25 May 2018). Responding in English, a college-educated large-landholding Gadhvi male asserted, "We still require basic amenities from the government. Around 30 big companies operate here in solar park. They are earning handsomely from the solar park. We only say that they should give at least 1% to 5% of their profit for the welfare of the village. They can invest this as CSR activity, and there is a clause as well. The company has to return some benefit to the local community. But such a clause remains 'on paper' only. The ground reality is altogether different" (CI.001, 12 February 2018). Thus, 'on paper' CSR opportunities for female empowerment are reserved for those enjoying 'middle-to-high' class positionality and a relatively higher caste positionality.

In concluding the discussion on CSR activities conducted in the region, GPCL discusses future CSR activities envisioned for the region: "In the immediate future, we intend to widen our scope towards the development & strengthening of girl child [sic]" (GPCL, 2015). Adding confusion to their commitment to institutionalizing dispossessed women's support for the neoliberal governance of solar infrastructure, GPCL rejected a 2015 proposal from SEWA for childcare-related CSR activities and a female hygiene training seminar in Charanka, as well as a 2017 proposal for a CSR activity to distribute school uniforms to school-aged girls in Charanka and surrounding villages (personal communication, 10 April 2018). The hollow claims of female empowerment by developers and companies within the GSP echo other climate change adaptation and vulnerability discourses from government officials that homogenize women and essentialize their social vulnerability (Stock, 2020; Stock et al., 2020). Following Rajak (2011), I assert that the SEWA CSR was a thinly veiled move to institutionalize dispossessed women's support for the solar park by rendering technical their political claims, reserved for women of relatively higher caste and class status. As the above antinomies reveal, female empowerment and 'gender positive' development through the GSP exists 'on paper' only.

4. Discussion

Accelerating economic development in India necessitates a low-carbon pathway of development toward a sustainable energy transition (Gupta, Ghersi, Vishwanathan, & Garg, 2019), of which solar photovoltaic systems are a vital contribution. The effects of such a low-carbon transition will likely improve the precarious fate of many Indian populations vulnerable to climate-related stressors (Barros et al., 2014). However, this renewable energy transition has largely not been equitable (McEwan, 2017; Newell & Mulvaney, 2013)—yet another extractive energy infrastructure delivering dispossession without development (Levien, 2018;

Table 5
Participation roster by caste affiliation from the GPCL-sponsored skill-building scheme for women (SEWA, 2015), compared with percentage of residents surveyed.

Village		General Caste	Dominant OBCs	Marginal OBCs	Scheduled Castes	Muslim
Charanka	Attendance percentage	40%	40%	5%	0%	15%
	Survey percentage	7%	30%	36%	21%	6%
Fangli	Attendance Percentage	10%	90%	0%	0%	0%
	Survey Percentage	36%	44%	12%	8%	0%

Stock & Birkenholtz, 2019). New configurations of land, labor and schemes related to the GSP have reinforced local social power relations. The few women employed at the solar park are of relative higher caste and class positionality. Likewise, the opportunity to participate in the social development scheme (SEWA CSR) was reserved for only women of 'middle to high' class status and those of dominant castes. These realities corroborate survey findings of the majority stating that women's status has largely 'remained the same,' despite 'female empowerment' ambitions of the GSP, and that there have been no new income opportunities for women at the solar park.

The present policy discourses of 'gender positive' project design, combined with female empowerment pledges by institutions associated with the GSP, reflect a narrow focus on individual agency at the expense of challenging structural causes of oppression within 'gender mainstreaming' and 'gender-smart' approaches (Spary, 2019; Chant & Sweetman, 2012). Additionally, the ideology behind these gender approaches harken back to earlier eras of gender and development paradigms, insofar as they are rooted in market-based solutions, decenter the male subject, overemphasize women's productive capacity, obscure power relations that constitute gendered social power, and ignore caste and other social differences that are articulated and intersect through solar development (see Ramamurthy, 2000; Leach, 2007; Resurreccion & Elmhirst, 2008; Arora-Jonsson, 2014). For example, the SEWA CSR was designed to tap into a homogenous female labor force to mass produce 'fair trade' artisanal goods for global export. This project was captured by village female elites and circumvented the political demand of redistributing material resources expropriated by the state for the solar park.

Uncritical of past mistakes, bureaucrats leverage the discursive power of gender to enact a dispossessive modality of solar development, making the further subjugation of marginalized groups all but guaranteed despite empowerment claims. Efforts to mainstream gender concerns in policy and project documents that enable the GSP to generate solar energy fail to truly empower lower-caste and lower-class women (cf. Arora-Jonsson, 2014; Bock, 2015; Spary, 2019). Essentializing gender-based difference serves the interests of government agencies, companies operating within the solar park (e.g., Tata Power, Roha Energy) and other agencies who have supported this project (e.g., Asian Development Bank, Clinton Climate Initiative) uninterested in fundamentally restructuring modes of production by which they accrue surplus value and redistribute power and material resources, beginning with historically marginalized populations upon whose land and labor such profitable climate mitigation projects operate. Putting this study in conversation with the history of gender and development, the GSP falls into a genealogy of development schemes that reproduce marginality for resource-dependent women (Stock & Birkenholtz, 2020; cf. Mehta, 2009; Birkenholtz, 2013). Further, it represents an antinomy of gender and development, insofar as its claims of female empowerment paradoxically produce female disempowerment. The GSP represents a vital infrastructure within India's sustainable energy transition that reproduces structural inequalities and patriarchal exclusions.

5. Conclusion

The Gujarat Solar Park (GSP) is a renewable energy infrastructure and contributes to climate change mitigation goals outlined in the Paris Agreement and the Kyoto Protocol, as well as national climate-related schemes (e.g., National Solar Mission, National Action Plan on Climate Change). Per the mandates of these policies, the solar park must abide by procedures and deliver outcomes that are 'gender positive' that lead to "gender equality and women empowerment" and the "upliftment of Women & Child" in adjacent villages (UNFCCC, 2012; Government of India: 4, 2015; GPCL, 2015). Yet the discourse of female empowerment through 'gender positive' solar power has not been realized on the ground. In practice, gender, caste and class-based positionalities enable or disable opportunities for employment at the solar park and participation in solar companies' corporate social responsibility (CSR) activities. The solar park developer (GPCL) deploys CSR activities as a technology of institutionalizing dispossessed women's support for project goals, which ultimately has not been successful. This manuscript draws from mixed methods fieldwork and analyzes empirical results using a conceptual framework from feminist political ecology with an intersectional approach.

No doubt, the GSP is an essential contribution to India's carbon emissions reductions. Yet the current modalities of solar park development and associated social development schemes represent *antinomies,* or logical contradictions. National and subnational policies governing solar development and articulations of international treaties mandate 'gender positive' outcomes and boast claims of female empowerment. However, these discourses stand in stark contrast to the dispossession of resource-dependent women's access to marginal lands for firewood procurement (Stock & Birkenholtz, 2020), lack of employment opportunities and exclusionary corporate social responsibility schemes that effectively disempower local women. Bright as night, female (dis) empowerment paradoxically eclipses 'gender positive' guarantees of the solar park.

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