THE JOURNAL OF PEASANT STUDIES
https://doi.org/10.1080/03066150.2019.1683002

Routledge
Taylor & Francis Group

The sun and the scythe: energy dispossessions and the agrarian question of labor in solar parks

Ryan Stock [a] and Trevor Birkenholtz[b]

[a]Department of Earth, Environmental and Geographical Sciences, Northern Michigan University, Marquette, MI, USA; [b]Department of Geography, Pennsylvania State University, University Park, PA, USA

ABSTRACT
Green grabbing is accelerating throughout the Global South to facilitate climate change mitigation. This paper illuminates the discursive and extra-economic means through which the state dispossesses agropastoralists of both land and energy to develop solar parks in semi-arid rural India. We advance the empirical and theoretical aspects of energy dispossessions, with implications for the agrarian question of labor. Using data obtained from mixed methods fieldwork, this research reestablishes the urgency of responding to the classical agrarian question in the context of low-carbon energy transitions.

KEYWORDS
Solar parks; agrarian question of labor; energy dispossession; green grabbing; India

Introduction

Throughout the Global South, renewable energy transitions are under way in an effort to increase electricity production without increasing CO_2 emissions (Newell and Mulvaney 2013; Dunlap 2018). This includes the expansion of hydropower, wind farms and solar photovoltaic generated electricity. A worldwide transition to renewable energy would require ~1.16% of global land area (Jacobson and Delucchi 2011). This will likely occur in rural spaces where land is relatively undeveloped (Rignall 2016; Dunlap 2018). Indeed, large-scale land acquisition for renewable energy transitions comprise a defining feature of the present 'global land rush' (Scheidel and Sorman 2012; Borras and Franco 2013; Avila 2018), which is likely to reconfigure land-use patterns and rural livelihoods (McCarthy 2015; Huber and McCarthy 2017). India is emblematic of these trends, concurrently building numerous large-scale solar parks to increase electricity generation and to mitigate climate change. India is also the world's third largest emitter of greenhouse gases (Olivier, Schure, and Peters 2017) and has the world's second largest population (Government of India 2011). As an indicator of widespread poverty, India's per capita consumption of electricity is 917 kilowatt-hours, roughly one-third of the world's average per capita energy consumption (Government of India 2015). It is likely that the country's emissions will continue to climb rapidly despite rapid development of the renewable energy industry (Government of India 2017). In India, as with other developing countries, expanding energy

CONTACT Ryan Stock rystock@nmu.edu Department of Earth, Environmental and Geographical Sciences, Northern Michigan University, 1401 Presque Isle Ave., Marquette, MI 49855, USA

production, while reducing CO_2 emissions, is seen as necessary to help raise India's 363 million poor out of poverty (Government of India 2015, 4).

In an effort to slow rising emissions and scale-up renewable electricity generation, the central government of India launched the 2010 Jawaharlal Nehru National Solar Mission (JNNSM) as part of their 2008 National Action Plan on Climate Change (NAPCC; Government of India 2008; MNRE 2012). The JNNSM figures centrally in India's efforts to meet its 2015 UN Paris Agreement commitments to reduce emissions by 33% before 2030 (Government of India 2015). Currently in its third phase of implementation (2017–2022), the JNNSM contributes to this effort by seeking the ambitious goal of achieving 100 GW of solar energy generating capacity by 2022. The JNNSM projects are divided into utilities projects (i.e. ground-mounted solar panels, solar panels covering canal extensions) and residential projects (i.e. solar water heaters, solar irrigation pumps). The largest electricity generating JNNSM projects are large-scale, ground-mounted solar panel parks (MNRE 2016; Yenneti 2016). Backing these efforts, the Government of India has allocated Rs. 4050 crore (roughly USD $648 million) to develop 25 'ultra-mega' solar power projects (defined as solar parks with a minimum generating capacity of 500 MW) by 2020 throughout India.

However, each of these ultra-mega solar parks require thousands of acres of open land. Despite these large financial outlays, amenable land resources are scarce, insofar as they must be of sufficient size, availability, and in locations where electricity is in high demand. In many instances, the only lands available that meet these criteria are so-called government-owned 'marginal' lands or 'wastelands' (Baka 2013; Rignall 2016). Following Baka (2014), Indian wastelands are a census category denoting public space in rural settings not being used for agriculture. The labeling of them as being 'wasted' allows for the construction of these spaces as '"empty", [and] "unproductive" land "available" for development.' Yet, these lands are part of the commons, used and managed by agropastoralists, who rely on these spaces for grazing, fodder and fuelwood foraging (Yenneti and Day 2015; MNRE 2016; Stock 2019). Their transformation from commons to solar parks necessitates prohibiting agropastoralists' usage through the creation of new policies that transform property relations, making land amenable to enclosure.

In this paper, we examine the political and economic processes through which the state and private capital engage to enclose these commons lands away from agropastoralists and render them investable for solar parks. We seek to advance recent research on accumulation by dispossession (see Harvey 2003; Levien 2013; Birkenholtz 2016), land grabbing (Borras and Franco 2013) and energy grabbing (Baka 2017) to explore the extra-economic means through which this occurs, while demonstrating its implications for agropastoralists' livelihoods. To do so, we rely on primary data collected in 2018 comparing two of India's largest solar parks: (1) Gujarat Solar Park (GSP); (2) Kurnool Solar Park (KSP). Drawing upon literature from the fields of political ecology and critical agrarian studies, this research is motivated by the following research questions: (1) *what are the extra-economic means through which land is acquired for the GSP and KSP;* and (2) *how and through what processes are peasant labor relations and access to energy being reconfigured through these land dispossessions?* This paper seeks to contribute to discussions of *energy dispossessions*, where agropastoralists are dispossessed of both their land as well as forms of energy and natural resources, such as fuelwood (Baka 2017). We also intend to advance research into the *agrarian question of labor* (Levien, Watts, and Hairong

2018, 866), 'namely the question of the survival and politics of increasingly fragmented and differentiated agrarian workers and producers,' in the context of land dispossession for solar development. Our theoretical contribution lies in integrating these literatures to discern agrarian transformations by renewable energy regimes. This paper progresses in five further sections. The next section examines recent research on accumulation by dispossession as green, land and energy grabbing, and its implications for the agrarian question of labor. Section three details our methods for data collection, including a detailed contextualization of the study areas in Gujarat and Andhra Pradesh, India. Section four presents the results from field research, including demonstrating land and energy dispossessions and the transformation of agrarian labor relations. Section five discusses our findings to advance a conceptualization of accumulation by dispossession and energy dispossessions, while placing this work in conversation with the agrarian question of labor. Section six concludes the paper with broader implications for solar development.

Accumulation by dispossession via land/green/energy grabbing: implications for the agrarian question of labor

The original enclosure of the commons in Europe alienated producers from the means of production, turning peasant farmers into wage laborers and the latter into capital through state-driven expropriation, also known as 'extra-economic' means (Marx 1990). Marx referred to this process as primitive accumulation, which he theorized created the conditions for capitalism and would cease as capitalism superseded previous economic systems (i.e. feudalism). Harvey (2003), in advancing the accumulation by dispossession (ABD) framework, departs from this original formulation by demonstrating that dispossession is an ongoing process, rather than simply a precondition for the development of capitalism. But for Harvey, the main forms of dispossession in contemporary capitalism are economic: finance capital and the credit system. He further argues that these forms of economic dispossession are necessary for capital to remedy the ongoing crises of over-accumulated capital in contemporary capitalism. But under what conditions might we get ongoing extra-economic forms of dispossession that serve to enable capital accumulation rather than as simply a remedy for over-accumulated capital?

In his research on land enclosures in Rajasthan, India for the creation of Special Economic Zones (SEZs), Levien (2013a) argues that ABD is not 'simply an economic process of overaccumulated capital seizing hold of under-commodified assets [as Harvey has argued] but fundamentally a political process in which states – or other coercion wielding entities– use extra-economic force to help capitalists overcome barriers to accumulation' (p. 940; as cited in Birkenholtz 2016). Consequently, the state sanctions forms of extra-economic dispossession as an ongoing process to alienate peasants from their means of production to *enable* capital accumulation (see also McCarthy 2004, 2015; Glassman 2006; Brass 2011). In a similar vein, examining ABD in irrigation systems of India, Birkenholtz (2016) demonstrates that the state created new water allocation policies in order to disposess irrigators of irrigation water. Through the creation of new extra-economic political-legal-administrative institutions in Rajasthan, he showed how water is being transferred to urban spaces and out of irrigation to enable new forms of urban-based capital accumulation. This is similar to the process of land dispossessions, through extra-economic means, to make way for new solar parks. The precise mechanisms of this process for the acquisition of

land for solar farms have been underexplored and is a focus of this paper via recent work on land grabbing.

Land and energy grabbing

Large-scale land acquisition for the siting of renewable energy facilities is now a global phenomenon (Baka 2017; Huber and McCarthy 2017; Avila 2018; Dunlap 2018). The concept of *land grabbing* captures this process of the enclosure of vast tracts of land, often driven by capitalist firms and enforced through state-led extra-economic coercion (Borras and Franco 2013, 1725; see Cotula 2012). Land grabs are a vital part of a 'global land rush' to sustain low-carbon transitions (Scheidel and Sorman 2012; Newell and Mulvaney 2013; Rignall 2016). Recent research has demonstrated the transformation of the use of space in these transitions to low-carbon economies (Pasqualetti 2011; Scheidel and Sorman 2012; Bridge et al. 2013; McCarthy 2015; Rignall 2016; Huber and McCarthy 2017). For example, Dunlap (2018) demonstrates how vast tracts of common lands are being privatized through a coalition of coercive state and private actors for wind energy development across the Isthmus of Tehuantepec in Mexico. The research further showed that customary uses of these spaces (i.e. grazing) were denied once privatized.

Similarly, land enclosures are increasing in western India through state-assistance via public-private partnerships (Sampat 2015; Levien 2015a). These include the state using eminent domain to create Special Economic Zones (SEZs)[1] (Levien 2011b, 2013). This is similar to processes of land grabbing and enclosure with JNNSM projects. Yenneti, Day, and Golubchikov (2016), for example, show how the state of Gujarat used a colonial-era eminent domain law, the Land Acquisition Act of 1894 (LAA), to transfer land to private solar energy developers via the dispossession of marginalized user groups through land enclosure, the *sine qua non* for solar parks (Yenneti and Day 2016; Yenneti, Day, and Golubchikov 2016). Subsequent solar lands (as the case study in Andhra Pradesh will demonstrate) are acquired through the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act of 2013 (LARR), which replaced the former law. Through these processes, peasants are also denied access to and use of additional land-based natural resources.

As a form of land grabbing, *green grabbing* is a form of elite capture that dispossesses peasants of both land and natural resources in the name of sustainable development (Fairhead, Leach, and Scoones 2012). For instance, Baka and Bailis (2014) have shown state-defined 'wastelands' in southern India that were transferred into biofuel production undermined access to these spaces for resource-dependent households' collection of *Prosopis juliflora,* which they made into charcoal (Baka and Bailis 2014). In this way, the concept of 'green' grabbing may also be extended to the dispossession of energy with respect to being denied access to both fuelwood *and* to the electricity generated from the new solar parks. Again, drawing on Baka (2017), we seek to advance the concept of *energy dispossessions*. She describes energy dispossession as a state-led process of dispossession

[1]The Santalpur Special Investment Region, the Euro Multivision Special Economic Zone, and the Gujarat International Finance Tec-City (GIFT) are all SEZs that are geographically proximate to GSP (Government of Gujarat 2017; GIFT 2018). The larger Andhra Pradesh-Telangana region also has many SEZs and ICTs nearby KSP, including the futuristically branded *Cyberabad* (Zoomers 2010). Each of these industrial and financial centers receives electricity from the grid-connected solar parks.

where commons land once used for grazing and fuelwood was converted into biofuel production. This resulted in undermining rural energy security for peasant producers. We seek to innovate this concept by examining energy dispossessions with respect to agropastoralists who rely on the commons for the collection of firewood, their main source of fuel. They are denied access to this while simultaneously not receiving solar-generated electricity. As with many other cases of land and energy grabbing, this is supported through a state-led discursive process that attempts to transform the meaning of these lands as underutilized or degraded.

Constructing wastelands

Underpinning the state-sanctioned extra-economic means enabling ABD, as it is expressed in land and green grabbing, is the discursive representation of specific natural resources (i.e. land, water, forests) as being unutilized or empty and in need of investment to overcome spatial impediments to sustaining capital accumulation under the auspices of climate change mitigation (Li 2014; McCarthy 2015). In a case from Morocco focused on state-driven land dispossession for solar parks, Rignall (2016) demonstrates the state constructed 'land as marginal so as to facilitate investment [while] foreclosing resident's broader political claims' (p. 540; see also Siamanta 2018). In this way, prior to new policies to enclose land, the state attempted to construct a sense of those lands as poor quality and unmanaged.

In the case of India, so-called marginal lands fall under the category of 'wastelands.' This is an official government classification, denoting marginal or degraded lands (ICAR 2010; see also Gidwani 1992). The arbitrary political construction of wastelands is often aesthetic. In a case from Tamil Nadu, Baka (2013) showed that the state disseminated *Prosopis juliflora* for the purposes of social forestry (see also Kaur et al. 2012). The plant subsequently spread over the landscape, rendering it unfit for pastoralism. Now, the presence of *Prosopis juliflora* serves as an aesthetic shorthand for wastelands according to the state, even though pastoralists utilize it for fuel wood (Baka 2013).

In constructing commons lands as wastelands, the state discursively erases existing uses of these areas by deeming them 'backwards' spaces that need to be 'improved upon.' This enables the appropriation of both the land, as well as natural resources contained therein, through the formation of new property institutions. Nalepa, Gianotti, and Bauer (2017) illustrates this process through a case study of land grabbing in Ethiopia where the state characterized commons 'land as "marginal", "wasteland", "barren", or "unused"' to enable them to be recategorized as belonging to the state 'land bank' and subject to outside investment. Similarly, Baka (2013, 2017) has shown how the state created a series of policies to transform 'wastelands' into sites of biofuel production, after labeling them as degraded (see also Ariza-Montobbio et al. 2010; Harms and Baird 2014; Makki 2014; Rignall 2016) (Figure 1).

Elsewhere, research has shown how the state used mapping techniques to demarcate wastelands to render these spaces legible for investment (Nalepa and Bauer 2012; McCarthy 2015; Fogelman and Bassett 2017; Le Billon and Sommerville 2017; McCarthy and Thatcher 2017; see also Robbins 2001; Li 2014). As we will demonstrate below, this is done in tandem with research institutions producing maps of solar irradiance that discursively render vast areas of land able to generate maximum solar energy

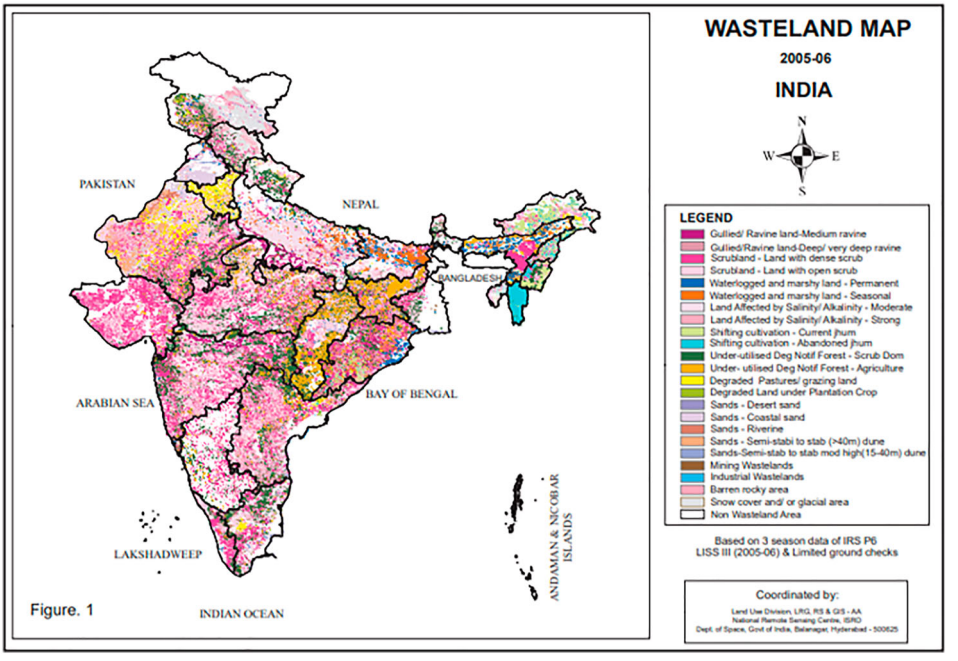

Figure 1. Map of degraded and wastelands of India (Government of India 2010).

(Figure 2). Taken together, these practices enable these spaces to be investible for solar parks.

During this process, the livelihoods of rural producers are altered by changing land tenure arrangements and a transformation of labor relations. In this regard, a lacuna in the ABD and land/energy/green grabbing literatures is that studies have yet to fully examine the labor dynamics of dispossessed peasants undergoing agrarian transformations. While Yenneti, Day, and Golubchikov (2016) illuminate the social justice implications of the spread of solar parks in rural areas, arguably at the root of social justice is the 'agrarian question of labor' (Bernstein 2004; Levien, Watts, and Hairong 2018).

The agrarian question of labor

Historically, research on the classic *agrarian question* focused on the penetration of capital into the countryside and the transformation of the peasantry into wage laborers (Kautsky 1988). More recently, Bernstein (2004, 190) argues for a focus on the 'agrarian question of labour … now detached from that of capital, and which generates a politics of struggles over land (and its distribution).' This sentiment is echoed most recently by Levien, Watts, and Hairong (2018) in a wide-ranging review and in charting a future research agenda for agrarian Marxist research, arguing for the same. Specifically, the agrarian question of labor challenges us to consider the conditions under which peasants continue to survive under the penetration of dispossessing forces of capitalism, as well as the transformation of their politics. In other words, we must examine the specific forms dispossession takes, what peasants are being dispossessed of exactly and how they continue to persist.

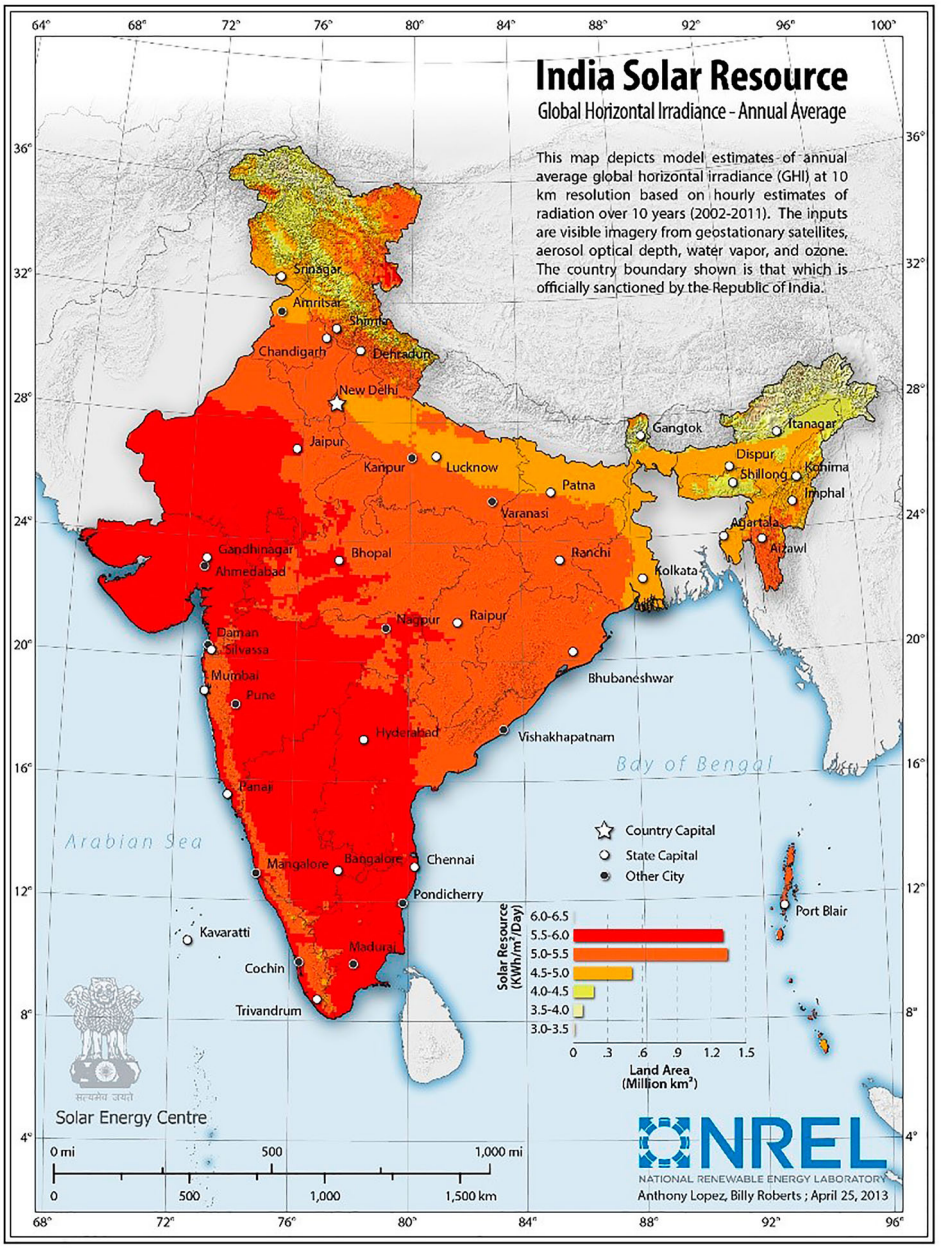

Figure 2. Map depicting annual average solar irradiance at 10 kms, with warmer hues indicating better solar potential (National Renewable Energy Laboratory 2013).

As many have shown, the penetration of capitalist relations into the countryside reconfigures the relationship between the state and peasants by redefining land politics and labor opportunities (Bernstein 2004; McMichael 2008; Garvey et al. 2019). For instance, Garvey et al. (2019) found a reworking of labor relations harkening back to unfree forms of colonial slavery under Brazil's transformation of land towards ethanol production. In this

case, the transformation produced opportunities for wage labor but through repressive tactics. Yet, much contemporary research focused on changing labor dynamics has shown that these kinds of shifts do not produce opportunities for wage labor (Lerche 2013; Moyo, Jha, and Yeros 2013; Levien 2018). Given the vast amount of land required for solar parks and the large number of dispossessed agrarian peasants, the agrarian question of labor is more important than ever.

Recent research on solar park establishment and subsequent agrarian transformation has demonstrated few opportunities for new wage labor in solar parks (Rignall 2016; Yenneti, Day, and Golubchikov 2016) and precarious labor opportunities along the solar commodity chain (Mulvaney 2019). In some ways this is predictable. In India, a defining feature of India's breakneck development since the 1990s is jobless economic growth, producing surplus populations increasingly reliant upon livelihood activities of the informal sector (Dasgupta and Singh 2005). It is not clear what agropastoralists are doing to make ends meet in areas being transformed into solar parks. In the case of solar park project developers (SPPDs), the state often claims that these agrarian transformations will lead to a 'rural resurgence' (Ramamurthy 2014). In reality, these land transformations alter relations of production, which may ultimately undermine the vitality of Indian peasant agriculture due to a coercive redistribution of land (see also Levien 2012, 2018; Patnaik 2012; Lerche 2013). This highlights the need to examine the agrarian question of labor to understand the vast dispossession experienced by agropastoral peasants in these solar regions. By conceptually integrating the agrarian question of labor with energy dispossessions, we provide a robust explanation, substantiated with empirical data, of the uneven costs of solar energy development on resource-dependent populations in agrarian settings. Next, we describe the processes by which data was collected in Gujarat and Andhra Pradesh near two of India's largest solar parks.

Materials and methods

Fieldwork for this research was conducted from January to August 2018 in Gujarat, Andhra Pradesh and New Delhi, India. Household survey questionnaires were administered to eight villages bordering the GSP and the KSP (Table 1; see Figures 3 and 4), fifty ($n = 50$) households per village, for a total of four hundred ($n = 400$) surveys. Three of the villages surveyed experienced land enclosures by the solar park and the remaining five villages surveyed serve as comparison studies (see Table 1). The parameters for selecting the

Table 1. Research sites in the two solar regions. Measured by primary author using GPS waypoints, collected March-July 2018.

Solar park	Village	Distance from Solar Park (kms)	Population
Gujarat Solar Park	Charanka	2.5	1,233
	Fangli	7.7	1,040
	Jamvada	13.7	1,332
	Dhokavada	7.4	2,597
Kurnool Solar Park	Gani	3.7	3,448
	Sakunala	1.7	2,253
	Brahman Palle	1.8	1,520
	Kazipeta	3.7	*

Note: *Omitted from census (Government of India 2011).

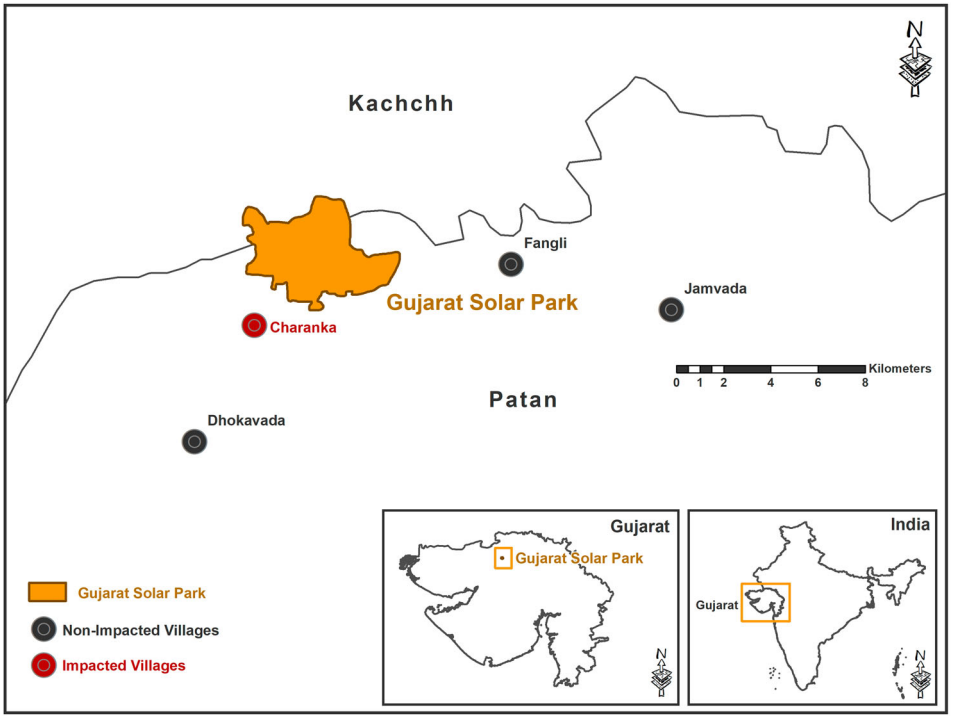

Figure 3. The Gujarat Solar Park and study villages in Gujarat, India.

GSP and the KSP, as well as specific villages within these solar regions, are listed in Table 2. Households were selected using an *every third household* sampling technique, stratified by class, caste and gender. The surveys were conducted in Gujarati, Telugu, Hindi or Urdu languages, per the respondents' fluency and preference. Semi-structured interviews were conducted with 84 people from the impacted villages, as well as with government officials and employees from companies operating at the solar parks in the locations of New Delhi, Gandhinagar, Hyderabad, Patan district (Gujarat) and Kurnool district (Andhra Pradesh).

Study areas

Patan, Gujarat

The Gujarat Solar Park (GSP) is situated in the semi-arid and economically prosperous state of Gujarat (Figure 3), built on 5384 acres of land. Of this, roughly 2669 acres were designated as government 'wastelands'[2] and the remaining portion was local farmers' private land purchased by the park's SPPD, Gujarat Power Corporation Limited (GPCL). The land enclosed for the GSP is from the village of Charanka (see Figure 5). The majority of interlocuters from the 4 study villages fall within the

[2]Roughly 40% of Gujarat's land mass is 'either left barren or unculturable/culturable waste' (ICAR 2010). Total estimated degraded lands in Patan district is 317,000 hectares (ICAR 2010).

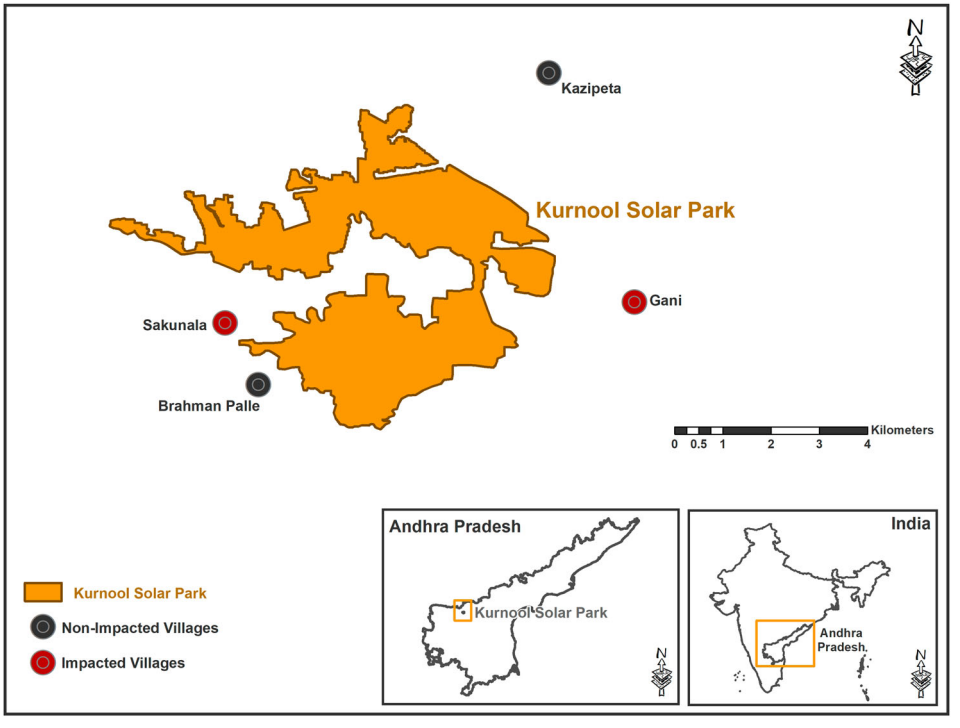

Figure 4. The Kurnool Solar Park and study villages in Andhra Pradesh, India.

Table 2. Parameters for selecting solar parks and villages.

Solar park selection criteria	
1	Ultra-Mega Solar Park ≤1000 MW generating capacity
2	Solar park developed by public sector institutions
3	Dryland ecosystem (average annual rainfall below 750 mm)
4	Primarily rainfed smallholder agricultural systems in adjacent villages
Village selection criteria	
1	Villages whose land was enclosed for the park
2	Villages adjacent to solar park and adjacent to enclosed village lands
3	Villages within 15 kilometers of the solar park
4	Villages with a population of less than 3,000

government's Other Backward Castes (OBC) category of castes, largely Rabari (semi-nomadic pastoralists), Ahir, Gadhvi, Thakore and Koli, with Muslim and Dalit minorities. The average landholdings of survey respondents was 6.54 acres. Farmers surveyed were largely dependent upon rainfed agriculture, with no surface irrigation systems, and grow one season per year (*kharif*), typically cumin, pearl millet, sorghum and wheat. In the case of customary use of government land or encroachment, these lands were expropriated by GPCL. The GSP was India's first solar park, commissioned on April 19, 2012. At present, the GSP has 640 MW solar power generation capacity installed by roughly 30 companies (GPCL 2017), and will likely be expanded to 800 MW by 2020 (personal communication, 7 August 2018).

Figure 5. Land enclosed from Charanka village for the GSP. (Photo: Ryan Stock).

Kurnool, Andhra Pradesh

The Kurnool Solar Park (KSP) is an ultra-mega solar park with 1000 MW generating capacity, commissioned in July 13, 2017. This park's SPPD is Andhra Pradesh Solar Power Corporation Pvt Ltd (APSPCL), a joint venture between the Andhra Pradesh government and the central government's Solar Energy Corporation of India (SECI). The KSP is built on 5683.22 acres of semi-arid land[3], of which 3494.29 acres (61.5%) is government land. The non-government land was enclosed from the villages of Gani and Sakunala (see Figure 4), which remains a politically contentious issue as discussed below (see The Hindu 2017). These private lands constitute a mix of conventional private lands with titles and public lands that were distributed[4] by the AP government to poor and landless peasants of marginalized communities (i.e. Scheduled Castes, Scheduled Tribes; hereafter *assigned land*) and hence private. When fieldwork was conducted, KSP was the world's largest completed single-location solar park, with larger parks proposed and being developed. The KSP was built in the semi-arid region of Rayalaseema. All agriculture in these four villages is rainfed with no irrigation systems known to the primary author. Typical crops grown in this region are cotton, sorghum, and chili peppers. Residents within the 4 villages surveyed belong to a variety of castes, including Reddy (general caste), Kuruva (OBC), Boya (Scheduled Caste), and Madiga (Scheduled Caste), with sizeable Muslim populations (belonging to the Sheik caste). Next, we discuss issues of land dispossession, energy dispossession and partial proletarianization occurring within these two case studies.

Results: land dispossession, energy dispossessions and partial proletarianization

The solar park concept in India was modeled after Special Economic Zones (personal communication, 17 July 2018), which have been described as modern 'green' configurations of

[3]Roughly 549,000 hectares of Kurnool district considered to be 'degraded and wastelands,' mostly due to mining activities (ICAR 2010).

[4]The category of 'assigned land' (D-form patta land) and the resulting process of land distribution to the landless poor emerged with the Andhra Pradesh Assigned Lands (Prohibition of Transfers) Act, 1977. Unlike private land, assigned lands are inheritable and alienable but not transferrable.

Nehruvian steel towns and industrial estates (Levien 2013). The two solar parks examined in this case are public-private partnerships, where the state acquires land and then allocates it to SPPDs or firms that lease the land from the SPPD to generate solar-based electricity (i.e. Tata Power Solar, Adani Solar, GreenKo). The acquisition of land follows a multistep process that includes: (1) defining, demarcating and identifying specific tracts of commons land as 'marginal' or 'wastelands'; (2) assertion of state's authority over these lands and their acquisition through extra-economic means; and (3) their allocation of lands to the SPPD (see Borras and Franco 2013, 1729).

The state discursively constructs lands designated for future solar parks as wastelands through a series of signifying practices. These government-owned and state-defined 'marginal' lands are rendered legible for solar development through maps depicting the geographical extent of wastelands and solar irradiance (Figures 1 and 2). On the question of land, according to a research scientist from the Ministry of New and Renewable Energy: 'In India, land is a different commodity [that should be put to more profitable use]' (MNRE.001, 17 July 2018). For the development of solar parks, the state facilitates the conversion of unprofitable 'wastelands' or wasteland resources (i.e. solar radiation in sparsely populated drylands) into investible space through signifying practices of creating maps that identify lands deemed amenable to acquisition for large-scale solar projects (Figure 1).

This is done in tandem with research institutions producing maps of solar irradiance that discursively render vast areas of land able to generate maximum solar energy (Figure 2). Circling his finger around the Northern region on a map of Gujarat, an electrical engineer working at the GSP reproduced this concept: 'Radiation is best, best in this portion of India. And the efficient days for receiving solar energy are 330 days a year, except 30–35 days during monsoon' (GPCL.001, 22 March 2018). In addition to wasteland availability and solar irradiance, and in coordination with the central government's Solar Energy Corporation of India (SECI), states also consider electrical grid-connectivity to provision urban centers with energy. A project director for GreenKo company (operating at KSP) spoke to this consideration when selecting the geographical location of KSP:

> Another aspect is the connectivity to different big cities like Bangalore, Chennai and Hyderabad. Within this triangular zone, Rayalaseema can transfer so much power to cities possessing high energy potential zones. This is a major aspect which can be considered in developing a solar plant. (GK.003, 16 June 2018)

The remainder of this section is organized into two sub-sections focused on the two case study sites. In each sub-section, we first examine the extra-economic means through which the state dispossesses farmers of land. Then, we show the degree to which land dispossessions also produce a form of energy dispossession as peasants are also alienated from fuelwood, while simultaneously not receiving sustained or reliable electricity generated by the solar park. In the third part of each sub-section, we demonstrate the impact of these dispossessions on agrarian labor dynamics, namely the partial proletarianization of labor. We discuss the two parks relationally, pointing out their similarities and points of diversion, in the Discussion section that follows this section. There, we also discuss what they mean for land and energy grabbing, and the agrarian question of labor.

Case study one: evidence from Gujarat Solar Park

As noted above, private land for the GSP was acquired under the colonial-era LAA (1894).

Among the 200 interlocuters in this region, 14% had land enclosed for the GSP. Expectedly, this number was higher (56%) for those farmers who owned land in Charanka (where all land was acquired) with an average loss of 16.7 acres per farmer. One smallholder in Charanka gave firsthand experience about variable payment schemes:

> A simple agreement letter handed over to the landowners. If they agree, they have to sign the document and receive the payment. The first compensation of Rs. 6,90,000 per acre required exhaustive filing which extend even to the capital of the state. And those who followed later were given Rs. 7,51,000, a huge difference of Rs. 60,000 per acre. Those who joined earlier in the project bore financial losses and completed exhaustive bureaucratic and legal procedures. On the other hand, those who joined later received Rs. 60,000 more and received payment without any extra efforts. Injustice is done to those who joined earlier. (CI.009, 12 February 2018)

These variable payment schemes are a form of extra-economic pressure by the state of Gujarat. There were multiple allegations and a lawsuit in 2012 (subsequently dismissed) claiming that the GSP project was involved in a land purchasing scam, wherein a small group of speculators bought wide swathes of land in Charanka earmarked for the project just prior to government notification of the project in 2011 (High Court of Gujarat 2015). Ostensibly, these speculators were paid Rs. 198 ($2.83) per sq. mt. of land by the SPPDs for approximately 918 hectares for solar park development, instead of the market price of Rs. 110 ($1.57) per sq. mt. paid to farmers (Press Trust of India 2015). One famer disclosed his skepticism of solar development: 'The solar park is good for India but not for Charanka. It's good as it generates electricity but it has stolen the property of my village. It's not development for Charanka, it's destruction' (CI.009, 12 February 2018). Understandably, villagers hoped that the large solar energy generating facility would at least provide them better electricity.

But even the electricity generated has not lived up to the promises made by solar park developers. Solar energy provision to villages adjacent to GSP has not improved the reliability of electricity, the amount of hours they receive energy, nor decreased the cost of electricity. Within the 200 households surveyed in the GSP solar region, only 40.7% of respondents said their solar park improved the reliability of electricity (Table 3). Likewise, only 43.4% of respondents said that the solar parks have improved the hours of electricity received (Table 3). The primary author experienced numerous blackouts in villages adjacent to both solar parks, corroborating accounts of the unreliability of electricity. A female respondent at Charanka summed up the situation:

> We get electricity but at a decided rate, not free of charge. Electricity generated at the solar park is re-routed to the substation at Varahi, then to our village. Earlier, they have promised to provide free electricity to Charanka, but now the price has doubled. (CI.002, 12 February 2018)

Table 3. Responses from household surveys regarding reliability and hours received of energy after solar park development ($n = 200$ in each state, 400 total). Percentages shown reflect responses in the affirmative.

	Gujarat	Andhra Pradesh
Reliability of electricity has improved	40.7%	23.6%
Hours of electricity have increased	43.4%	24.5%

Overwhelmingly, producers near the solar park complained that their electricity bills increased after the implementation of the solar park.

Additionally, 66.95% of households experienced energy dispossession in the form of their inability to access these marginal lands to procure firewood, a primary source of energy needed for cooking and many other daily tasks. As a woman from Fangli of the Ahir caste attested, 'The green cover was removed for the solar site, so the quantity of firewood is reduced. The land is reduced and so reduced the cattle fodder' (FI.009, 8 March 2018). Overall, GSP land enclosures dispossessed access to firewood for women responsible for daily tasks of household reproduction, an energy dispossession impacting 95.9% of households surveyed in the region (Stock 2019). These energy dispossessions are interacting with significant changes to opportunities for on-farm and off-farm labor.

Among all interlocuters ($n = 200$), only 63 people (31.5%) were ever employed at the solar park, which included short-term construction work at the founding of the project. Of those employed, only 6 of these were women (10.5%). A smallholding farmer from Jamvada identified the disparity in employment opportunities after the GSP was built: 'When the new solar park was constructed, only that time we got some work. After finishing the construction work, we do not get any work' (J035, 23 May 2018). Of those whose land was acquired for solar development, only 39.3% were offered employment at the solar park. A female respondent in Dhokavada reflected on inequalities in opportunities at the GSP: 'People who work at the solar park get a low salary. People like the village "head" or contractor get good money. They are doing corruption' (D035, 25 May 2018). One such village 'head' in Charanka candidly admitted his privileged position in the solar park development: 'As a contractor, only I am benefitting from the solar park. Not other families. It's great if employment increases' (C001, 7 February 2018). This person is of a relatively higher caste positionality (Rajput) in Charanka. Being a large landowner, he was able to sell 20 acres of his 40-acre plot of private land to GPCL. He oversees a security business and contracting business at GSP and even rents out his tractor for use by companies within the solar park. As is evident from this case study, solar park development is often rife with elite capture. Large landholding village elites, like this man, have benefitted from new opportunities to become contractors. The unemployment of smallholders whose land was enclosed for the solar park stands in cruel contrast. These findings complement Levien's (2012, 2015b) work in Rajasthan, where elite farmers with more social capital could capitalize off of land brokerage for SEZ development.

For those who do work at the solar park, there are numerous complaints of wage theft or artificially depressed wages.

> There is a lot of corruption. The company gives Rs. 20,000 per month but the middleman gives only Rs. 8,000 per month salary. Some people get jobs as security guards at the solar park. It takes 2 or more months to get the salary. Most non-Gujarati people get jobs and earn money at the solar park. GPCL promised to give employment to people from the Santalpur region. But now a lot of people working there are not residents of Santalpur and nearby villages. (F026, 6 March 2018)

Many solar engineers come from urban centers far from Patan (i.e. New Delhi, Vadodara, Bhuj, Mumbai). In doing so, they live away from their families. Many of these men relish the homosociality. A solar engineer from Orange company at GSP laughingly told me, 'This is a bachelor's place! We are all bachelors here.' Despite GPCL having taken 31 men from

Charanka to a 3-day training in Gandhinagar to learn solar skills, none of them were offered permanent jobs. One respondent from Fangli sums up this grim predicament: 'One labors hard at the solar park and does not get any money. Such is the functioning of solar – starving the laborers' (FI.007, 8 March 2018). Evidence from Kurnool suggests similar impacts.

Case study two: evidence from Kurnool Solar Park

Private land for the KSP was acquired under the newer LARR (2013).[5] The LARR was designed to provide more transparency into land acquisition processes, fairer compensation for lands obtained, and a range of options to resettle those affected. However, in the case of solar park development, the LARR precludes any claims for rehabilitation and resettlement because the Ministry of New and Renewable Energy defines wastelands as not having any 'project-affected persons' (MNRE 2016, 40). As such, many recipients of government distributed marginal lands in Andhra Pradesh are unable to benefit from their claims to wastelands acquired for the KSP. SPPDs in Andhra Pradesh make distinctions between *patta land*, private land with proper title, and *D-form patta land* (hereafter *assigned land*), a classification system for marginal public lands distributed by the government of Andhra Pradesh to poor and lower-caste populations through the Andhra Pradesh Assigned Lands (Prohibition of Transfers) Act, 1977. However, the extension of patta through assigned land was not complete in Gani and Sakunala villages (The Hindu 2017). Assigned land is issued with the conditionality that assignees must cultivate the land within 3 years, a formidable task given the rocky terrain and poor quality of soils. This transformation of land categorization and productive use renders it investible ultimately. Assigned land tenure also includes cases of customary tenure, encroachment and illegal cultivation of government lands or 'areas on old maps demarcated in dotted lines' (APSPCL.002, 23 June 2018). Given its conditional nature, assigned land is more easily dispossessed.

Near the KSP, roughly 28% of interlocuters had land acquired for the solar park (Gani: 48%; Sakunala: 64%). The average landholdings acquired from these farmers near KSP was 4.15 acres in Gani and 4.19 acres in Sakunala. Through LARR (or circumventing LARR; The Hindu 2017), peasants were offered consent awards for private land sales. Those with properly titled private land (*patta*) were given Rs. 5,50,000 (USD $7,857.14)[6] per acre for their lands, compared with assigned landholders (*D-form patta*) receiving Rs. 4,20,000 (USD $6,000) per acre. However, as legal ownership of assigned lands is conditional on cultivation, they may be dispossessed without remuneration. As one assigned landholder from Sakunala lamented, 'We sold 11 acres of our land to the solar park but only received money for 1 acre' (S034, 10 June 2018). A respondent from Gani echoed these sentiments: 'I lost 13 acres of land for the solar park. They never paid me for those lands. I had to sell my cattle too' (G006, 17 June 2018). An assigned land Dalit farmer in Gani, who sold 4 acres for the KSP and was only paid for 2 acres, shed light on the problematic of payment differentials: 'Patta land was given Rs. 5.5 lakhs. D-category lands were given Rs. 4.2 lakhs. There is a gap of almost one lakh. We had to give all the lands without any consultation. It was forcibly taken away' (GI.006, 18 June 2018). Like these men, numerous farmers within both of

[5]See Levien (2011a) for a generative critique of this bill.
[6]The authors have used the following conversion rate between US dollar and rupees: USD $1 = Rs. 70.

these categories expressed that there were not fully paid for lands sold. Those who did not have proper titles for their land (*D-form patta*) received nothing and had their lands expropriated by the SPPDs. In Sakunala, near the KSP, there were 428 farmers who were denied compensation and patta titles for customary use of lands that were expropriated by the solar park (The Hindu 2017). One farmer in Sakunala summed it up succinctly: 'For people who owned the right documents, they received money. If the land is having some problems, the government didn't give money' (S033, 10 June 2018). A different farmer whose farming encroached on public land expressed his dismay at land dispossession: 'The government took our 10 acres of land for free because we don't have any documents to prove it is our land. The solar park only did good for 10 out of 100 people in Sakunala' (S049, 10 June 2018). A Muslim smallholder from Gani village (near KSP) reflected on the promises made by APSPCL and officials from the District Collector's office to obtain farmer's consent for land acquisition:

> I worked as a laborer to build the solar park. They promised they would construct a hostel, hospital, school [in Gani] and give free electricity and water [to all Gani households]. They promised to give permanent employment and they didn't. We just lost our land. (G035, 18 June 2018)

Land dispossession facilitated various forms of energy dispossessions, discussed below. Next, we discuss the energy-specific forms of dispossession occurring at the KSP.

Solar energy provision to villages adjacent to the KSP has not improved the reliability of electricity, the amount of hours they receive energy, nor decreased the cost of electricity. Within the 200 households surveyed in the KSP solar regions, only 23.6% of respondents said their solar park improved the reliability of electricity (Table 3). Additionally, 24.5% of respondents said that the solar parks have improved the hours of electricity received (Table 3). Echoing the promises invoked by the farmer from Gani (G035), a smallholding farmer from Brahman Palle thus explained it: 'There are frequent electricity cuts. They promised to give 24-hour electricity for free but they didn't' (B027, 15 June 2018). Living in these villages to conduct fieldwork, the primary author also experienced daily electrical blackouts. In contrast to the GSP case, energy dispossessions through lack of access to marginal lands for collecting firewood was less severe in KSP-adjacent villages, impacting only 38% of households surveyed. 'We have no trees for firewood, they have felled the trees and flattened the land for solar installation,' proclaimed a woman from Sakunala (SI.001, 11 June 2018). Residents were also dismayed by the lack of employment opportunities at the solar park.

Among all 200 interlocuters in this region, only 41 people (20.5%) were ever employed at the solar park. Of these, only 4 were women (10.3%). Additionally, only 33.3% of famers whose land was acquired for solar development were offered employment at KSP. Overwhelmingly, those employed at the solar park did menial labor jobs, such as washing the solar panels (Figure 6), cutting grass that grows under the solar panels, or working as security guards. As is the case with GSP, most solar park workers at KSP come from elsewhere in the state or country (Bangalore, Hyderabad, New Delhi). GreenKo company at KSP created a skill development center at the KSP and offered a 6-month training in solar engineering. However, GreenKo did not offer jobs to graduates of this program, nor local technical school graduates for reasons unclear to the primary author. These 2 case

Figure 6. Laborers cleaning the solar panels at the Kurnool Solar Park. (Photo: Ryan Stock).

studies reveal frictions between solar development and social development, frictions that are likely emblematic of solar park development nationwide.

Discussion

The true cost of generating solar energy in Gujarat and Andhra Pradesh has been land dispossession, energy dispossessions and a partial proletarianization of the peasantry. Within the two solar regions, 21% of respondents had their lands enclosed for the solar park. The average landholdings lost were 5.42 acres. As vast tracts of land are now missing from the two solar regions' agricultural productivity, opportunities for wage labor on farms have also decreased. Araghi (2009) refers to this phenomenon as 'enclosure-induced displacement.' The solar land grab has not resulted in complete displacement or expulsion from the areas surrounding the solar parks. Instead, it created a surplus population for the vast majority who do not receive employment (cf. Li 2010, 2011). Moreover, solar park development has produced a partial proletarianization in the solar regions (Byres 1981; Breman 1996; Akram-Lodhi and Kay 2010b; Misra 2017), creating many landless peasants who are not being absorbed into wage-labor positions resulting from the solar park schemes (Li 2011), a form of dispossession without development (Levien 2018). Within both solar regions, only 26% of respondents were employed at the solar park doing menial labor jobs. In both solar regions, only 12.5% of respondents whose land was enclosed for the project were offered employment at the solar parks. Most of the employment generated by the solar parks were highly technical and specialized, thereby excluding local peasants whose average level of education completed is 5th standard (GSP: 4.8; KSP: 5.2).

In agreement with Baka (2017), the development of these two solar parks has led to *energy dispossessions*. Local producers whose land was dispossessed or living adjacent to the solar parks do not receive benefits vis-à-vis electrification, cheaper or more reliable electricity and also dispossessed of fuelwood collection, their principle energy source. In the present case, improvement of the villages' electrification has not transpired following construction of the solar parks, despite promises by the state. These findings demonstrate the prediction by Huber and McCarthy (2017) that the global transition to renewable energy will be spatially extensive, while reworking existing land-uses and rural livelihoods. In this case, the establishment of solar parks has led to land and energy dispossessions. This further demonstrates the degree to which the goal of expanding solar electricity generation is not agrarian development, but instead to enhance capital accumulation without changing capitalist social relations (see McCarthy 2015).

Indisputably, a breakneck transition to renewable energy generation in India is necessary to stave off additional emissions to a changing climate system that delivers unforetold present and future natural and political hazards in this underdeveloped nation. Smallholding peasants in rural spaces are already experiencing livelihood changes because of anthropogenic climate change (Stock, Birkenholtz, and Garg 2019). Pledging to expand its renewable power capacity to 175 gigawatts by 2022 to meet Paris Agreement commitments, India will increasingly use JNNSM solar parks to achieve this goal. Further, India has become a global power broker for solar development, whose solar parks are globally renowned. Through its new leadership in the International Solar Alliance (UNEP 2018), the OPEC of solar development (Mohan 2018), India will seek to latitudinally export its large-scale dispossessive model of solar development throughout the Global South. India's solar state has become a major geopolitical force that is reshaping relations of production in agrarian systems globally with grave implications for the agrarian question of labor.

Tracing the contours of development trajectories long espoused in classical agrarian studies by Kautsky (1988) and 'successors' (see Lenin 1967; Patnaik 2007; Akram-Lodhi and Kay 2010a, 2010b; Levien, Watts, and Hairong 2018), land acquisition for solar park development in India accelerated agrarian class differentiation, thereby fragmenting the petty commodity producing peasant sector. Large landholders, who were surplus producers previously, capitalized on agrarian transformation for solar through gainful employment opportunities and renting out industrial farming technology to the solar developers. Increasingly, these proto-capitalists seek employment opportunities in the provisioning of machinery for the solar sector. In contrast, smallholder peasants whose agriculture was largely subsistence for the purposes of household reproduction, who earlier worked for wages as proletarians on large-holders' farms (who needed them for accumulation), lost vital wage-labor opportunities as land under cultivation was transformed for solar parks, their full proletarianization interrupted. These peasants are now forced to sell their labor power for survival in a region with diminished farming possibilities and farm wage-labor opportunities to no avail. The resulting partial proletarianization for peasants signals a crisis of reproduction in this class whose agrarian labor power has been rendered redundant by the dispossessive forces of solar development (see Akram-Lodhi and Kay 2010b). This follows patterns of capital accumulation via dispossessive land grabs across the Global South, wherein the landless peasants' labor is not needed nor integrated into new relations of production (Li 2011). Following Bernstein (2004), these

findings corroborate Akram-Lodhi and Kay's 'decoupled agrarian question of labor', wherein the globalization of 'sustainable' infrastructures of capital accumulation (i.e. solar parks) in the Global South (to mitigate global climate change largely created by the Global North) has rendered agrarian capital within these solar regions (not globally) as irrelevant, shaping class politics as peasants struggle to preserve their livelihoods or adopt new livelihoods (Akram-Lodhi and Kay 2010b).

In addition to economic development, the JNNSM solar parks fail to resolve questions of gender equity, despite discourses otherwise (Stock 2019). As discussed in the two case studies, the aggregate composition of workers at the solar park from the 8 comparison villages is 90.4% male, with only 10 females surveyed working at the solar parks (GSP: 6; KSP: 4). An Ahir caste woman from Charanka succinctly reflected on marginal land acquisition, energy dispossession and partial proletarianization:

> I want to work at the solar park, but I don't get any work there. I don't get any job. If someone gets a job, they will be terminated easily. They give a job for 2–3 months, only when they want people or laborers. We were farming government land. Now we don't have or can't do any work. Now in monsoon, sometimes we don't get any electricity. Before, we were getting electricity from Jyotigram [Yojana]. Now we get less firewood, and we need to go far to get it. Water problems were already there. Before we can do work in farms. Now we are at home. (C008, 18 February 2018)

The results of this study highlight the importance of answering Akram-Lodhi and Kay's (2010b) 'gendered agrarian question' in the context of capital accumulation in a male-dominated solar sector. Repeating the quote of the interlocuter from Orange company at GSP, solar parks are 'bachelor's places.' For the mostly-male populations employed doing menial jobs at the solar parks (former petty commodity producers themselves), the burdens of agriculture disproportionately fall on women of the household (Ramamurthy 2014; Stock 2019). Following Gidwani and Ramamurthy (2018), this article discusses the agrarian question of labor with insights on the gendered politics of social reproduction, albeit through energy dispossessions (i.e. fuelwood) instead of the translocal householding strategies of labor migrants. This study also extends Akram-Lodhi and Kay's (2010b) 'ecological agrarian question' by examining the agrarian question of labor in the context of agrarian transformations for renewable energy production to mitigate anthropogenic climate change. In sum, agrarian questions otherwise unresolved gain new importance in patriarchal labor arrangements of neoliberal green grabbing.

Conclusion

In this paper, we argue that green grabbing is occurring in rural India for solar park development. The state draws upon discursive constructions of wastelands and solar irradiance to render marginal lands investible for solar park development under the auspices of mitigating climate change. Through empirical data from the Gujarat Solar Park and Kurnool Solar Park obtained from household surveys, we illuminate how solar park developers dispossess local producers' land and livelihoods with insights on the agrarian question of labor. Local residents also experience energy dispossessions, as they are prevented access to firewood sourced from the enclosed lands. Additionally, the provision of renewable energy is 'incommensurate with local needs' (Baka 2017), as the electricity received from the solar park is not more reliable or of improved quality. Further, we highlight

the realities and affectations of residents through semi-structured interviews. In comparison, affected peasants of the Kurnool Solar Park were less likely to receive employment at the solar park and were less sanguine about electricity received. Affected peasants of the Gujarat Solar Park had larger amounts of land lost per farmer. These findings suggest global climate capital is producing agrarian transformations, albeit with minimal social and economic development of adjacent villages.

The fate of petty commodity producing peasants in the Anthropocene is precarious. The development of ultra-mega solar parks reorganizes land and labor in a globally ascendant neoliberal capitalism. The urgency of low-carbon transitions must not reproduce alienation through green grabbing. As the Government of India develops more solar parks in the drylands to profitably mitigate climate change and generate much-needed renewable energy, marginalized populations should not be left in the dark. The cases of the Gujarat Solar Park and the Kurnool Solar Park serve as grim admonitions. Equitable transitions to renewable energy systems necessitate procedural justice, energy access and employment (Newell and Mulvaney 2013). The accumulation of solar surplus value on peasant lands has created a new surplus population without employment opportunities. Although jobs in the solar sector are not uniformly 'just' jobs (see Mulvaney 2014; Mulvaney 2019), they are jobs nonetheless. As this paper argues, the agrarian question of labor remains an important theoretical debate, gaining new significance in the era of solar development in the Global South.

Acknowledgements

We extend our heartfelt gratitude to friends, respondents, colleagues and key informants in Gujarat and Andhra Pradesh. Special thanks to Pradipsinh Parmar, Vasae MD Munawar and Lakshmi Reddy Yeruva for fieldwork support. We dedicate this article to Shilpa, Shyan and Lakshay.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was generously supported by the Fulbright-Hays Doctoral Dissertation Research Abroad fellowship under [grant number P022A170064].

ORCID

Ryan Stock http://orcid.org/0000-0002-6218-3725

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Ryan Stock is an Assistant Professor in the Department of Earth, Environmental and Geographical Sciences at Northern Michigan University. He is a political ecologist whose work examines development interventions, social power and intersectional social difference, and the political economy of environmental change.

Trevor Birkenholtz is an Associate Professor in the Department of Geography at Pennsylvania State University. He is a political ecologist and critical development scholar who specializes in understanding agrarian change in South Asia.