



“Lead the district into the light”: Solar energy infrastructure injustices in Kerala, India

Heather P. Bedi

Dickinson College, Environmental Studies Department, 28 North College Street, PO Box 1773, Carlisle, PA, 17013, United States



ARTICLE INFO

Article history:

Received 13 June 2019

Received in revised form

22 October 2019

Accepted 25 October 2019

Available online 12 November 2019

ABSTRACT

Solar energy represents a fossil fuel alternative to meet India's rising energy demand. Large mega-watt solar projects require contiguous land, which is sparse in the South Indian state of Kerala. Drawing from ethnographic research in Kerala, this paper traces the role that solar infrastructure plays in making and unmaking land and lives in pursuit of light. Government officials promoted the Kasaragod solar park and associated green corridor transmission line as climate-friendly infrastructure development for the energy deficit state. Select government officials encouraged solar projects as the renewable resource would help, “lead the district into the light.” Although the energy infrastructure promoters promised development benefits for local stakeholders, *Adivasis* (indigenous peoples) without legal land titles and others opposed the acquisition of their land for the solar project. The Kasaragod Solar Park exemplifies how national climate goals for renewable energy and empty infrastructure pledges translated into the reification of land unevenness, with particularly profound implications for *Adivasis*. This reproduction of socio-environmental injustices did not go unchallenged. Local political opposition significantly reduced the 200 Megawatt (MW) solar park to 50 MW, but not before some *Adivasis* and others without land titles lost their land and livelihoods. This case illustrates how the completion of renewable energy infrastructure to meet national and state climate goals may hinge on the assertion of local political power to thwart or promote large-scale projects. Efforts to pursue ambitious national renewable energy infrastructure goals without recognition of historical land and development unevenness may hinder India's capacity to pursue renewable energy transition goals.

© 2019 The Authors. Production and hosting by Elsevier B.V. on behalf of KeAi Communications Co., Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Infrastructure and land conflicts

Large-scale projects, including those for renewable energy, frequently link infrastructure to the ‘fate of the nation’ ([1]: 1). India is a part of this global trend, with national ambitions tied intimately to energy infrastructure. Promoted nationally as a climate friendly way to power the growing nation, there has been a steady increase in solar energy infrastructure in India [2]. This push is part of national climate change mitigation plans. Introduced in 2008, the National Action Plan on Climate Change notes the need for India to

undergo a transition to renewable energy to balance economic growth with climate change mitigation [3]. Simultaneously, the plan articulates the need to protect the nation's poor and promote climate sensitive sustainable development [4]. When introducing the plan, former Prime Minister Dr. Manmohan Singh highlighted the important role solar energy would play in the nation's energy transition [4]. With an annual potential of 6000 million gigawatts per hour (GWh) of energy from an average of 250–300 sunny days per year, solar energy has the greatest potential to meet energy demand in India, compared with other renewable energy resources ([50]: 230).

With 60% of India's electricity supply derived from carbon intensive coal, renewable energy sources—including solar energy—offer the country a form of climate change mitigation. There is also national anticipation that solar projects may meet part of India's growing energy needs, including for the 300 million people living in energy poverty. Although not perfect, solar is an attractive energy source because it is renewable and releases minimal

E-mail address: bedih@dickinson.edu.



Production and Hosting by Elsevier on behalf of KeAi

<https://doi.org/10.1016/j.glt.2019.10.005>

2589-7918/© 2019 The Authors. Production and hosting by Elsevier B.V. on behalf of KeAi Communications Co., Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

greenhouse gas emissions. The downsides of solar include dependence on existing electrical infrastructure, and the intermittent nature of the energy due to weather changes [5]. Further, it is plausible that solar energy access for some will deepen the nation's energy poverty cleavages.

Current Prime Minister Narendra Modi pledged to have 100 gigawatts (GW) of grid solar power by 2022. There has been a notable renewable energy electricity expansion from 2% in 2005 to 13% of electricity sourced by 2015. Although this is an impressive increase, India has not met the ambitious renewable energy goals promoted by the central government. In part, this is because not all the 29 states of India have embraced the national goals with the same fervor. Elizabeth Chatterjee [6] charts how the national 100 GW target galvanizes a coalition of renewable energy willing states who view the projects as aligned to their political and economic interests. As a result, the approach to renewable energy adoption in India does not correlate with per capita state wealth, infrastructural electricity needs, or geographies amenable to the projects. For example, renewable initiatives in the relatively impoverished states of Rajasthan and Madhya Pradesh outpace wealthy Maharashtra [6]. Solar adoption may further be hampered or bolstered based on the availability and status of land.

Large-scale solar projects in India represent nascent spaces for land conflicts. While recent land acquisition tensions related to development infrastructure are well documented in India [7–9,51], the green goals of the renewable energy projects gave a short-lived hope for more equitable land acquisition. However, climate goals to reduce the nation's fossil fuel dependency do not make solar projects immune to repeat land acquisition and uneven development mistakes of the past. Big mega-watt solar projects need linked land plots, which are expensive and in limited supply in India.

The state of Kerala, which is under-represented in the burgeoning literature on solar energy in India, exemplifies the challenges associated with securing the land necessary for large-scale solar projects. Unused land is sparse in Kerala, a state also facing energy shortages and climatic vulnerability. A Kerala government official details how, "solar basically requires a huge amount of land ... Kerala has a very complex terrain, and such kind of large-scale land in a single location is not available" (Interview, 9/28/18). Echoed by other government officials and solar entrepreneurs was the sentiment that Kerala's geography, filled with waterways, floodplains, and hills, coupled with population density make it difficult to find connected plots of land for renewable infrastructure. This land challenge is illustrated by the research presented here.

Following village level opposition to land acquisition, the Kerala state government significantly scaled back the Kasaragod Solar Park project from 200 MW to 50 MW installed capacity. Drawing from the Kasaragod example, this research examines the everyday impacts of solar projects to understand who has power to shape or stop the associated infrastructures across scales. Ethnographic research completed from August to November 2018, funded through a Fulbright-Nehru Research and Academic Excellence Fellowship, included 110 in-depth survey interviews conducted by the author and two research assistants with a range of randomly selected stakeholders living in and around solar sites in Kerala. Completed in Malayalam, the in-depth survey interview questions were then translated into English. The author coded the responses for themes and analyzed for trends. The author completed 23 semi-structured interviews in English with solar entrepreneurs, government officials, journalists, NGO representatives, and academics, which provided supplemental information about the nature and history of solar energy in the state. Common narratives to describe solar energy and target populations emerged through text analysis of Kasaragod, Kerala state, and Central Government policies,

reports, NGO materials, and media coverage. Participant observation at government and non-profit workshops on renewable energy provided additional insights. The Institutional Review Board at the author's institution approved the research methods.

The following section opens with a theoretical examination of how energy justice and infrastructure insights offer tools to understand the profound everyday human and ecological implications of renewable energy initiatives, with particular focus on the capacity for energy infrastructures to make and unmake lives and land. Next, a review of uneven land reform and the development status of *Adivasis* in Kerala contextualizes solar infrastructure. Following details of national renewable energy efforts and the Kasaragod Solar Park, the research reviews the daily impacts of the solar site and examines the power forces which enable or disable solar infrastructure efforts. In closing, the project's similarities to land injustices prevalent in both renewable and non-renewable infrastructures underscore the importance for future research to review these trends across scales to reveal the power structures permitting and deepening persistent development injustices and unmet infrastructure promises [10].

2. Energy justice and infrastructure

Although access to electricity is necessary to improve health, education, and development indicators [11], injustices are possible through energy extraction, processing, and the associated energy infrastructure [12]. Emanating from the field of environmental justice, energy justice highlights efforts to ensure that certain populations do not disproportionately bear the burdens of providing or accessing energy. Energy access and deprivation are intimately shaped by geographical inequities entrenched in economies, infrastructures, and cultures of society [13]. An energy just world is one that acknowledges this geographical unevenness and, "equitably shares both the benefits and burdens involved in the production and consumption of energy services, as well as one that is fair in how it treats people and communities in energy decision-making" ([14]:5).

Well documented are the energy injustices associated with the fossil fuel industry [12,15–18]. Emerging scholarship warns that renewable energy processes may also further injustice cleavages [19]. The frequently incongruent nature of economic goals and local priorities present challenges for renewable and non-renewable energy projects alike. For example, Curley [20] argues that a renewable energy jobs effort promoted in the Navajo Nation failed because of the project's neoliberal governance and development assumptions. While attempting to transition the nation's energy source from coal to renewables, the project undervalued the cultural and historical importance of coal for the legitimacy and sovereignty of the tribal government. Curley's insights undergird that projects premised on climate and clean energy goals must be culturally appropriate, attuned to development priorities, and reflective of distributional power relations. Injustices in India also raise cautionary tales about energy infrastructure deepening existing social and economic disparities.

Renewable energy projects represent a convergence of India's land tensions, with emerging research detailing the associated livelihood and social costs for those living in and around the energy sites. One of the world's largest solar plants heightened precarity for vulnerable social groups in Gujarat, India through the transition of common grazing lands and farming land into non-agricultural use [21]. Renewable projects can replicate historical mistakes of marginalizing populations through land accumulation. Yenneti and colleagues ([21]: 90) conclude that, "solar mega-projects may manifest a regime of accumulation whereby low carbon coalitions of interests can maximize their gains by dispossessing vulnerable

social groups of their life-sustaining assets". Due to historical social, educational, and economic inequalities, any efforts for community dialogue are likely to be dominated by the affluent and well-educated in India [22]. Yenneti and Day ([22]: 672) conclude that procedural equality for the poorest and least educated cannot be achieved unless there are specific mechanisms to ensure meaningful participation and say over solar projects. Similarly, Sareen and Kale ([27]: 277) detail the need to acknowledge the role that renewable energy projects may play in entrenching the "deep-seated inequities" associated with energy access and other development benefits. They challenge governments and renewable energy transition proponents to view renewable energy not as an end in itself, but as a means to ensure energy equity and enhance domestic energy sources.

The justice implications of energy infrastructure provide insight into the potential for spatial unevenness in relation to who benefits from or is burdened by energy systems. The everyday realities and political economies of energy infrastructure remain under-examined [23]. The infrastructural turn examines the human consequences of both visible and invisible technical infrastructure, including the governance structures that enable or disable infrastructure. Examining energy infrastructure mega-projects, Sovacool and Cooper ([24]: 8) define governance as the coalitions who coalesce in support or opposition to the project and the associated economic and political systems. This multi-scalar view of energy infrastructure governance recognizes the importance of a range of stakeholders, including local communities, to the project's manifestation or downfall. Goldthau ([25]: 138) analyzes the importance of energy infrastructure governance across scales, although governance systems rarely address each scale evenly. In particular, regulatory entities commonly make energy infrastructure decisions without any or adequate consultation with lower governance levels, including community stakeholders. Further, the fragmented nature of access to governance decision-making can lead to uneven outcomes for stakeholders not endowed with power. With energy access a critical part of infrastructure, decentralized and dynamic governance solutions are needed to implement low carbon energy transitions in nations around the globe ([25]: 134).

It is valuable to understand the formal and informal power structures that shape infrastructure and the associated everyday environmental and social realities for impacted stakeholders. Amin ([26]: 146) examines the role infrastructure plays in forming, "how the communal landscape looks, and how it is curated and spoken of, turns out to be quite significant in shaping sociality". Amin traces a government housing infrastructure effort in a Brazilian favela to explore the social making or unmaking implications of infrastructure. The government housing yielded sterile spaces for the residents, which prohibits them from airing their laundry and provides no informal space for social groups to congregate. This changed social landscape inhibits their ability to participate fully in their lives, using design to silence preferred living arrangements ([26]: 153). Underlying Amin's analysis is the broader question of who has power to create or uncreate spaces via infrastructure.

Appel and co-authors [10] detail how infrastructures, including electricity lines and water pipes, promise to provide populations with the tools to meet their everyday modern development needs. They deconstruct how the creation, maintenance, or absence of these everyday infrastructures reveal the uneven nature of resource provisioning and access. Infrastructures thus become terrains of power and contestation, with associated decision-making determining what resources will or won't be provisioned to whom. The material building of physical infrastructures are also embedded in structures of power. Infrastructures may bifurcate communities, heighten segregation, or create new accessibility. The decisions made by those endowed with power to grant access or change local

spaces can make or unmake the lives and livelihoods of those impacted.

Conceptualizations of the social implications of inappropriate infrastructure help to understand how planners and officials in India, frequently with limited participation from local stakeholders, pursue infrastructure projects from a narrow perspective not attuned to the land, development, and social implications of their interventions. This research places infrastructural turn insights into conversation with energy justice theory. This examination of infrastructures through the lens of energy injustice allows for a review of the everyday ways that renewable energy infrastructures make or unmake lives and livelihoods, particularly for populations who historically and contemporarily bear the brunt of bads associated with development and environment projects in India. This case, in tandem with emerging evidence from Rajasthan and Gujarat [21,27], represents that the premise for India's emerging renewable energy infrastructure is built on, "the reproduction of multiple levels of socio-environmental injustices" [28]. In the case detailed here, the government promoted solar energy infrastructure on land identified by the government as "barren" or "uncultivable" [29], without review of the development and social implications for local stakeholders. This attempt to promote a solar project without acknowledgement of historical injustices proved pyrrhic for broader renewable infrastructure goals and reveal dynamic power relations.

3. Uneven development in Kerala

Given the capacity for infrastructures to make and unmake lives and livelihoods, it is important to examine the development context of the sites designated for infrastructure initiatives. The injustices which may accompany energy infrastructure build from and exacerbate historical uneven development, some of which may not be apparent at first review. With human development indicators consistent with Western nations, the state of Kerala has long been a darling of the development community [30]. The state defies the slow development rates which plague many parts of India. While 22% of the national population lives below the poverty line, 7% of Keralites live below the poverty line [31]. Despite a slow rate of economic growth, the expansion of state-run public service programs (including food security, social security, income generation, housing, and education) helped to reduce rural poverty and achieve almost full literacy in Kerala [32]. It is noteworthy that the state also benefits from large financial remittances, predominantly from Keralites working in the Middle East Gulf states [33]. 94% of the state's population of roughly 33 million are literate, the highest rate in India [52]. However, adulation for the Kerala development model universalizes the experience for all Keralites, assuming the model benefited everyone evenly [34]. A more precise review reveals the uneven nature of Kerala's development.

Despite development achievements, inequalities persist among social classes, historically marginalised indigenous communities, fisherfolk, and women [33,35]. This is particularly noteworthy among *Adivasis*. The word *Adivasi* derives from the Sanskrit words for 'adi' (beginning) and 'vasi' (resident of), and became commonly used by activists in central India in the 1930s ([36]: 6). *Adivasis* are officially categorized in the Indian constitution as 'scheduled tribes'. *Adivasis* were bonded laborers long after the official abolishment of slavery in the 19th century. This historical context frames the current experience for *adivasis* in Kerala.

While they make up only 11% of Kerala's population, scheduled

castes and *Adivasis*¹ represent 30.33% of the poor, with the majority being landless [53]. Starvation deaths of 32 *Adivasis* in 2001 prompted some scholars to hypothesize that Kerala's development experience victimized *Adivasis*, including through a lack of regular access to decision-making forums [54]. In the wake of this tragedy, the *Adivasi Gothra Maha Sabha* movement advocated for land redistribution to landless *Adivasis*. In 2008, the Government of India acknowledged these development disparities noting, "the *adivasis* of Kerala appear to be struggling, with meagre access to basic resources, particularly land, as is evident from the numerous ongoing land struggles" ([4]: 356). The government attributes these differences to persistent uneven access to land, employment, education, medical facilities, and social security safeguards ([3]: 358). This mirrors national trends of poverty endemic among *Adivasis* related to remote location, high forest dependency, and low levels of literacy ([37]: 56). Despite this historical marginalization, these issues remain absent from many state level and national development debates and policies:

the underdevelopment and marginality of the *Adivasis* is not an accident, but rather a product of the historical trajectory of development, receives little attention in debates on *Adivasi* development in general, or in the debates on the *Adivasi* land question ([36]: 9)

Although land reform was a key platform of the ruling Communist party when Kerala became a state in 1956, *Adivasis* have not benefited evenly from the land transitions. Following political instability and land-owner opposition, the Kerala Agrarian Relations Act, passed in 1960, aimed to end tenancy and to provide land ownership to 'hutment dwellers', but did not specifically address *Adivasi* land concerns. The Government of India concludes that the, "land reforms in Kerala not only failed to yield any benefits to the tribals but also marginalised them further" ([3]: 358). *Adivasis* suffered from high land encroachment by non-*Adivasis* from 1966 to 1982. The Patent Act of 1975 invalidated land transfers of *Adivasi* land to non-*Adivasis*, but the government has a dismal record at enforcing the law-with only 9% of disputed land cases settled ([4]: 359). Despite multiple levels of exploitation and oppression, there is *Adivasi* agency to transcend marginalization ([38]: 94), with specific articulation of the importance of land to their identity:

Adivasis see themselves as the original, or first inhabitants of the lands that have been taken away or are being taken away from them. The articulation of their identity in their struggle for land is a response to dispossession and disempowerment caused by the process of modernization. Politically, their strategies are meant to reclaim their land, but not to return to a life of isolation ([36]: 7)

Further land disadvantages are present for *Adivasis*, derived from how the state classifies land.

The state's use of technology can cloak actual land uses and environmental vulnerabilities [39]. In the Kerala context, Wolfgang Hoeschele [40] documented how the state government used geographic information engineering to substitute land-cover data for land-use data, which were not collected. Using satellite data, the government's analysis, "greatly overstates the amount of wastelands in the region, and consequently minimizes the productive

roles of peasants and *adivasis* (tribals) in managing the land" ([40]: 239). This technical rendering furthered *Adivasi* precarity, as the Kerala government made official land-use decisions using this opaque data.

There are distinct discourses regarding *Adivasi* land and development aspirations. Steur ([41]: 30) challenges the assertion that *Adivasis* have been excluded from the state's development benefits, noting the relative higher literacy rate of *Adivasis* in Kerala compared to the national average and *Adivasi* agency to engage with local governance. Land is a critical issue, but Steur cautions against a land-only solution for the uneven development experience of *Adivasis*. "Against the over-emphasis on 'land rights' by the media and intellectuals in Kerala, many *Adivasi* activists emphasise that they also need support in making their land productive as well as education and employment opportunities for their youth" ([41]: 41). Given the high dependency on land and persistent land tenure challenges, the preferences, needs, and desires of those impacted directly by energy infrastructure are required to achieve energy justice.

Highly reliant on hydro-electricity and electricity imported from neighboring states, Kerala is keen to increase renewable energy capacity. The uneven nature of land reform provides the foundation for the state's land acquisition efforts for large-scale solar projects. The Kerala State Energy Policy, 2013 mandates that land reservation for renewable projects on *Adivasi* land requires land owner agreement, allows for continued agricultural use, and includes a mechanism for revenue (not profit) sharing directly into the land owner's bank account. While the government is implementing the revenue sharing mechanism for a wind project in the state, it has not been applied to a solar project.

The introduction of a solar park in the northern Kerala district of Kasaragod² demonstrates the continuation of historical land injustices, with significant social, economic, and ecological implications. Kasaragod was likely selected for the project as the district has some of Kerala's most relatively affordable land. Kasaragod has a lower population density of 657 people per square kilometer, compared to the state's average of 860 people [53].³ The district is one of the slowest to urbanize in Kerala, and 49.1% of the district's rural population is landless [55].⁴ Collectively, these factors made Kasaragod district attractive for renewable infrastructure, while also heightening *Adivasi* land precarity.

4. National solar targets and the politics of local infrastructure

A large-scale solar park requires a continuous swath of land. Although the national and state government may provide incentives and frameworks to encourage a project, the construction of an infrastructure initiative is dependent on the ability of local and state officials to acquire or lease the appropriate land. In Kerala, local *Panchayat* (local governance bodies) and citizen political dissent blocked the full-scale 200 MW Kasaragod solar park, which significantly reduced the overall land available for the initiative. The inability of the state government to secure adequate land for the larger solar project reduced the park to 50 MW and led the central government to rescind project subsidies and to halt the

² Kasaragod district is divided into two taluks (Kasaragod and Hosdurg) and 75 villages. The district has one revenue division, 6 Block *Panchayats* (Manjeshwar, Kasaragod, Kanhangad, Nileshwar, Karadka and Parappa) and 38 *Gram Panchayats*, and three Municipalities (Kasaragod, Kanhangad and Nileshwar) [49].

³ The population density in Kerala is 860 persons per square kilometer, compared to the national level of 382 persons [55].

⁴ 72.5% of the rural households in Kerala are landless, compared to the national average of 56.4% landless households.

¹ The Government of India classifies the *Adivasis* of Kerala into the following four categories: hunters and gatherers; agricultural laborers, shifting cultivators; and settled cultivators ([4]: 356).

associated green corridor electricity infrastructure.

Local *Panchayats* strategically used their political power to scale down the project's scope, representing a barrier to the state's ambitions to meet national solar energy goals, as the Kasaragod solar park would have been Kerala's largest solar installation. Through this solar installation and other smaller projects, Kerala aimed to install 500 MW of solar energy by 2017, but as of 2018 installed 120 MW. The state revised the 2030 goal of 2,500 MW to 1,870 MW, with rooftop solar initiatives increasingly playing a major role in plans to meet state and national targets. The new state emphasis on rooftop solar partially reflects the land challenges associated with ground based solar installations, but also an emphasis on middle and upper-class energy consumers. Rising consumer energy demands, particularly from these middle and upper-class consumers in Kerala, demonstrate the need for national renewable energy efforts.

The National Solar Mission of the Government of India is a federal program to encourage the generation of clean energy. Through the Ministry of New and Renewable Energy (MNRE), the government provides financial support for the infrastructure (land, roads, water access, and transmission lines) necessary to create the solar parks. Solar parks are collaboratively developed by the state and central governments, usually with a capacity of 500 MW and above.

The central government promotes the parks to help a state to, "meet its Solar Purchase Obligation mandates and provide employment opportunities to local population. The state will also be able to reduce its carbon footprint by avoiding emissions equivalent to the solar park's generated capacity" [2]. The central government encourages ambitious solar goals and sets renewable purchase obligations for states to achieve 21% renewable energy power by 2022 (10.5% of the 21% must be solar power). Each state's electricity regulatory commission determines how the state will achieve their obligations. As of 2019, only six Indian states have been able to meet their renewable purchase obligations. Kerala has been unable to meet the obligation, and the state promoted the Kasaragod initiative as a means to meet future solar targets.

Various scales of the government promoted and implemented the Kasaragod solar park. The Tehri Hydro Development Corporation India Limited (THDCIL), a joint initiative of the Government of India and the state of Uttar Pradesh, made a commitment to the MNRE to develop a 200 MW solar park in Kasaragod, Kerala. The Solar Energy Corporation of India (SECI) and the THDCIL signed a Memorandum of Understanding for the project on February 13, 2015. The Kerala State Electricity Board (KSEB) signed a further agreement with the SECI and THDCIL on March 31, 2015 to develop the solar project in Kasaragod. The Renewable Power Corporation of Kerala Ltd. (RPCKL), a joint venture of SECI and KSEB, took on the state level land acquisition responsibility. The SECI invited competitive bids for the project on June 28, 2016, with the bidding process completed by April 2017. Under a power sale agreement, the KSEB agreed to purchase the electricity generated by the project, with a set tariff of 3.55 per kwh unit generated. For the Kasaragod solar park, the central government granted conditional subsidy approval on October 18, 2016.

KSEB planned to provide 1,086 acres for the full 200 MW solar park, and surveyed land for the project across four *Panchayats* in July 2015. The SECI and KSEB held a meeting to discuss the pending land transfers in December 2015. On April 7, 2016 the *Panchayats*, *Gram Sabhas*, District Collector, MLA, and Municipal Chairman received written information about the project in English (the government issued an earlier notice in Malayalam). This would have been an ideal time to begin consultations with a range of stakeholders at the local scale. In 2016, the state government transferred land to KSEB in Karinthalam (169 acres) and Paivalike

(430 acres) for the project. The original area comprised 484 acres of leased revenue land in Velluda, Ambalathara village located in the Madikai *Panchayat*. Interestingly, this land change happened in the same year as a political change in the state. This political transition provides part of the explanation of why the solar park could not proceed at the originally planned scale.

Since 1982, political power in Kerala has transferred between two political alliances—the Left Democratic Front led by the Community Party of India (Marxist) (CPI(M)), and the United Democratic Front led by the Indian National Congress. On May 16, 2016 the people of Kerala voted the Left Democratic Front coalition into power. The United Democratic Front was instrumental in proposing the Kasaragod solar park, while the newly elected Left Democratic Front had to make decisions about the future of the project. Noteworthy in this changeover is the prominence of solar park opposition in the CPI(M)-ruled *Panchayats* of Kinanur-Karinthalam and Madikai. Local scale project disapproval in Paivalike and the Meencha *Gram Panchayat* further made land transfers challenging. The changing nature of political control thus impacted the local and state ability and interest to meet the solar target metrics established by the national government, which presently is led by the Bharatiya Janata Party. This follows the broader national trend of state's pursuing renewable projects when it suits their political and/or economic interests [6]. Across scales, local, state, and national elections have consequences for selective state engagement or disengagement with renewable projects. They had further ramifications for broader electricity infrastructure and transmission in the state.

The Kerala government planned for the Kasaragod solar park to be a part of the broader Green Energy Corridor initiative, which is a central government scheme to transport and integrate renewable energy in target geographies. The government program promotes the renewable energy integration infrastructure to transmit 20,000 MW within and across 21 states [42]. Originally, the central government intended to subsidize a green energy corridor line to transmit the electricity generated in the Kasaragod solar park to areas in need in Kerala [43]. The government dropped plans for the Green Energy Corridor in Kerala when land for the full-scale 200 MW solar park was not available.

While the funding and impetus for solar infrastructure emanates from the central government in New Delhi, the ultimate ability to implement the project depends on local and state-level power players. In the case of Kasaragod, not all district officials opposed the project. For example, the District Development Committee in Kasaragod expressed their support for the project in a 2018 resolution. The committee noted, "unfortunately the government has decided to take back the land acquired in other two localities for solar park from KSEB. This is a big loss to Kasaragod district. The government will lose the (broader) project costing Rs. 9000 crore (\$1.2 Billion USD)⁵ because of this decision" [44]. Further, the committee explained the development implications of this move:

Therefore, the government decision will push the Kasaragod district into dark and it also decelerates the development of this district. In this circumstance, the DDC requests the government to revoke the decision and lead the district into light [44].

In contradiction to some of the *Panchayats*, the District Development Committee expressed that the loss of the full solar park and

⁵ The *Panchayat* implicitly appears to be placing a financial value on both the Kasaragod solar park and the broader Green Corridor project, as these figures are larger than the solar park value.

green corridor would actually and metaphorically push the district away from light into development darkness. While lacking the power to over-turn the decision, the committee articulated their concern that this project was the only potential for development in the district. Other *Panchayats* note their interest in educational initiatives as a means to bring a different form of light to the district. For example, local political leaders in Kanhirapoyil, Hosdurg taluk rejected the project, as they preferred for the land to be used for a higher education institution. These views represent distinct local visions for what development means for district politicians and officials. Does development mean an educational institute? Does development mean a renewable energy project? For many stakeholders living in and around the Kasaragod site, the large-scale solar energy initiative did not equate development and did not “lead the district into light” [44].

5. Kasaragod solar infrastructure promises and power relations

The Kasaragod infrastructural promises of “modernity and development” [10] represent a contrast from the realities of unmade land and lives in Kasaragod. The disconnect between the infrastructural promises and the ground realities arise from the differing scales and goals of those involved in the project. The Kasaragod solar park exemplifies the distinct goals and development visions at the national, state, and local scales. National climate mitigation targets lead the federal government to provide financial support to states to pursue renewable energy projects. The state of Kerala eagerly promotes solar energy. Geographically distant from Kerala’s capital city, the local land and development priorities in the district of Kasaragod contrasted with state and national scale priorities.

Local opposition centered around unjust land acquisitions and differing development visions. *Adivasi* populations without land titles and other land-owners opposed the acquisition of their land for solar fields in Kasaragod. Research documents how the *Adivasi* families living in the area without land titles are not legally entitled to receive compensation for lost land. With one stakeholder noting, “they surveyed this land by informing us as re-survey of land for the distribution to landless. Our house also included in this survey. We don’t have land title to this land and we put forward some demands, but they didn’t agree. This area is highly populated area and it is a tribal settlement. Because of protest they left now” (Interview, 9/17/18). “We have lost our small piece of land because of this project” (Interview, 9/29/18). One stakeholder narrates,

many people lost their land because of big projects. People are not getting any protection. Now working here is only for the benefit of company. Government is standing for the company. In this area 9 people lost land and among them five people don’t have title. They first told that they will give land, but till now they didn’t give ... There are many households residing in this solar park area, they were shifted to the side of the solar park, company only did this. There is nothing done from the part of the Government (Interview, 9/29/18)

There was an assumption made by the state government that the land was “barren” [29], and yet it is actively being used and lived in. This mis-calculation arises from broader challenges regarding who has the power and authority to categorize certain lands as ‘barren’, even if the land is used for grazing, living, or agricultural purposes which may or may not be recognized by local, state, or national government officials. Among stakeholders in and around the solar site there is a general sense that the solar park disrupted their connectivity to neighboring villages and common

social areas, and reduced access to water sources. One respondent noted that they feel, “no benefit from solar energy. It also restricted our movements from one place to another. We have to walk more now to reach another house as it closed footpaths” (Interview, 9/21/18). In creating new boundaries and destroying previous roads to connect villages, the new project ultimately silenced the communal landscape and unmade everyday resource access [26]. A male stakeholder details how, “we lost our drinking water sources. We lost our playground and even they damaged public roads in this area. Some of the *Adivasi* families lost their land too” (Interview, 9/29/18).

The issue of water access was a theme raised by a range of respondents. “There was one drinking water tank and we cannot use it now because of this project. Roads are damaged and vehicles are not ready to come to this area and now we have to walk more to reach shops and town” (Interview, 9/29/18). Another respondent elaborates on concerns related to the road connectivity concerns:

And another thing was the road, they dismantled roads in this area. They used a tanker, like big, big vehicles, which are overloaded to shift their materials that vehicles destroyed this road. Not only that, now no vehicles are coming to this area to go to even District hospital. Because of these bad roads, drivers are not willing to take residents to the hospital. Others are not supporting us because we are poor, if it happens to a rich man even government will interfere in this matter. News has come in newspaper, TV, and even social media, but still no response from the government. There are laws, but officials are not implementing them. Children lost their playground. District collector came and promised to give a playground. Even the district collector told the company and KSEB officials to make arrangements for playground without affecting the operations of solar park. It has been three years now, nothing has been done (Interview, 9/29/18)

The respondent notes a reoccurring theme—that the project impacted stakeholders are poor, and therefore the state government officials are not concerned about their input or development requirements. Stakeholders perceive this in part, as they were not invited to meaningfully participate in the solar park planning process. Through this exclusion, local residents interpret that they lack the power to question or engage in the building or operation of the solar park. A female respondent details:

Here the government didn’t make any rehabilitation package. I don’t know exactly about the solar project, things done for the company only. There is no use for people in this locality. Our roads are gone and drinking water projects are gone, some people are trapped inside the solar park. There are houses inside the solar park (Interview, 10/26/18)

Stakeholders note how the lack of connectivity impacts their social relations, particularly the making and unmaking of their lives in relation to their extended families. A female respondent explains, “earlier we were able to move freely here, we could visit relatives frequently. Now there is no chance to unite and conduct gathering. And, also some of our relatives land is also gone, they didn’t get it back. Also, they didn’t make any alternative arrangements for those who lost land. They strategically talked to get the things to happen smoothly” (Interview, 10/26/18).

Overall, there were concerns that many empty development promises were made to the impacted communities. “They did this big project and didn’t do any social work here” (Interview, 9/29/18). For example, some stakeholders note what they were specifically

promised, but never received. “Company and political leaders offered a community hall and rehabilitation package for those who would give land for the project, but those promises didn’t materialize” (Interview, 9/29/18). An elderly man laments that the project precludes further development in the area, “no other development is possible in this area because of the huge area acquired for solar plant. There is no land for further development” (Interview, 10/26/18). Although sentiments of disempowerment and lack of voice pervade, it is precisely the concerns of these stakeholders that have stalled further expansion of the park. The largely negative responses to the initial land transferred for the solar park led some *Panchayats* to politically oppose the project’s further expansion. A meeting held on January 1, 2017 of the Paivalike *Gram Panchayat* provided the opportunity for community members to narrate land transfer concerns with the manager of Renewable Power Corporation of Kerala Limited (M. Kunhiraman) and a liaison officer (Balakrishnan K.T.).

Despite this local opposition, on October 13, 2017 the state’s Chief Secretary created a committee headed by the District Collector, the CEO of the Renewable Power Corporation of Kerala Limited, and Agriculture Department officials to locate available land in Cheemeni. Government officials could not secure land for the project at Paivalike, Manjeswaram, or Kanhirapoyil. The United Democratic Front government did make attempts to secure the land for the project proposed by the previous government, but did not have the same resolve to force the extension of the locally unpopular solar park. Recognizing the lack of local project viability that same month, the Revenue Minister E Chandrasekhran explained that, “no new land will be made available for the project” [45]. Given the land uncertainty, the land agreement remains unsigned by the KSEB until April 4, 2018, when the Managing Director of the SECI intervened to request that the issue be resolved. The Government of Kerala communicated that uncertainties regarding local land clearance were a state-level obstacle to national cabinet-level project approval. This demonstrates the importance of local scale support to fulfill state and national renewable energy goals.

On May 7, 2018 the Ministry of New and Renewable Energy cancelled the \$3.5 million USD subsidy when Kerala could not secure the land necessary for the promised 200 MW project [46]. This act of authority demonstrated to the Kerala state government that they did not meet the central government expectations, becoming a source of disgrace for some state politicians. Kerala government officials noted that the land challenges were a, “considerable embarrassment” to the state, as the project involves “commitment given to the Central government” [45]. What these politicians fail to acknowledge is the unresolved issue of landlessness among *Adivasis* in the district. For any large-scale project to proceed in the future in Kasaragod, land reforms must legalize the status of *Adivasis* living on the land and meaningfully consult local stakeholders in project planning and operations.

6. The making and unmaking of land, lives, and light

Energy infrastructures are infused with power, and these power structures may frame and reproduce development unevenness. Who asserts power ultimately shapes the nature and form of infrastructure and associated development futures. Amin reminds us that infrastructures are “deeply implicated in not only the making and unmaking of individual lives, but also in the experience of community, solidarity and struggle for recognition” ([26]: 137). The changing nature and forms of infrastructure have profound daily impacts on spaces, people, objects, and social connections. While national framing of solar goals in India reference the need to protect ‘vulnerable’ communities, in practice this intent may be lost as states struggle to meet the ambitious national solar targets.

Given the large land requirements for solar projects and strong social connections to land in India, a project with climate goals may ultimately unmake individual and collective community lives at the local scale.

The climate change mitigation goals or development promises associated with renewable energy projects do not alter their everyday impacts on lives, lands, and natural resources. Geographically, the territorial boundaries used to separate a coal mine or industrial park may be the same type of physical fences or barriers used at a large-scale renewable energy project. These physical infrastructures become embedded with power [10]. Land is fundamental to these infrastructure initiatives, particularly when barriers block access to land. The acquiring or leasing of land for the infrastructure alters the space available for people in and around the site. In turn, the project changes the development opportunities for people living in the area in relation to land, mobility, social connectivity, and education.

In a rush to achieve their solar obligations, states, such as Kerala, overlook the high probability for the associated infrastructure to unmake impacted lives. The Kasaragod case reveals how large, national goals for infrastructure projects render certain populations invisible or indispensable in pursuit of broader objectives. The development promises were in stark contrast to the development realities for local stakeholders, amplifying the energy injustices experienced. Although project promoters promised the project would provide development opportunities for stakeholders, this research documents the local social and resource access implications. The district, state, and national level governance goals to pursue this project as a means to lead the ‘district into light’ did not resonate locally with many stakeholders who were or would be disenfranchised from their land or have alternate development priorities. In fact, the project inhibited their ability to fully participate in their largely land-dependent lives, as the infrastructure initiative led to social dis-connection and land loss. Although local opposition changed the course of other large-scale projects in India [47], this case remains unique among renewable energy efforts. In response to energy infrastructure injustices, stakeholder voices emerged to alter the scope of the project. The *Adivasi* assertion of political power in Kasaragod demonstrates agency to change energy infrastructure.

As Sovacool and Cooper ([24]: 8) note, energy infrastructure governance requires multi-scalar stakeholder support, including from local communities. In contexts such as Kasaragod, spaces of energy injustice also may lead to the emergence of agency to contest inequalities. In common with energy infrastructure decisions for other projects [25], the regulatory entities at the state level did not incorporate a range of community stakeholders in the solar park planning or implementation. The local governance system critiqued the associated uneven outcomes, and significantly reduced the scope of the project. Although the first phase of the solar park was underway, the election of 2016 provided a political opportunity for Communist Party of India-Marxist *Panchayats* to question the solar initiative and to block the park’s further expansion. The *Panchayats* use of their local governing power rendered the state and national aspirations for a full solar park untenable. While the Kasaragod solar park is unlikely to further expand, the fate of contested land reforms remains unsettled. Renewable energy projects, real estate ventures, and other infrastructure will likely desire the lands of Kasaragod in the future. The question remains if further attempts to achieve justice in Kasaragod may happen within the existing social and political systems, which are ultimately also responsible for the underlying historical land and development injustices.

Foundational and intersectional inequalities shape a range of infrastructure projects across the nation. From energy corridors to

water pipelines to inter-city expressways, infrastructure projects can cross geographical scales with implications for the impacted people and places. Infrastructure provides a vantage point to understand social and political practices across and within scales. In concert with Sareen and Kale's findings (2018), the Kasaragod solar project continues the recent pattern of renewable energy efforts furthering the "deep-seated inequities" associated with energy access and development benefits. This research illustrates how solar infrastructure can replicate land mistakes of the past, with social and development implications. The Kasaragod project represents a broader multi-scalar trend, witnessed in distinct geographies across India for renewable and other infrastructure projects. This example, in concurrence with the emerging research in Gujarat and Rajasthan [21,27], underscores the need to examine the cumulative implications of energy infrastructure. It is noteworthy that private players dominate the Gujarat renewable context, while the Kerala state takes the lead in renewable energy efforts. Whether state or corporate promoted, the challenges of large-scale renewable energy projects permeate. This could provide another interesting area for future inquiry into the national drive to meet rising energy demand.

Given the empirical evidence of injustices, renewable energy infrastructure should be approached not as an isolated climate mitigation initiative, but should be actualized as a broader opportunity to acknowledge the historical uneven nature of land reforms and to understand the role of energy in development. In practice, there are frequently disaggregated treatments of energy goals and the development implications of associated infrastructures. Uneven development infrastructures and the energy transition must be addressed in conjunction, an approach which is under attended to at the present. There is potential for national, state, and local level planners and politicians to think more holistically about renewable infrastructure in concert with development ambitions. This connected approach would take a more geographical view of what land, resources, and social spaces could be impacted by a large-scale renewable energy initiative. Through an examination across scales, it is possible to unearth and examine the role decision-makers play in potentially facilitating or normalizing infrastructure injustices ([48]: 15). This would be a productive area of inquiry for future research, with an aim to ensuring more just energy transitions in India and beyond.

Acknowledgements

This research was funded by a Fulbright-Nehru Research and Academic Excellence Fellowship in India. The content benefited greatly from participant comments at the Legitimacy and Accountability in the Governance of Sustainable Energy Transitions workshop at the University of Bergen. Insightful ideas from Sunila Kale and Siddharth Sareen strengthened the argument. Appreciation is also due to the Global Transitions editors and two anonymous reviewers. Kunhikrishnan Velultholy and Abel Abraham provided excellent research assistant work in support of this project. Any emissions or errors are solely the author's responsibility.

References

- [1] G. Bridge, B. Özkaynak, E. Turhan, Energy infrastructure and the fate of the nation: introduction to special issue, *Energy Res. Soc. Sci.* 41 (2018) 1–11.
- [2] Government of India, Solar energy corporation of India, limited, Solar Park Introduction, http://seci.co.in/other_page.php?mmid=4&page=solar_park_introduction, 2019. (Accessed 29 January 2019).
- [3] Government of India, Planning Commission, Kerala Development Report, Academic Foundation, New Delhi, 2008a.
- [4] Government of India, Prime Minister's Council on Climate Change, National action plan on climate change. <http://www.moef.nic.in/modules/about-the>
- ministry/CCD/NAP_E.pdf, 2008b. (Accessed 10 June 2018).
- [5] R. Corkish, W. Lipiński, R.J. Patterson, I. Rey-Stolle, M. Becker, R. Pitz-Paal, A. Turhollow, Introduction to solar energy, *Sol. Energy* 2 (2016) 1.
- [6] E. Chatterjee, Soft Targets: Persuasive Numbers and Multilevel Environmental Governance in India, 2019 (Working Paper).
- [7] H.P. Bedi, L. Tillin, Inter-state competition, land conflicts and resistance in India, *Oxf. Dev. Stud.* 43 (2) (2015) 194–211.
- [8] P. Oskarsson, K.B. Nielsen (Eds.), *Industrialising Rural India: Land, Policy and Resistance*, Routledge, 2017.
- [9] N. Sud, The Indian state in a liberalizing landscape, *Dev. Change* 40 (4) (2009) 645–665.
- [10] H. Appel, N. Anand, A. Gupta, Introduction, in: N. Anand, A. Gupta, H. Appel (Eds.), (2018). *The Promise of Infrastructure*, Duke University Press, 2018, pp. 1–40.
- [11] C.E.E. Hess, W.C. Ribeiro, Energy and environmental justice: closing the gap, *Environ. Justice* 9 (5) (2016) 153–158.
- [12] H.P. Bedi, 'Our energy, our rights': national extraction legacies and contested energy justice futures in Bangladesh, *Energy Res. Soc. Sci.* 41 (2018) 168–175.
- [13] S. Bouzarovski, N. Simcock, Spatializing energy justice, *Energy Policy* 107 (2017) 640–648.
- [14] B.K. Sovacool, M.H. Dworkin, *Global Energy Justice*, Cambridge University Press, 2014.
- [15] F. Lu, G. Valdivia, N.L. Silva, *Oil, Revolution, and Indigenous Citizenship in Ecuadorian Amazonia*, Springer, 2016.
- [16] C.I. Obi, Oil extraction, dispossession, resistance, and conflict in Nigeria's oil-rich Niger Delta, *Can. J. Develop. Stud./Revue canadienne d'études du développement* 30 (1–2) (2010) 219–236.
- [17] D. O'Rourke, S. Connolly, Just oil? The distribution of environmental and social impacts of oil production and consumption, *Annu. Rev. Environ. Resour.* 28 (1) (2003) 587–617.
- [18] A. Willow, S. Wylie, Politics, ecology, and the new anthropology of energy: exploring the emerging frontiers of hydraulic fracking, *J. Polit. Ecol.* 21 (12) (2014) 222–236.
- [19] D. Mulvaney, Opening the black box of solar energy technologies: exploring tensions between innovation and environmental justice, *Sci. Cult.* 22 (2) (2013) 230–237.
- [20] A. Curley, A failed green future: Navajo Green Jobs and energy "transition" in the Navajo Nation, *Geoforum* 88 (2018) 57–65.
- [21] K. Yenneti, R. Day, O. Golubchikov, Spatial justice and the land politics of renewables: dispossessing vulnerable communities through solar energy mega-projects, *Geoforum* 76 (2016) 90–99.
- [22] K. Yenneti, R. Day, Procedural (in) justice in the implementation of solar energy: the case of Charanaka solar park, Gujarat, India, *Energy Policy* 86 (2015) 664–673.
- [23] H. Bulkeley, V. Castán Broto, A. Maassen, Low-carbon transitions and the reconfiguration of urban infrastructure, *Urban Stud.* 51 (7) (2014) 1471–1486.
- [24] B. Sovacool, C.J. Cooper, *The Governance of Energy Megaprojects: Politics, Hubris and Energy Security*, Edward Elgar; 2013, London, 2013.
- [25] A. Goldthau, Rethinking the governance of energy infrastructure: scale, decentralization and polycentrism, *Energy Res. Soc. Sci.* 1 (2014) 134–140.
- [26] A. Amin, Lively infrastructure, *Theory Cult. Soc.* 31 (7–8) (2014) 137–161.
- [27] S. Sareen, S.S. Kale, Solar 'power': socio-political dynamics of infrastructural development in two Western Indian states, *Energy Res. Soc. Sci.* (2018).
- [28] A. Cardoso, E. Turhan, Examining new geographies of coal: dissenting energy scapes in Colombia and Turkey, *Appl. Energy* 224 (2018) 398–408.
- [29] ANERT, Registration of Barren Land for Setting up Solar Power Plants, Government of Kerala, 2019. <https://anert.gov.in/index.php/node/183>. (Accessed 15 April 2019).
- [30] K.R. Raman (Ed.), *Development, Democracy and the State: Critiquing the Kerala Model of Development*, Routledge, 2010a.
- [31] Government of India, Planning Commission, Press Note on Poverty Estimates 2011–2012, 2013. http://planningcommission.nic.in/news/press_pov2307.pdf. (Accessed 22 January 2019).
- [32] K.P. Kannan, Public intervention and poverty alleviation: a study of the declining incidence of rural poverty in Kerala, India, *Dev. Change* 26 (4) (1995) 701–728.
- [33] R.W. Franke, B.H. Chasin, *Kerala: Radical Reform as Development in an Indian State*, Food First Book, 1989.
- [34] M.S. John, J. Chathukulam, Issues in tribal development: recent experience of Kerala, in: G.C. Rath (Ed.), (2006). *Tribal Development in India: the Contemporary Debate*, Sage, 2006.
- [35] K.R. Raman, The Kerala model: situating the critique, in: K.R. Raman (Ed.), (2010). *Development, Democracy and the State: Critiquing the Kerala Model of Development*, Routledge, 2010b.
- [36] D.J. Kjosavik, N. Shanmugaratnam, *Political Economy of Development in India: Indigeneity in Transition in the State of Kerala*, Routledge, 2015.
- [37] S. Corbridge, G. Williams, M. Srivastava, R. Veron, *Seeing the State: Governance and Governmentality in India*, vol 10, Cambridge University Press, 2005.
- [38] K.R. Raman, Subaltern modernity: Kerala, the eastern theatre of resistance in the global south, *Sociology* 51 (1) (2017) 91–110.
- [39] P. Oskarsson, H.P. Bedi, Extracting environmental justice: countering technical renditions of pollution in India's coal industry, *Extract. Industr. Soc.* 5 (3) (2018) 340–347.
- [40] W. Hoeschele, Geographic information engineering and social ground truth in

- Attappadi, Kerala State, India, *Ann. Assoc. Am. Geogr.* 90 (2) (2000) 293–321.
- [41] L. Steur, Adivasi mobilisation: 'identity' versus 'class' after the Kerala model of development? *J. South Asian Dev.* 4 (1) (2009) 25–44.
- [42] G.O.I. Ministry of Power, Transmission Works under Green Energy Corridors-I, 2019. <https://powermin.nic.in/en/content/transmission-works-under-green-energy-corridors-i>. (Accessed 25 April 2019).
- [43] T. Kenning, Kerala Directs Utility to Provide 'Indian First' Rooftop Solar Training, *PV Tech*, 2017, November 15, <https://www.pv-tech.org/news/kerala-directs-utility-to-provide-indian-first-rooftop-solar-training>. (Accessed 25 April 2019).
- [44] District Development Committee, Resolution on Kasaragod Solar Park, Kasaragod, Kerala, 2018.
- [45] G. Poikayil, Protests drown ambitious solar plans in Kasargod, *Indian Express* (2017). <http://www.newindianexpress.com/states/kerala/2017/oct/21/protests-drown-ambitious-solar-plans-in-kasargod-1678879.html>. (Accessed 5 February 2019).
- [46] THDCIL, Government of India, June 18 progress report. <http://www.thdc.co.in/sites/default/files/THDC%20June18Progress%20Reprt.pdf>, 2018. (Accessed 6 February 2019).
- [47] H.P. Bedi, Judicial justice for special economic zone land resistance, *J. Contemp. Asia* 45 (4) (2015) 596–617.
- [48] D.N. Pellow, *What Is Critical Environmental Justice?* John Wiley & Sons, 2017.
- [49] Government of India, Ministry of Water Resources, Ground water information booklet of Kasaragod district Kerala state. http://cgwb.gov.in/District_Profile/Kerala/Kasargod.pdf, 2013b. (Accessed 29 January 2019).
- [50] L. Tripathi, A.K. Mishra, A.K. Dubey, C.B. Tripathi, P. Baredar, Renewable energy: An overview on its contribution in current energy scenario of India, *Renew. Sustain. Energy Rev.* 60 (2016) 226–233.
- [51] M. Levien, *Dispossession Without Development: Land Grabs in Neoliberal India*, Oxford University Press, 2018.
- [52] Ministry of Home Affairs, Government of India, Indian Census. Office of the Registrar General & Census Commissioner, India, 2011. <http://www.censusindia.gov.in/2011census>. (Accessed 18 July 2018).
- [53] Ministry of Rural Development, Government of India, Socio Economic and Caste Census 2011, 2011. <https://secc.gov.in/aboutusReport>. (Accessed 26 February 2019).
- [54] J. Chathukulam, M.S. John, Issues in tribal development: the recent experience of Kerala, in: Govinda Chandra Rath (Ed.), *Tribal Development in India: The contemporary Debate*, Sage Publications, London, 2006.
- [55] Kerala State Planning Board, Kerala Economic Report, Government of Kerala, 2016.