Social sustainability of Mini-grids in the Global South

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Introduction

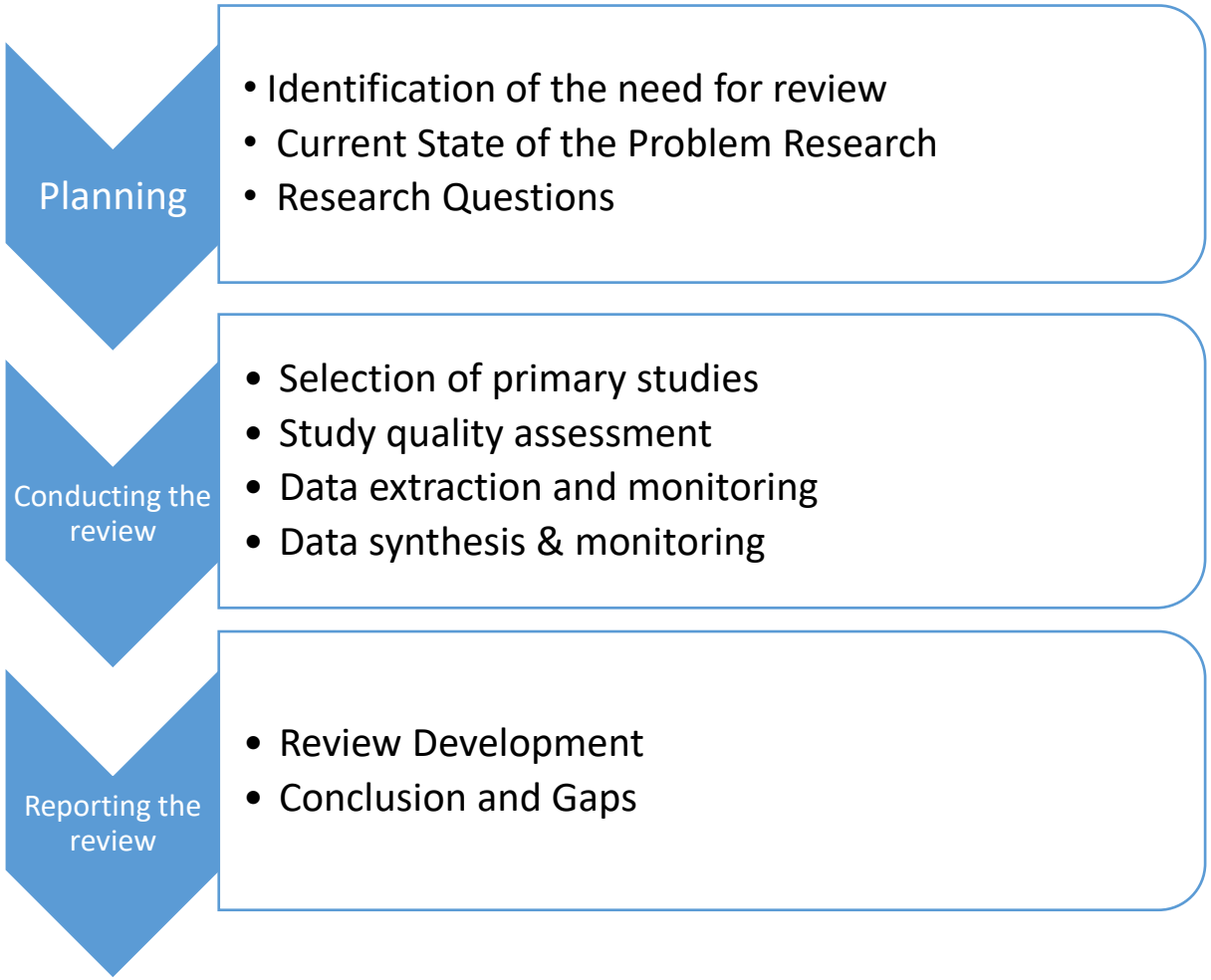
- The literature on mini-grids has had a significant techno-economic focus
- On the demand side: Taken for granted that marginalised, vulnerable communities automatically benefit from minigrids. Conflicting findings on impacts on households and local economies
- On the suppy side: Research gap on how inclusive minigrid development processes are; local content; the extent and effectiveness of community participation
- At the macro-level: Little exploration into whether policy processes are inclusive, or structural impacts of minigrids are socially sustainable
- An emerging stream of literature on energy justice, social inclusion, just transitions in the energy sector is starting to address these issues
    - Still, there is a gap on developing countries

Introduction

- Research questions
  - What are the indicators and sub-indicators used to measure the social sustainability of mini-grids?
  - Who is included in the supply chain, and how? Who reaps the benefits?
    - the roles of local vs international actors, social dimensions such as gender, age, income
    - Nature and outcomes of participatory processes
  - Who reaps economic and social benefits from the use of mini-grids, and how do these benefits happen?
    - Impacts for households
    - Impacts for productive users, and local economic development
    - How community involvement and the design of the minigrids affect impact
  - How inclusive are mini-grids at the structural level?
    - Inclusiveness in policy and regulation, in policy processes
    - Structural impacts

Methodology

- We conduct a SLR to assess progress in research on inclusivity of mini grids and formulate recommendations for future areas of research.
- Proposed systemic literature review (SLR) structure
- Our methodology combines the methods proposed by Kitchenham, (2004) and Mayring (2010)



Material Collection

- **Database:** SCOPUS
- **Keywords:** minigrid, mini grid, offgrid, off grid, decentral, electric, sustainable, inclusi, poverty, gender, productiv, household, Business, enterprise, welfare, supply chain, employment, labour, labor, livelihood, income, energy justice, socio technical
- **Timeframe:** 1988- 2022
- **Unit of analysis:** Written in English, taken from developing countries as per the World Bank classifications
- **Filter:** Keywords in the title and abstract

Descriptive Analysis

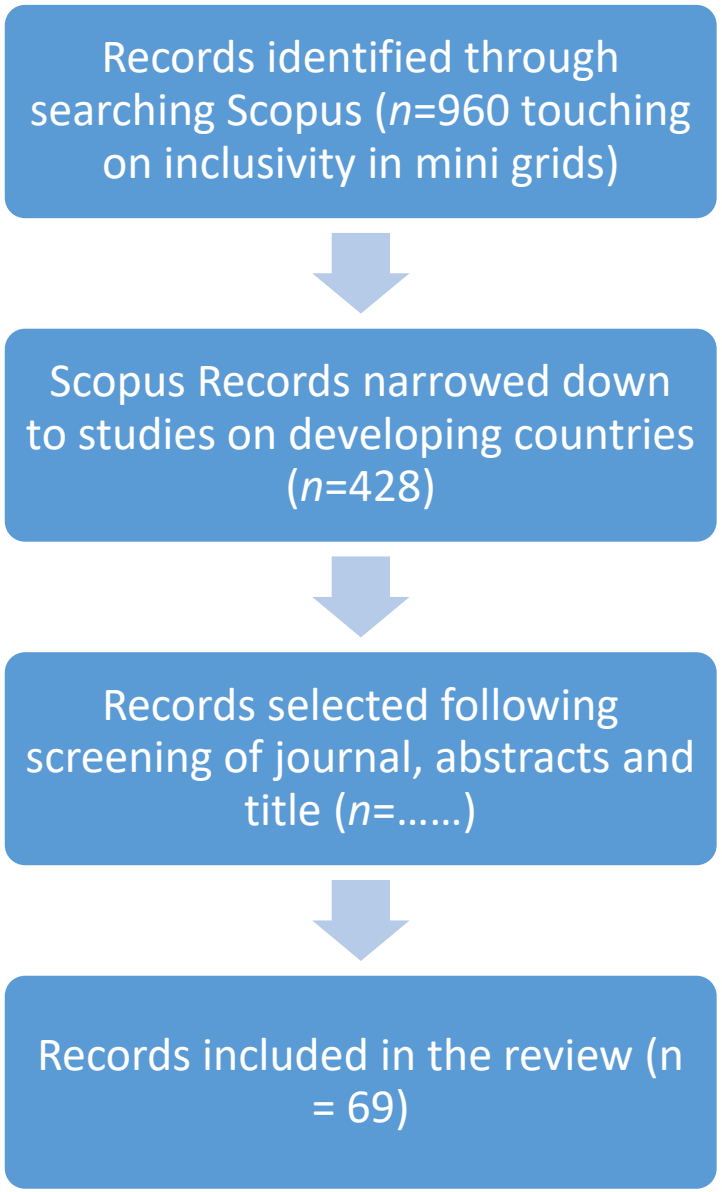
- Authors, year of publication, journal/publication name, region/ countries, discipline
- Conceptual vs empirical
- For empirical studies: Analysis on data collection methods, use of qualitative vs quantitative data, data analysis techniques,

Category Selection

- Based on the broad themes of the studies

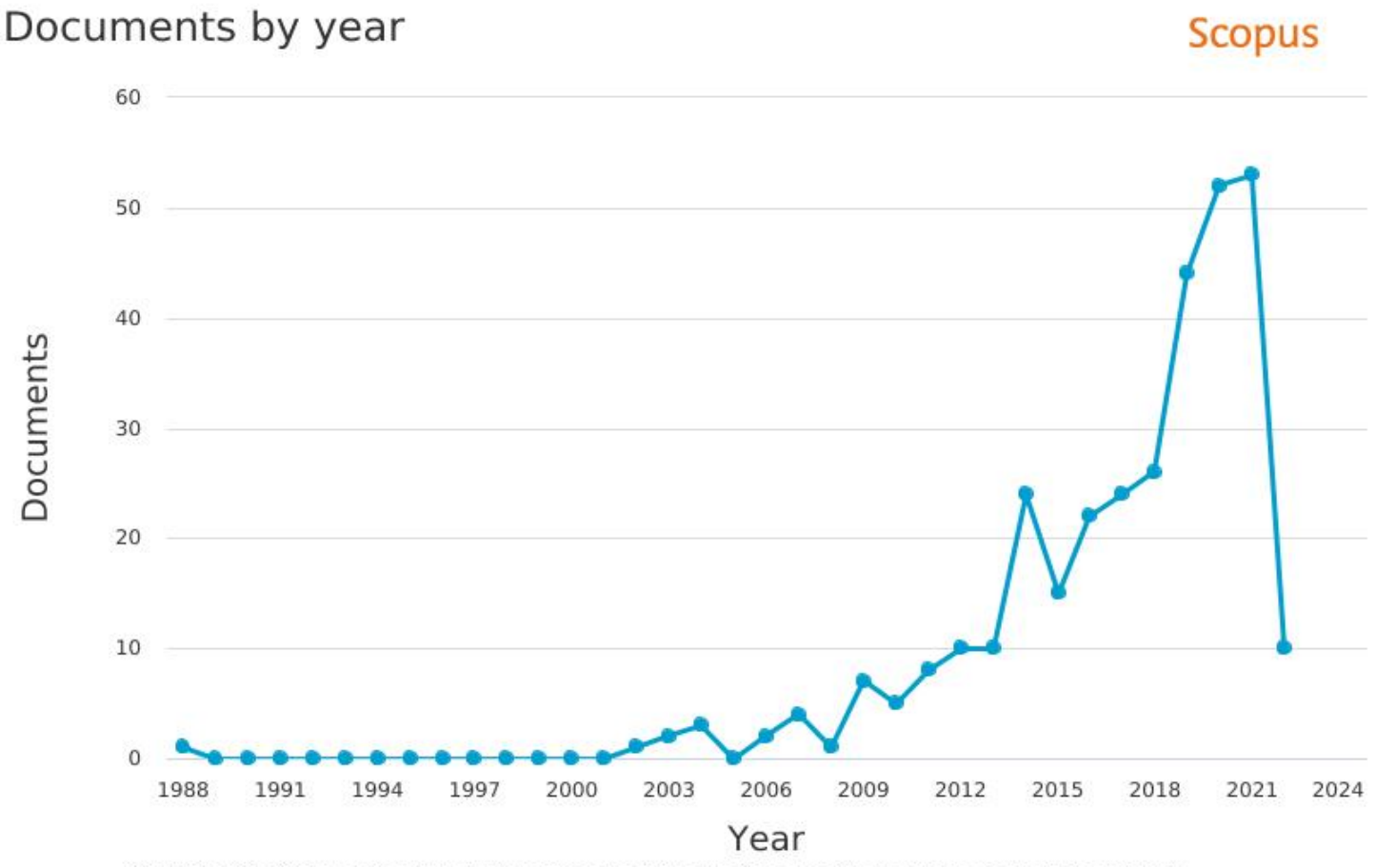
Material Evaluation

- Coding by researchers
- Discussions within the research team
- Peer evaluation
- Presentation of findings

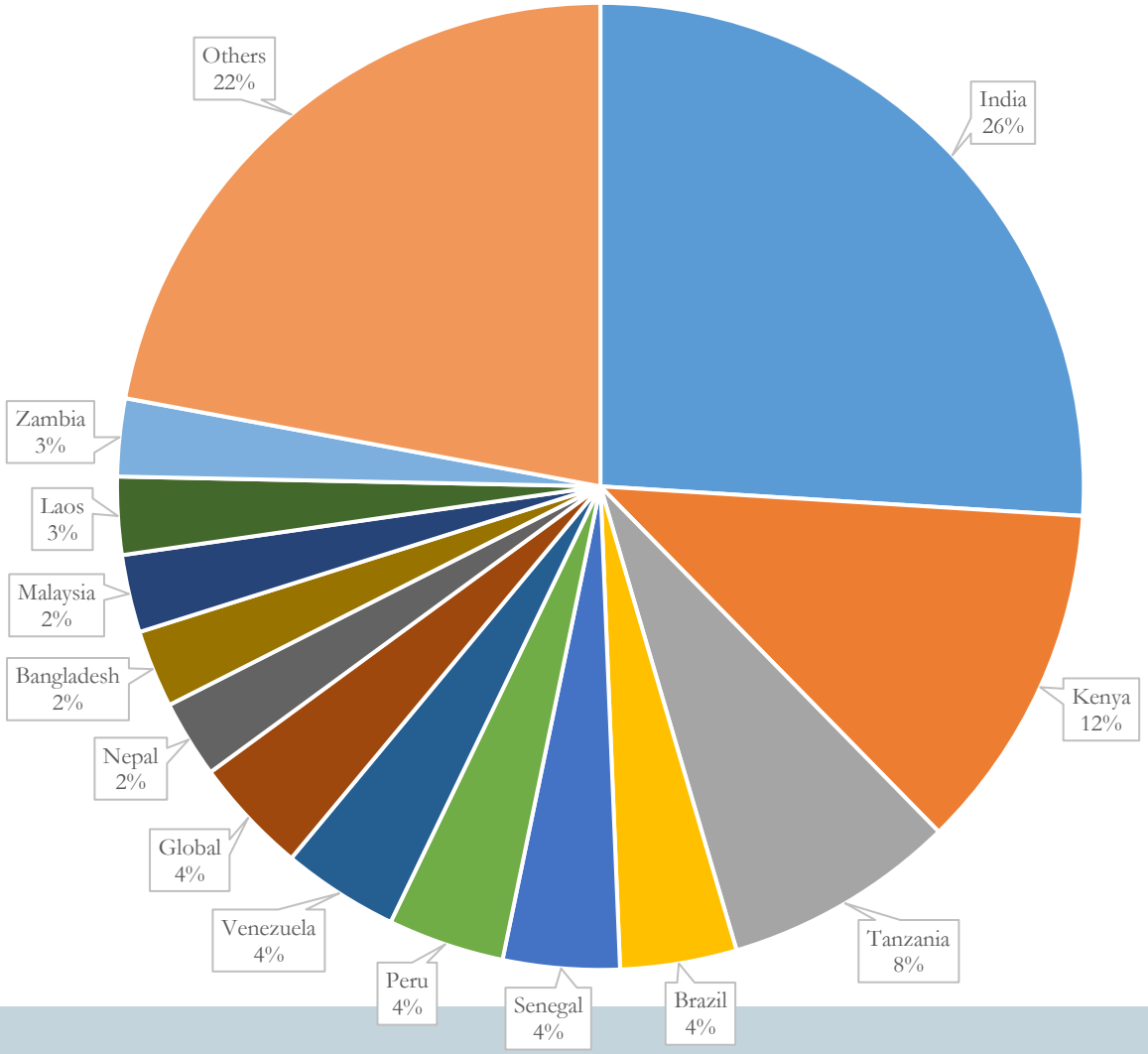


- Peer-reviewed journal articles, book chapters and conference papers between 1988 and 2020
- Expanding to Web of Knowledge, EBSCOHost

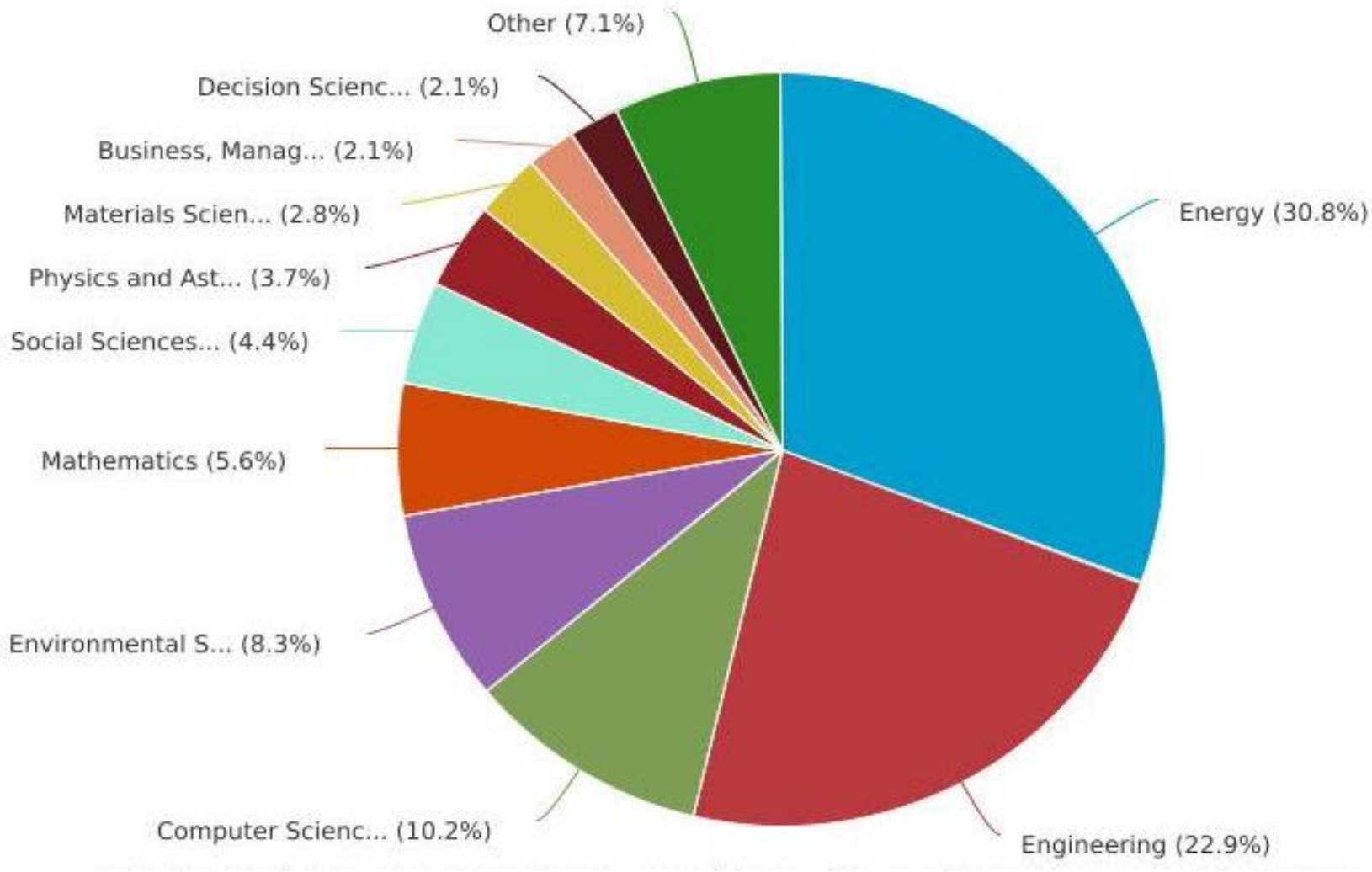
Descriptive analysis: Publications per year



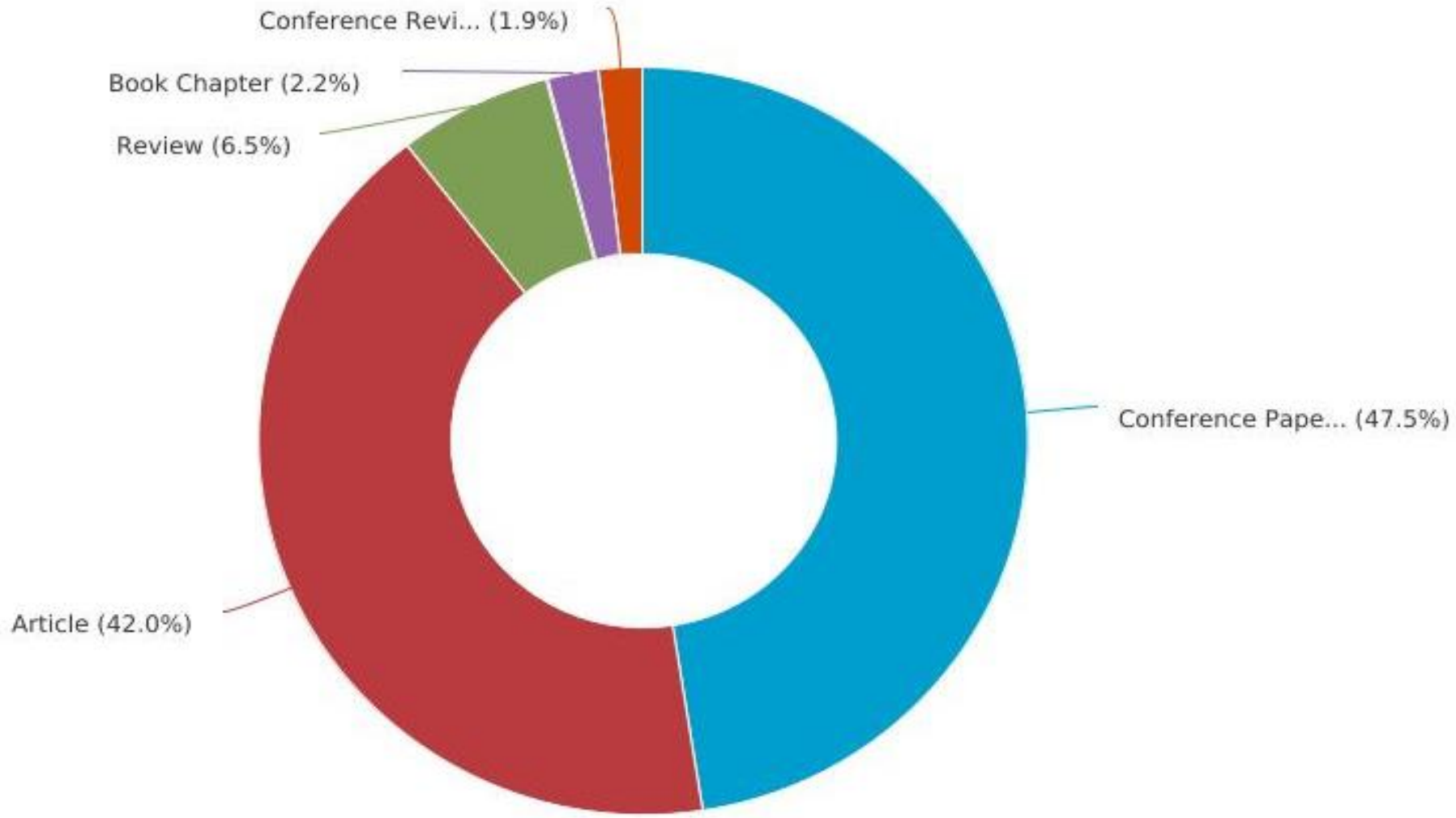
Descriptive analysis: Focus countries of study



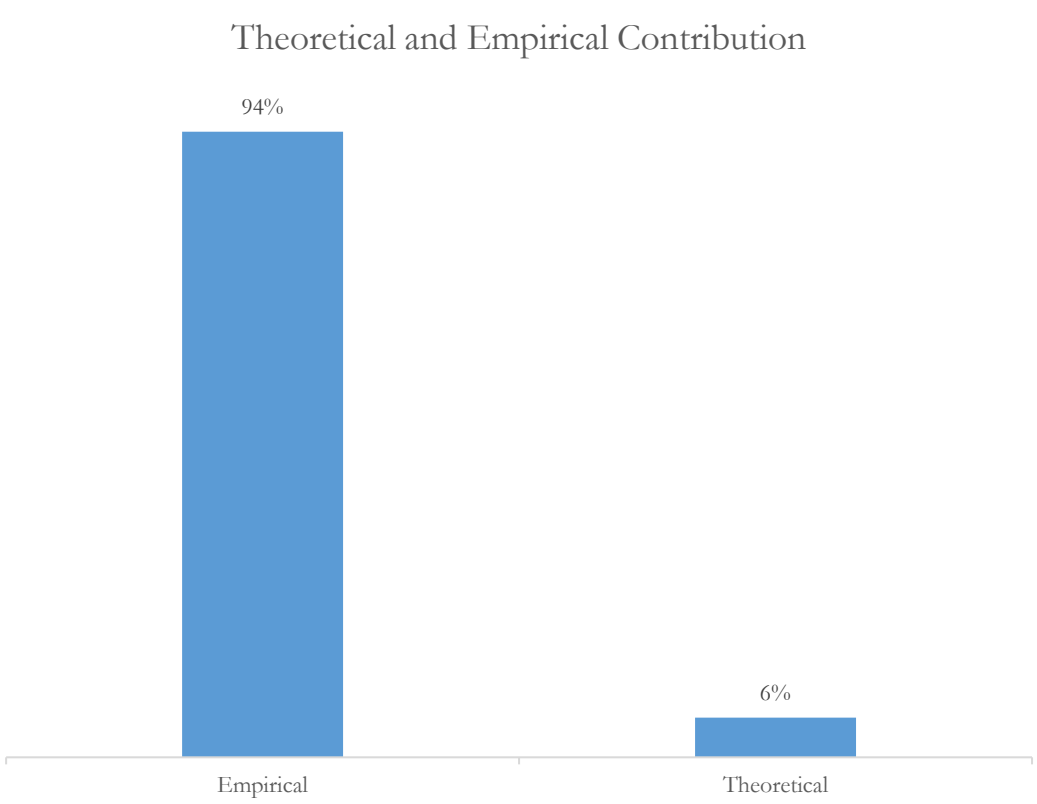
Descriptive analysis: Documents by subject area

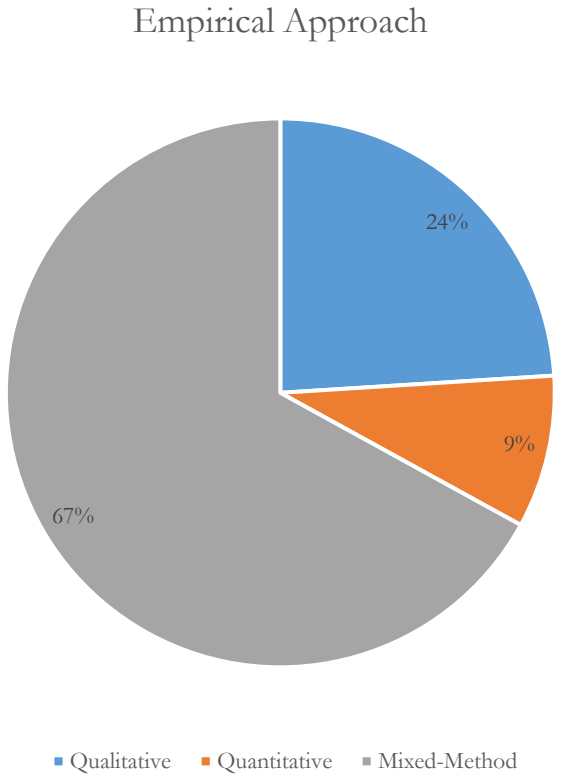


Descriptive analysis: Documents by type



Descriptive analysis: Methodologies





Defining social sustainability/ Inclusivity

- The enhancement of the lives of the community: benefits to the household, business operations within the community, the operations of institutions, community connectedness within and without
- Community empowerment, inclusion, and governance, taking into account the issues of community participation, the reduction of social vulnerability through improving health and education outcomes, promoting equity in energy access, and strengthening requisite institutions
- An economic angle:
  - gender equity
  - energy poverty
  - productive growth

The Case for Mini-grids (aspiration, intention)

- The prohibitively high cost of grid extension due to:
  - Geographical barriers: remote, isolated areas, e.g.
    - archipelagic nature of the Philippines (Duran and Sahinyazan, 2020)
    - the vastness of the Amazon and the geographical isolation of the region Mazzone, (2019)
    - In India, wide rivers and creeks that separates an island from the mainland Moharil and Kulkarni, (2007)
  - Sparse population and lack of adequate infrastructure
- Available renewable energy resource, e.g.
  - A small waterfall, abundant sunshine, strong winds
- Nature of economic activities and corresponding electricity demand
  - a demonstrable demand for power reduces the risk on non-payment (e.g., Pedersen et al., 2020)
- Policy barriers to the expansion of the national grid
  - Regulations preventing grid extension into forest reserves in India (Sharma and Palit, 2020)
- 'Catalyse development' (Ahlborg, 2018)

Inclusion during mini-grid development

- Feasibility, site acquisition, approval
  - Land ownership, compensation (under review)

Inclusion during mini-grid development contd.

- Financing
  - Sources:
    - Development partners (donations, grants, soft loans); non-financial resources;
    - Government financing as a key source: for EPC, subsidies
    - Private sector financing is pervasive, but in some places is limited, e.g., in Laos
    - Community financing through cooperatives/CBOs
    - Venture capital not well documented
  - Issues
    - Governments act rather opportunistically by accepting financial support for all kinds of electrification concepts from international donors, leads to discontinuity and inconsistency
      - Lack of clear electrification planning
      - Lack of a technology strategy
  - Gaps: Inclusiveness in financing mechanisms:
    - Who sets the agenda, who makes decisions, efforts to involve communities in financing models
    - Local financing sources not on the landscape

Inclusion during mini-grid development contd.

- Engineering, procurement, construction
  - Few studies discuss inclusiveness in these processes
  - In some developments, none of the communities participated in the decision making about the design of the systems. Uninvolved users often do not develop a sense of identification with technology.
  - More community participation where CBOs exist
    - alignment of the developers and community's expectations by engaging CBOs, e.g., in India (Katre & Tozzi, 2018).

(under review in the new documents identified)

Inclusion during mini-grid development contd.

- Operation & Maintenance
  - Several cases of community-driven O&M
    - CBOs in O&M, independent local/village committees; local cooperatives
    - Issues: Capacity development, local employment creation, revenues for micro-loans to members, gender issues, local politics (elections). Empowered committees run the whole operation
  - NGOs in O&M
    - Failures reported, NGO-run minigrids sustainability in question.
  - Local governments in O&M
    - Subject to political capture, poor maintenance, low investment by local govt
  - Outsourced to private entities (appears to be the most common model)

Inclusion during mini-grid development contd.

- Ownership models
  - Land ownership: examples of communal land held in trust, leases, purchased outright
  - Several configurations of co-ownership models, e.g.
    - Public private partnerships
    - between community and developer
    - NGOs and community
  - Example of locally women-owned renewable energy systems in India thriving (Joshi and Yenneti, 2020).

(under review in the new documents identified)

Inclusion during mini-grid development contd.

- Participatory processes, community engagement
  - Models of participation (under review)
  - Some findings
    - active community involvement in managing the energy intervention and crafting local forms of governance can lead to more inclusive institutional arrangements, capable to promptly adapt to local realities and respond to upcoming issues
    - Local knowledge of energy matters a hinderance to community participation
      - E.g., in evaluating technologies (solar vs wind vs biomass; Ac vs DC, microgrids vs individual systems)
    - mixed project outcomes and high levels of failures call for a systematic investigation into the nature and extent of community involvement

Inclusiveness in the Outcomes/Impacts of mini-grids

- The literature broadly analyzes 4 impact channels
    1. Domestic use (most papers focus here)
        - Access to lighting the most pervasive. Most emotive issue, most important to households
            - Discussions about quality of lighting, impact on educational outcomes (performance), gender disparities in using electric light to study
            - Reduced drudgery of housework
        - Educational outcomes
            - Extended study time is extensively used as a measure of increment in the social welfare of the household
            - higher educational achievement in the case of children from electrified households
        - Entertainment and communication (TV, radio, internet access)
            - Better informed communities

Inclusiveness in Impacts of mini-grids contd.

- Health outcomes
  - The nexus between activities at the household level, community, and within healthcare facilities
  - Access to educational content on healthcare: preventive measures, management, and treatment of the ailments, family planning, hygiene
  - Use of home appliances e.g., refrigerators enhance health
  - Improved nutrition from the arrival of the mini grid: cooked foods, boiled water; increase in food supply of diverse foods – linked to improved incomes
  - Less injuries and overall bodily harm from use of other fuels: improved respiratory health

Inclusiveness in Impacts of mini-grids contd.

2. Productive use (focus on income generation activities)
   - Income generation and employment creation
     - Same benefits as households (lighting, entertainment, health, etc)
     - Emergence of new businesses: barber shops, carpentry, chilling units, bars, ice-block provider and photocopying among others
     - Increased income: use of electricity both directly to create or obtain the goods and services AND extended business hours
     - Women owned businesses increased
     - increased business competition within the community, conflicts
     - storage of perishable commodities, specifically meat and milk
     - forward and backward linkages that the arrival of the mini grid has spurred between agriculture and SMEs
   - improved farming techniques
   - Income diversification/ better quality products
   - Trade beyond “borders”

Inclusiveness in Impacts of mini-grids contd.

3. Institutional use
    - Electrification of health facilities
        - Improved service delivery
        - 24-hr services in hospitals; night-time births
        - Powering medical equipment e.g. diagnostic machines, sterilizers, and refrigerate medicines; improved lab testing; a rise in the number of tests; refrigerate medicines and vaccines
        - increase in the number of prenatal visits by women to local health clinics (linked to reduced drudgery)
        - reduction in maternal and infant mortality
        - Attracting qualified healthcare workers
    - Schools
        - Powered learning institutions; new learning institutions; improvement in the quality of education facilities; use of electricity with science laboratories; Electricity-based resources such as computers, projectors and photocopy machines, cassette players, TVs; influx of teachers into education facilities with minigrid access
        - Newly-electrified schools are also able to prolong their school days
        - significantly higher school attendance, rise in the enrolment of students; improvement in the transition rate to tertiary education by pupils
        - Improved overall school academic performance
        - cost-cutting by learning facilities

Inclusiveness in Impacts of mini-grids contd.

4. Supply chain

(under review)

- Broader benefits to the community
  - Improved security through improved street lighting. The community was able to attend overnight activities such as keeping vigil before a burial.
  - Improved social cohesion: community activities after dark

Emerging issues

- Gender dimension of inclusivity
  - Reduced drudgery. Empowerment of women
  - However, inclusivity indicators has been reported to vary between men and women, right from childhood
    - girls do not have as much study time after dark, even in electrified households
    - higher income generating activities are expected to be run by men
  - Women non-involvement during minigrid negotiations, development, training
  - The arrival of electricity linked to increased dropout rates among boys, given the obligation to take up productive work that can sustain their families financially
  - Disparities in the way that women and men spend their time post-electrification
    - Men spend more time after dark engaging in recreational activities
    - For women, electric lighting extends the amount of working time. (NB. firewood is still the main source of cooking fuel)
      - higher energy loads might see to increased inclusivity of women as it would allow for the connection of cooking appliances and standalone kitchens.

Emerging issues contd

- Absolutely vulnerable households (income-poor)
  - Absolutely excluded from the minigrid due to affordability constraints, illiteracy, distance from the mini-grid
  - Training: their levels of assimilation of the concepts are usually low
  - Excluded from participatory processes
    - Low perception of technical know-how and is therefore (not) necessary to involve
    - Low availability to take part in forums
    - Their participation in meetings is weak, they are more likely to miss payments, and they do not perform the operation and maintenance tasks correctly.
  - Excluded from local value chain building activities by mini-grid developers, income generation doe to lack of capital

Emerging issues contd

- Mismatch between the design of the mini-grid system, the monthly flat-rate payment schemes and the socio-economic reality of seasonal income cycles
  - E.g. in fishing communities

Next steps

- Explore other inclusivity dimensions apart from gender and income-level
  - Age, religion, ethnicity, disability
- Explore how the following issues are addressed:
  - Participation in minigrid development
  - Role of local knowledge, if any
  - Local politics that include/exclude in access to the minigrid, in participatory processes, revenue sharing, etc. Do minigrid developers intervene, and how?
  - Local content
  - Inclusion at the ‘structural’ level: in policy and regulatory processes for minigrids, in the types of actors involved the sector

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