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Institutions for sustainable forest governance: Robustness, equity, and cross-level interactions in Mawlyngbna, Meghalaya, India

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Abstract: This study adopts Ostrom's Social-Ecological Systems (SES) framework in empirical fieldwork to explain how local forestry institutions affect forest ecosystems and social equity in the community of Mawlyngbna in North-East India. Data was collected through 26 semi-structured interviews, participatory timeline development, policy documents, direct observation, periodicals, transect walks, and a concurrent forest-ecological study in the village. Results show that Mawlyngbna's forests provide important sources of livelihood benefits for the villagers. However, ecological disturbance and diversity vary among the different forest property types and forest-based livelihood benefits are inequitably distributed. Based on a behavioural rational choice approach, our analysis proposes a set of causal mechanisms that trace these observed social-ecological outcomes to the attributes of the resource system, resource units, actors

and governance system. We analyse opportunities and constraints of interactions between the village, regional, and state levels. We discuss how Ostrom's design principles for community-based resource governance inform the explanation of robustness but have a blind spot in explaining social equity. We report experiences made using the SES framework in empirical fieldwork. We conclude that mapping cross-level interactions in the SES framework needs conceptual refinement and that explaining social equity of forest governance needs theoretical advances.

Keywords: Cross-level interactions, equity, forestry, institutional analysis, North-East India, robustness, social-ecological systems

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1. Introduction

It is now widely acknowledged that there is no simple blueprint for sustainable governance of natural resources (Ostrom 2007). Problems of resource governance differ with the attributes of the affected resource systems, resource units, governance systems and actors (Ostrom 2009). They differ with the kind of encountered cross-level interactions (Cash et al. 2006) and with the normative criteria used for assessing the sustainability of social-ecological systems (e.g. robustness and longevity; equity and fairness; efficiency; biodiversity; food security). Rather than adopting blueprints, sustainable governance of natural resources therefore requires that governance arrangements are matched with the respective social-ecological setting and with the specific problems the involved actors face (Ostrom 2007).

A diagnostic approach has been suggested to integrate sustainability research from diverse contexts and to learn in a cumulative manner how governance arrangements affect incentives, social interactions, and outcomes of resource governance in specific social-ecological conditions (Young 2002; Ostrom 2007). The Social-Ecological Systems (SES) framework was suggested as an important step in this direction (Ostrom 2009; McGinnis and Ostrom 2014). Its detailed conceptual map compiles (i) attributes of resource systems, resource units, actors, and governance systems that were found to shape the sustainability of natural resource governance; (ii) contextual factors in which a social-ecological system is embedded (e.g. globalization pressures, technological change); and (iii) variables

that capture the multiple facets of social interaction and outcomes. This catalogue of variables is an answer to the question: Which factors account for diverging trajectories and outcomes of resource governance?

At this stage, one of the important next steps is to use the SES framework for the purpose of theory development. The catalogue of variables alone does not enable analysts to answer ‘how’ and ‘why’ success or failure has occurred. Furthermore, it does not enable analysts to predict likely consequences of governance proposals. For these purposes, we need to understand how configurations of SES variables shape the incentives and interactions among actors as well as social-ecological outcomes (Ostrom 2007; Cox et al. 2010; Frey and Rusch 2013). As Agrawal and Benson (2011) argue, this endeavour should pay particular attention to the multiple and potentially conflicting dimensions of social-ecological outcomes including sustainability, robustness, livelihoods, efficiency, and equity. Moreover, given that polycentric governance approaches are increasingly considered (e.g. Pahl-Wostl 2009; Ostrom 2010; Biggs et al. 2012), an analytical perspective is required that is sensitive to questions of spatial, jurisdictional, and temporal scales as well as cross-level interactions in resource governance.

This study intends to contribute to this research agenda in four ways. (1) It adopts the SES framework to conduct a case study of community forestry in the village of Mawlyngbna in North-East India. We report experiences made by using the SES framework as an analytical tool in empirical field research and suggest modifications. (2) We propose empirically validated mechanisms to explain how combinations of resource, governance, and actor variables shape ecological status and social inequity in private and community forests in Mawlyngbna. (3) We analyse cross-level interactions between various governance levels and suggest to slightly modify the SES framework for this task. (4) We discuss the relevance of Ostrom’s (1990, 2010) design principles of robust SES for explaining social inequities of forest governance.

The article is organised as follows. Section 2 describes the study area and Section 3 outlines the methods and the analytical approach. Section 4 presents the social-ecological system in Mawlyngbna, explains the observed ecological status and social equity outcomes and analyses cross-level interactions in Meghalaya’s community-based forest governance system. Section 5 discusses the varying diagnostic power of Ostrom’s (1990, 2010) design principles to explain the robustness and equity dimensions of sustainable forest governance in Mawlyngbna. Moreover, it discusses the essential role of trust and identities for polycentric governance and reports experiences with the SES framework in empirical fieldwork. Section 6 draws conclusions.

2. Context of the study area

The case study village Mawlyngbna is located in the East Khasi Hills district of Meghalaya on the edge of the Shillong plateau facing the plains of Bangladesh about 75 km south of the state’s capital Shillong (see Figure 1).

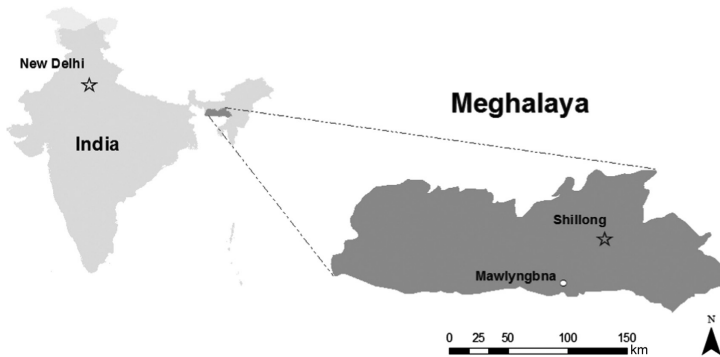


Figure 1: Location of the case study village Mawlyngbna.

Source: LaHaela 2013.

Case study village

The village of Mawlyngbna consists of 360 households (GIZ 2012). Its inhabitants all belong to the Khasi tribe with no fractions based on class, caste or tribes (Gurdon 1914). It received public attention through government investments in infrastructure (e.g. a multi-purpose reservoir), through its natural features (e.g. natural springs, urchin (*Echinoidea*) fossils), and through the development engagement of the German Development Organisation (GIZ) in the village (e.g. Times of India 30th January 2011; Northeast Today 4th March 2012; Shillong Times 12th November 2012).

Forest resources

Meghalaya is part of the Indo-Burma biodiversity hotspot (Myers et al. 2000). The variety in topographic, climatic, and edaphic conditions results in a vast diversity of vegetation in tropical evergreen/semi-evergreen forests (GoM 2005; Tiwari and Kumar 2008). However, in the period 2006 through 2009, the East Khasi Hills district lost 15.5% of its forest cover. The losses are ascribed to factors such as land conversion and short cycle shifting cultivation, rapid population growth, and mining activities (GoI 2011a).

Population and ethnicity

The population growth rate of the East Khasi Hills district of about 25% between 2001 and 2011 was one of the highest in India (GoI 2011b). The majority (89%) of Meghalaya's population belongs to one of three tribes, who predominantly inhabit three different regions of the state: Khasi in Khasi Hills, Garo in Garo Hills and Jaintia in Jaintia Hills (GoI 2001). The Khasi society has a tradition of governance through customary institutional arrangements with a strong bond between the family, the clan and the village council. They consider themselves

as descendent of single lineage. Meghalaya is one of the few Indian states where Christianity constitutes the predominant religion.

Matrilineality

Matrilineality is practiced by the three predominant tribes in Meghalaya, in which descent is traced through the mother and maternal ancestors (Karlsson 2006). The forms of matrilineality vary both among and within the tribes. The Khasi form generally privileges the youngest daughter by making her the custodian of the largest share of the ancestral property, jewellery, and family house. However, as such she is not a full owner since she does not have the right to alienate any of the inherited belongings. Along with the property come certain obligations such as the duty to care for the aging parents or to uphold the family rituals and traditions. An exception constitutes property acquired by the parents themselves. In this case the distribution and share among the children is on the parents to decide. Once inherited by the children, it counts for ancestral property (Nongbri 2000; Subba 2008).

Political system

The Sixth Schedule of the Indian Constitution grants a high degree of self-governing autonomy to tribal communities in Meghalaya. It formally acknowledges the full jurisdiction of tribal communities over land, forests (except reserved forests and protected areas), and natural resources (Dasgupta and Symlieh 2006; Karlsson 2006). The political system is structured into three tiers: the Legislative Assembly, the Autonomous District Councils (ADCs), and the local traditional institutions. The central law-making body in Meghalaya is the Legislative Assembly whereas the ADCs formally control the traditional institutions by appointing and suspending local chiefs and by passing regulations such as acts concerning forest management (Nongkynrih 2006).

There is remarkable diversity in traditional institutions of the Khasi tribal people. The Khasi territory is divided into states (“Himas”), which are associations of villages constituted as limited monarchies. The traditional head of a Hima is the king (“Syiem”), who is appointed by the Syiem family of the state. The Syiem controls the local village markets and the resource management of community land such as forests. He is responsible for conflict resolution and for the institutional arrangements applying on the Hima level. However, any decisions of importance require the endorsement of the executive council of ministers (“Myntries”) (Baruah 2004; Tiwari et al. 2010, 2013).

In the Hima Mawsynram, in which the study village is located, the Syiem is elected by the heads of four principal clans or in a people’s vote in case of an impasse (Gurdon 1914). On the village level, a headman (“Rangbah Shnong”) is elected by the village councils (“Dorbar Shnong”). Although endowed with particular importance through matrilineality, women are traditionally excluded from the local Khasi collective-choice institutions such as the village councils (Gurdon 1914; Subba 2008).

3. Methods and analytical approach

3.1. The social-ecological systems (SES) framework

We use the SES framework (Ostrom 2009; McGinnis and Ostrom 2014) to analyse the ecological status, social equity, and cross-level interactions of forest governance in Mawlyngbna, India. The framework conceives social-ecological systems as consisting of four main subsystems, i.e. the resource system, the resource units, the governance system and actors (Figure 2). McGinnis and Ostrom (2014) acknowledge that a SES can comprise multiple, concurrent sets of each subsystem. For example, several conceptually distinct governance systems may regulate one or more resource systems that are used by several actor groups. The broader social, economic, and political setting as well as related ecosystems define the wider context of a SES. The attributes of the context, resource systems, resource units, actors, and governance systems enable, constrain, and shape activities, processes (interactions), and outcomes in action situations (Ostrom 2011). Detailed information about these eight broad categories of SES context, structure, interactions, and outcomes is provided by second-tier variables that are subcomponents of the first-tier variables.

We utilised the SES framework in a mixed deductive-inductive approach for this study. As a deductive starting point, the second-tier variables as proposed by McGinnis and Ostrom (2014) structured our coding scheme for data analysis. In several inductive steps, the SES framework was adapted during data analysis in

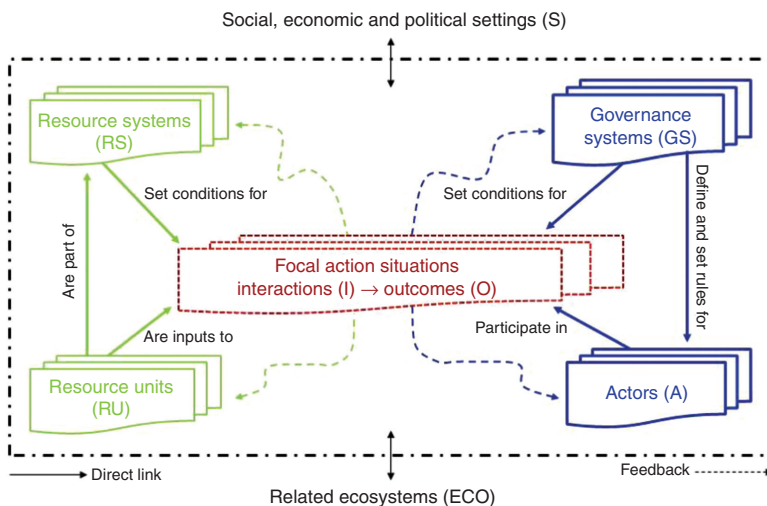


Figure 2: Revised social-ecological systems framework with multiple first-tier components. Source: McGinnis and Ostrom 2014.

order to capture relevant phenomena in this case study. Two main modifications were warranted. They concern how interactions between governance levels in polycentric systems and social equity are conceptualised in the SES framework. These modifications are discussed in detail in Section 5.3. Table 1 shows the adapted second-tier variables that result from our analysis of ecological outcomes, social equity, and cross-level interactions in forest governance in Mawlyngbna.

To conceptualise property rights (variable GS3) we adopt the terminology of Schlager and Ostrom (1992, 250): “A property right is the authority to undertake particular actions related to a specific domain.” Property rights are the products of operational, collective choice, and constitutional rules. Based on Schlager and Ostrom (1992), we distinguish five components of property rights (cf. McGinnis 2011): (i) access (right to enter specified parts of a resource system), (ii) withdrawal (right to obtain specified resource units), (iii) management (right to participate in decisions to regulate access and withdrawal and to make improvements in the resource system), (iv) exclusion (right to determine who will have access, withdrawal, and management rights), and (v) alienation (right to sell or lease one or more of the above rights). In addition, (vi) inheritance is important here, i.e. the passing on of one or more of the above rights from an older to a younger generation.

3.2. Explaining interactions and outcomes

This study explains how ecological outcomes and social (in)equity in forest governance are shaped by the attributes of the resource systems, resource units, governance systems, and actors in Mawlyngbna. Drawing these inferences requires sound theoretical guidance. We adopt the behavioural rational choice approach from Ostrom (2005) and Gibson et al. (2005) to draw inferences between the variables of the SES framework. This approach provides an analytical heuristics to infer from SES attributes to outcomes by analysing how SES variables affect individual decision-making and how decisions translate into interaction patterns and social-ecological outcomes. Figure 3 illustrates this analytical heuristics. It proceeds by analysing how the attributes of the resource systems, resource units, governance systems, actors, and the wider context of a SES shape the focal action situation. The action situation is characterised by the relevant positions, actors, their action spaces, information, possible outcomes, the actors' control over outcomes, and costs and benefits associated with outcomes (Ostrom 2005, 2011). The analysis continues to trace how these attributes of the action situation define the incentives that the relevant actors face for particular actions. Incentives consist of both the external stimuli and the internal reasons that actors have to choose particular actions in light of their information processing capacities, values, preferences, and decision heuristics (Gibson et al. 2005; Ostrom 2005). Through shaping the various choices of actors over time, the main incentives translate into patterns of social interactions (e.g. harvesting levels, monitoring, deliberation, rule changes) which in turn affect the ecological and social performance in the SES

Table 1: Coding scheme: second-tier variables of the SES framework (adapted from McGinnis and Ostrom 2014; underlined: added variables during iterative coding, cf. Section 5.3).

Social, economic, and political settings (S)		
S1 Economic development, S2 Demographic trends, S3 Political Stability, S4 Other governance systems, S5 Markets, S6 Media organisations, S7 Technology		
Resource Systems (RS)		Governance Systems (GS)
RS1 Sector		GS1 Organisations
RS2 Clarity of system boundaries		GS1.1 National level
RS3 Size of resource system		GS1.2 State level
RS4 Human-constructed facilities		GS1.3 District level
RS5 Productivity of system		GS1.4 Regional level
RS6 Equilibrium properties		GS1.5 Village level
RS7 Predictability of system dynamics		GS1.6 Boundary organisations
RS8 Storage capacities		GS2 Network structure
RS9 Location		GS3 Property rights system
<u>RS10 History</u>		GS4 Operational-choice rules
		GS4.1 Community reserve forest
		GS4.2 Private forest
		GS5 Collective-choice rules
		GS6 Constitutional-choice rules
		GS7 Monitoring and sanctioning rules
		<u>GS8 Conflict resolution rules</u>
Resource Units (RU)		Actors (A)
RU1 Resource unit mobility		A1 Number of relevant actors
RU2 Growth or replacement rate		A2 Socioeconomic attributes
RU3 Interaction among resource units		A3 History or past experiences
RU4 Economic value		A4 Location
RU5 Number of units		A5 Leadership/entrepreneurship
RU6 Distinctive characteristics		A6 Norms (trust-reciprocity)/ social capital
RU7 Spatial and temporal distribution		A7 Knowledge of SES/mental models
		A8 Importance of resource (dependence)
		A9 Technology available
Action Situations: Interactions (I) → Outcomes (O)		
Interactions (I) (Activities and Processes)		Outcomes (O)
<u>I1 Same-level interactions</u>	<u>I2 Cross-level interactions</u>	O1 Social outcomes
I1.1 Harvesting	<u>I2.1 Financial transactions</u>	<u>O1.1 Equity of livelihood opportunities</u>
I1.2 Information sharing	<u>I2.2 Information sharing</u>	
I1.3 Deliberation processes	<u>I2.3 Deliberation processes</u>	O2 Ecological outcomes
I1.4 Conflicts	<u>I2.4 Conflicts</u>	<u>O2.1 Level of disturbance</u>
I1.5 Investment activities	<u>I2.5 Investment activities</u>	<u>O2.2 Biodiversity</u>
I1.6 Lobbying activities	<u>I2.6 Lobbying activities</u>	<u>O2.3 Trend in forest area</u>
I1.7 Self-organising activities	<u>I2.7 Rule-making activities</u>	O3 Externalities to other SESs
I1.8 Networking activities	<u>I2.8 Networking activities</u>	<u>O4 Outcomes of cross-level interactions</u>
I1.9 Monitoring activities	<u>I2.9 Monitoring activities</u>	
I1.10 Evaluative activities	<u>I2.10 Evaluative activities</u>	
<u>I1.11 Rule compliance</u>	<u>I2.11 Rule compliance</u>	
Related Ecosystems (ECO)		
ECO1 Climate patterns, ECO2 Pollution patterns, ECO3 Flows into and out of focal SES		

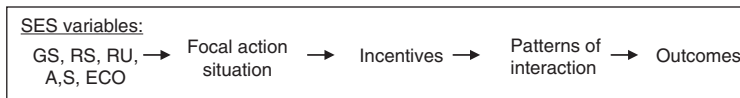


Figure 3: Explaining interactions and outcomes in SES.

Source: adapted from Gibson et al. 2005, 26.

(e.g. biodiversity, livelihoods). We use this heuristics to explain how the observed configurations of SES variables affect observed interactions and outcomes of forest governance in Mawlyngbna.

3.3. Case study methods

Empirical evidence was gained from 26 in-depth and focused, semi-structured interviews that were triangulated with direct observation of community meetings, participatory timeline development, periodicals, documents (GoM 2005, 2013; GoI 2011a,b; GIZ 2012), and transect walks within a fieldwork period of seven weeks from January through March 2013. Information about the biophysical features of the SES was gained from a concurrent forest vegetation study that was part of a joint research project (LaHaela 2013). Scholarly publications about forest governance in other parts of Meghalaya complemented our original data.

Following the field guide of the International Forestry Resources and Institutions research program (IFRI 2011) we prepared an interview guideline and used snowball sampling to identify appropriate interview partners. Our interview partners comprised government officials, village council members, school teachers, village elders, members of a Khasi organisation, youth organisation, religious organisation, and of NGOs. Based on IFRI's field guide, the interviews were noted in a field notebook, reviewed, and transcribed into a digital file. Qualitative Content Analysis was used to analyse the qualitative data. We followed a mixed deductive and inductive procedure. The variables of the SES framework initially structured our coding scheme by interpreting the data as manifestations of the first-tier and relevant sub-tier variables. The set of SES variables was modified inductively where needed in order to capture the empirical material most appropriately. Our preliminary findings were discussed and verified in Mawlyngbna during a second field stay in December 2013.

4. Results

The community of Mawlyngbna has governed the forest patches that surround its village for decades. Its members have been able to avoid a severe “tragedy of the commons”. The state government and the GIZ have identified Mawlyngbna as a model village for implementation of development schemes based on features such as better natural resource governance, a well knit society and working institutional

arrangements (GIZ 2012; Shillong Times 12th November 2012). However, forest governance is not without problems in Mawlyngbna. Some forest patches show comparatively low biodiversity and biomass parameters. Resource access, related livelihood options, and wealth are inequitably distributed among the villagers. Moreover, impacts of climate change and population growth are perceived to increase pressure on the local social-ecological system. To analyse these challenges, Section 4.1 describes the SES in Mawlyngbna by using the SES framework. Based on this description, Sections 4.2 and 4.3 analyse how the observed ecological outcomes and social inequities can be explained by the observed attributes of resources, governance system, and actors. Section 4.4 explores cross-level interactions between actors at the village, regional, district, and state levels.

4.1. Social-ecological system in Mawlyngbna, Meghalaya, India

Social, economic, and political setting (S-variables)

The context of Mawlyngbna's social-ecological system is characterised by a relatively stable political environment and constitutional rights granting autonomy to tribal communities. Population growth reached 25% between 2001 and 2011 and development parameters, although urban centric, are highest in the East Khasi Hills district (GoI 2011b). Recent economic developments such as infrastructure constructions entice private and community land users to exploit the region's natural resources for revenue purposes.

Related ecosystems (ECO)

Changing weather conditions over time was the predominant issue of the respondents with regard to Mawlyngbna's climate patterns. Most interviewees reported declining amounts of rainfall over the last decades both in the rainy season and in the dry period. Decreasing crop yields were reported that coincide with the period of decreased rainfall which confirms scholarly findings (e.g. Ravindranath et al. 2011).

Resource systems (RS)

Mawlyngbna is surrounded by open grasslands and sub-tropical evergreen forest (Figure 4). Boundaries between different patches of the resource system are clear, e.g. by water bodies, footpaths, rocks, and different vegetation types. The community reserve forest covers 119 ha, private patches another estimated 100 ha (LaHaela 2013). Human-constructed facilities include several paved roads that facilitate the extraction of resources, networks of footpaths, and a dammed lake for irrigation purposes.

Resource units (RU)

Mawlyngbna's forests provide resource units such as firewood, timber, medicinal plants, black pepper, betel and oranges that are essential to the villagers' livelihoods. Furthermore, on arable land of non-protected forests, income can be

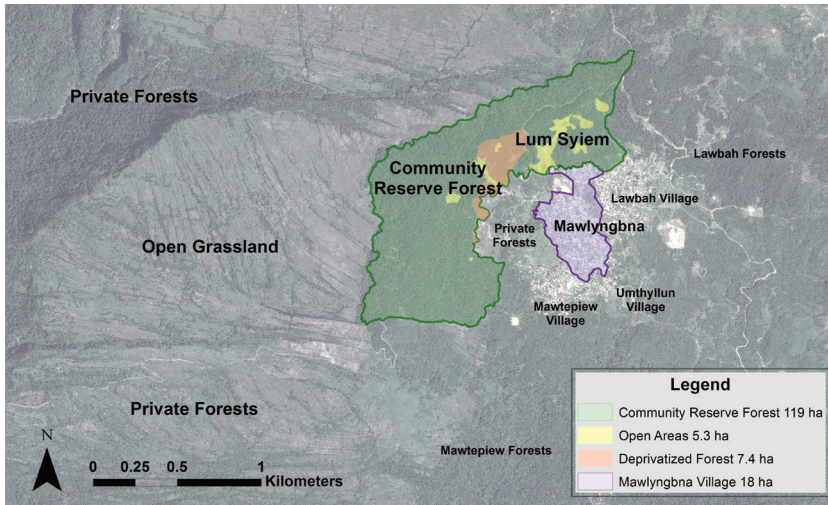


Figure 4: Land use map of Mawlyngbna.
Source: LaHaela 2013.

generated by cultivating cash crops such as broom grass (*Thysanolaena maxima*), bay leaf (*Cinnamomum tamala*) and areca nut (*Areca catechu*). Also, rice and vegetables such as potatoes and sweet potatoes are cultivated in clearings. In some areas the forest is removed for limestone quarrying. Moreover, the respondents identified several forest ecosystem services as vital to their livelihoods including water storage and filtration, protection against soil erosion, as well as aesthetic and touristic values. No systematic inventories of forest resources are collected in Mawlyngbna. However, the respondents reported a decreasing occurrence of timber with properties suitable for construction in the community reserve forest and increasing difficulties to find firewood.

Actors (A)

The majority of Mawlyngbna's 360 households rely on agroforestry as their main source of income and livelihoods. Most respondents cultivate in patches of private forest. Forest work is mostly executed by using traditional, labour-intensive technologies. More recently, motorised transportation facilitated extraction. Remarkable social capital and strong norms exist in Mawlyngbna as evidenced by active and frequent participation of respondents in several community organisations and religious rituals as well as by a strong bond between the families, clans, and village council. The clan and village heads are customarily described as a care taker of all families of their clan and village. The forest related norms of the villagers are rooted in the wisdom of their forefathers. For example, respondents traced their motivation for preservation to an inherited obligation from their forefathers' initial dedication for its protection. Actors from the district and state

level of India's political system influence Mawlyngbna's forest governance only sparsely and indirectly to date.

Governance system (GS)

Forest governance in Mawlyngbna is mostly handled by village-level entities. The village council is the legislative body for major collective choices. It consists of all male, long-standing residents over 18 years. The 18-person executive committee is the executive body of the village and decides in 3–4 meetings per month upon operational issues. The village headman bears major responsibilities for conflict resolution and sanctioning. He employs a graduated system of warnings and fines depending on the severity and frequency of infractions. He is supported by a forest assistant and secretary. All the functionaries of the village are appointed by the village council. The positions are volunteer positions but the village headman is offered a monetary gift at the end of his term. As for the property rights system, only the regional Syiem bears the exclusive right to alienate the land including the forests, agricultural, and open grass-land within the village boundaries. However, the village council can create their own institutional arrangements for Mawlyngbna and consultation with the Syiem is only required when it comes to change in land use. The villagers distinguish between the community reserve forest (CRF) and private forests (PF) as the two types of forest property rights systems in Mawlyngbna. They include extensive sets of operational-choice, collective-choice, and constitutional-choice rules regulating central issues such as access, use, taxation, sanctions, monitoring, resource protection, responsibilities and meeting procedures of governance bodies. These detailed rule sets are documented in Table A1 in the Appendix.

Interactions (I)

Mawlyngbna's villagers harvest a variety of forest products both in the CRF and private forests (see 'resource units'). The number of trees harvested in the CRF per year depends on the number of approved applications by families that decide to construct new houses. In private forests tree harvesting is largely unregulated and depends on the extent of wood use and crop cultivation. The introduction of stone quarrying and broom grass cultivation for revenue purposes increased the intensity of private forest use. Mawlyngbna's forest governance system is almost entirely self-organised. Information such as about institutional arrangements or the state of the forest resources is shared effectively through personal interaction and at community meetings. Conflicts among users are infrequent. Respondents often did not even remember when they experienced the last dispute. Illegal cutting of living trees for firewood purposes constitutes the most frequent type of infraction. Resolution of conflicts is executed by the village headman, executive committee and village council. The villagers are responsible for monitoring each other's forest use and the forest condition without a specifically appointed custodian. Forest resources in the CRF are renewed only through natural regeneration. In the private forest patches, crop trees are planted with seedlings from the CRF or from nurseries. For fire protection, a fund was implemented by the village council to

pay villagers who contribute to the fire suppression measures threatening the CRF. As detailed in Section 4.4 interactions with other governance levels are limited.

Outcomes (O)

With regard to ecological outcomes, the CRF and private forests significantly differ in basal area and average tree height, whereas stem density per hectare are very similar. As depicted in Table 2, many diversity indices were higher in the CRF (LaHaela 2013). There is an upward trend in total CRF area. However, the respondents reported increasing difficulties in finding appropriate construction timber and firewood in the CRF. Therefore, users of private forests stated that the opportunity to collect firewood in their own patches is of major importance.

With regard to social performance, the number of inhabitants without any access to a private forest patch was reported to be very small but accumulation of both land tenure and livelihood benefits is unequally distributed amongst the villagers of Mawlyngbna. As a respondent put it, “there are many more poor people than rich ones”. The respondents reported that income, education, clothing, and housing quality of a household are closely related to the amount and size of private forest patches under its control. Cultivable land and thus agricultural income opportunities can only be appropriated through inheritance or by monetary compensation for the growing crops in the rare occasions when a private forest patch is offered for alienation.

4.2. Explaining ecological outcomes

This section analyses the ecological outcomes of forest governance in Mawlyngbna. Forest users in Mawlyngbna have been able to avoid extraordinary forest degradation. However, lower values for tree height and basal area in combination with increased signs of disturbance (e.g. cutting and grazing) in a comparable environmental context (e.g. similar slope, exposition, soil properties) imply higher rates of resource extractions in the private forest patches. As a result, private forests contain less quality construction timber (tall, large-diameter trees of certain species), less genetic resources, as well as lower effects of production diversification and risk reduction (LaHaela 2013). In the following, we suggest an explanation for this pattern of ecological outcomes.

The incentives that resource users face depend directly on knowledge, values and the outcomes a user potentially has to face as a result of his or her actions. The villagers shared sound knowledge of the local institutional arrangements and forest boundaries. Frequent personal interaction and the mandatory presence at the village council meetings might contribute to effective information sharing amongst the village council members whereas non-members, in particular women and minors, are informed in less formal ways (e.g. conversations at home).

The combination of strong norms and social control (i.e. villagers notice other villagers' actions while in the forest) make infractions in Mawlyngbna's

Table 2: Structural and compositional parameter values for the mature tree life stage layer in the Community-Reserve Forest (CRF) and Private Forests (PF) and their α significance. Source: LaHaela 2013.

Parameter	CRF	PF	α Significance
Total basal area (m ² ha ⁻¹)	30.2	14.9	$\alpha=0.05$
Average height (m)	7.9	4.5	$\alpha=0.007$
Average density (stems ha ⁻¹)	1338	1344	$\alpha=1$
Total stumps	179	154	n/a
Total basal area (m ² ha ⁻¹) of stumps	9.4	8.9	n/a
Disturbance index (%)	17.7	39.0	$\alpha=0.156$
Genera richness	56	44	$\alpha=0.070$
Number of families	37	31	$\alpha=0.026$
Shannon-Wiener's diversity index (H')	2.60	2.22	$\alpha=0.028$
Simpson's dominance index (λ)	0.07	0.13	$\alpha=0.005$

forests potentially costly both monetarily and in terms of reputation in the village. Mawlyngbna's rules put the responsibility on every villager to monitor the other users and to report infractions to the headman. This responsibility might be supported by the level of trust in the efficiency of the monitoring and sanctioning setup. At the same time, forest resources are of great importance for the villagers' livelihoods and resource extraction can substantially increase their income. Therefore, this cluster of reasons supports the model of a decision heuristics of resource users that favours actions in compliance with the well-known rules while allowing for the promotion of resource extraction when and where it is permitted.

The above analysis implies that the difference in the ecological status of the community reserve forest and the private forests is the result of the differences in harvesting restrictions in Mawlyngbna's operational choice rules. Since harvesting actions in the CRF are substantially limited to certain forest resources (e.g. deadwood, fruits, approved amounts of construction timber) whereas users of private patches face hardly any restriction, the incentives infer higher extraction activities in the latter. This inference matches LaHaela's (2013) findings of a higher Shannon diversity index and a lower disturbance index in the CRF compared to the private forests (see Table 2).

4.3. Explaining social (in)equity

This section analyses the equity implications of Mawlyngbna's institutional system in terms of livelihood opportunities and wealth. It proposes four mechanisms that explain how Mawlyngbna's institutions affect social equity.

Livelihood opportunities and wealth distribution

The distribution of wealth was found to be substantially channelled by the rights to access forests and to withdraw resource units. Access to, and withdrawal from, the community reserve forest are rights that are equally inherent to every inhabitant

of Mawlyngbna. For instance, all families of married inhabitants – irrespective of wealth status, household size or private forest patches under their control – are eligible to apply once per year at the village headman to fell up to 50 living trees in the CRF for repairing or constructing houses.

In contrast to the CRF, most rights to access and withdraw from private forest patches are exclusive to particular households and they can only be transferred through inheritance or alienation. Inheritance is regulated through the matrilineal system (cf. Section 2), whereas alienation of forest land is possible only in the very rare instances if patches are offered and if the compensation for the growing stock can be afforded. The reported increase in effort required for collecting forest products in the CRF increases the importance of access to private forests.

An interesting institution implemented as an essential equity mechanism operates against the exclusivity of access and withdrawal rights in private forests. All residents are permitted to quarry stones in all private forests. Hence, substantial additional forest-related livelihood opportunities are created that do not depend on the amount of private forests in which the villager holds user rights. However, the ecological impact of the institution is severe since vegetation and soil is removed in the quarrying process.

Privatisation and commercialisation

A development in Mawlyngbna's property rights system, which might be most accurately termed privatisation, had a major impact on equity in the village. Over time, increasing amounts of arable land (that was initially mostly forested) was claimed through cultivation or through other investments as private patches for which the institutional arrangements grant exclusive user rights to the claimant. Respondents stated that population increase was a major driving force in this development. A "three-year-rule" applied that regulated exclusive withdrawal rights to the villager who initially cultivated a parcel of land. This exclusive withdrawal right would be lost only 3 years after the villager would have abandoned the land. This rule has promoted long-term claims over land and has shaped the overall distribution of land among families.

As increasing areas of land were taken under exclusive cultivation, abandonment of such patches decreased and the "three-year-rule" lost its relevance. When all arable land was claimed a single family could only acquire land through transfer of rights. If not inherited, such very rare transfers include a compensation for the crops growing on the alienated sites implying monetary valuation (i.e. the commercialisation of arable land).

Deprivatisation

In contrast to the mechanisms above, a total area of 7.4 ha of previously private forest was annexed to the CRF in recent years. The patches that are located along the eastern boundary of the CRF were previously used as cemeteries and as bay leaf cultivation fields. The prior users are still allowed to harvest their crop trees until these die off. However, no further cultivation is permitted.

Through the deprivatisation mechanism, although only used rarely so far, prior exclusively used forests are made available to all villagers. The deprivatisation mechanism restores forest area as CPR which increases equality of livelihood opportunities.

Gender equity

Women and men are equally active in operational activities such as collecting firewood and non-timber forest products as well as monitoring activities. Also, they have equal rights in the seizure of rule offenders. However, similar to many other Indian villages (Agarwal 2009), political equity in Mawlyngbna is constrained by the traditional custom of male dominance in collective-choice processes. Although women participate indirectly through networking activities of the women's organisation, final collective decisions are made by the male villagers. When asked about their limited influence on forest governance decisions, the female respondents expressed their acceptance of this traditional custom and reported influence through discussions with the male household members.

4.4. Cross-level interactions

Forest governance in Mawlyngbna is nested within the polycentric institutional system of Meghalaya. Polycentric institutions organise governance in multiple arenas of decision-making. Each arena provides its participants with a certain degree of autonomy on specific domains. To the extent that multiple arenas are linked through cross-level interactions, they function as a polycentric system (Ostrom et al. 1961). As noted, the community of Mawlyngbna has considerable autonomy on matters of governing the forests that surround its village. Nonetheless, the activities of several organisations from higher governance levels may imply a re-scaling of the de-facto institutional boundaries of forest governance (Andersson 2013). There is little literature on such cross-level interactions in Meghalaya which is often limited to evaluations of the relatively few Joint Forest Management (JFM) co-management partnerships (Malhotra et al. 2004; Poffenberger et al. 2007; Kumar 2008a,b). Hence, this section analyses opportunities and constraints of cross-level forest governance interactions between villagers of Mawlyngbna and actors of other governance levels.

As a village of exceptional social and natural features, Mawlyngbna has moved into the focus of various actors at the state and district level. The village became a model for local development efforts and government programs invested in its infrastructure such as irrigation and water facilities as well as solar lights. In terms of forest management in a narrow sense, almost no interactions were found between the village and organisations of other levels at present. However, several organisations from higher levels promote increased cross-level interplay. The Government of Meghalaya recognised the state's vulnerability to climate change and launched the State Climate Change Action Plan (GoM 2013). The plan encompasses an extensive list of suggestions for climate change adaptation

measures in forestry. The state-level Forest and Environment Department endeavours to provide remote-sensing based inventory data in efforts of implementing a working scheme for systematic forest management. Moreover, the district-level Khasi Hills Autonomous District Council (KHADC) launched a process for forest registration and rule codification. To date, only a few consultation meetings with the KHADC and a regional forest plan by the Syiem were found in Mawlyngbna and there appears to be minimal influence on the forest governance system by actors from other levels.

At the village-level, forest-related institutions from other levels were almost completely unknown and cross-level capacity building activities were not found. At the same time, the villagers' statements show both hopes and reservations towards cross-level interactions. The villagers voiced strong concerns about potential encroachment on their autonomy and independence. Moreover, some interviewees would perceive increased cross-level interaction as incompatible with their community-based tradition: "Our forefathers did not want cooperation with the government". Interviewees from higher levels mentioned constraints resulting from the abundant illiteracy among rural people which inhibits administrative processes. They also confirmed the suspicion of villagers that the motives of government authorities can be driven by their party's political and power interests. In addition, possible corruption on the government side and the often disproportionate demands raised by communities undermine the sincerity in cross-level interplay. A structural constraint was mentioned in terms of the state government's capacities. Cross-level interactions (e.g. law enforcement at the Indo-Bangladesh border to prevent timber smuggling, hearing of forest related cases at the courts, or constitution of new JFM committees) are limited by financial and staffing constraints.

Respondents also identified potential benefits from increased forest related cross-level interactions. Capacities to deal with large-scale hazards such as diseases and climate change impacts could be built with help from professional organisations of other levels. Furthermore, investments such as infrastructure facilities often exceed the financial capacities of communities which would require cross-level funding. Table 3 summarises the opportunities and constraints of cross-level interactions as stated by the respondents. Villagers showed interest in the potential benefits of cross-level interactions. However, they would continue to refuse such interactions unless agreements with the uncorrupted intention of mutual benefits are found with trustworthy partners.

5. Discussion

5.1. Ostrom's design principles and the multiple dimensions of sustainability

The SES framework has been introduced as a heuristic tool to study the "sustainability of social-ecological systems" (Ostrom 2009). In a complementary way, Ostrom's (1990, 2010) design principles for community-based natural

Table 3: Opportunities and constraints of increased cross-level interactions.

Possible partner	Opportunities	Constraints
Forest and Environment Department	High funding capacities High professional capacities Legal timber sale through 'forest working plan'	Low level of trust Legal preconditions Potential dependence and autonomy constraints Party politics-driven
Khasi Hills Autonomous District Council	High level of trust Contacts to FED	Low funding capacities Party politics-driven Limited political influence
NGOs (e.g. Bethany Society, FES, Community Forestry International, IFAD)	Politically independent Potentially high level of trust High professional capacities	Low political influence

resource governance continue to provide a parsimonious but powerful explanation how and why small-scale resource systems can survive productively over long time periods (Cox et al. 2010). In terms of the SES *framework*, the design principles provide a *theory* that traces the outcome parameter 'robustness of a SES' to eight specific features of the social-ecological system.

Robustness, however, constitutes only one of multiple dimensions of sustainability. In particular, robustness does not guarantee per se an equitable distribution of the livelihood benefits provided by a resource system (Agrawal and Benson 2011). The Mawlyngbna case study exemplifies this. On the one hand, the village governed its surrounding forests productively for generations and Ostrom's design principles are well fulfilled in Mawlyngbna, as Table 4 summarises. On the other hand, livelihood benefits of forests are inequitably distributed among the villagers (cf. Section 4.3). Hence, social-ecological systems that do fulfil the design principles do not necessarily imply equitable distributions.

To explain this puzzle, we argue that the design principles should be seen as a theory with the purpose to analyse robustness of, rather than equity in, social-ecological systems. Historically, the development of the design principles is rooted in a critique of the "tragedy of the commons" (Hardin 1968). This metaphor characterises ubiquitous free-rider problems as threats to the robustness of natural resource systems (Ostrom 1990). As a major response to the tragedy of the commons, the design principles reveal conditions that characterise long-living resource systems in which resource users alleviated or prevented free-rider problems.

However, because the design principles focus on robustness of resource systems, they are not sufficiently tailored to explain the distributional patterns of resource benefits. For Mawlyngbna we find that rules which regulate user boundaries (design principle 1A) as well as appropriation and provision (design principle 2B) have major distributional implications (cf. Section 4.3). First,

Table 4: The design principles of Ostrom (1990, 2010) for robust resource governance and assessment for Mawlyngbna's forest governance.

Design principle	Description (cited from Ostrom 2010, 13)	Fulfilled in Mawlyngbna?
1a User boundaries	Clear and locally understood boundaries between legitimate users and nonusers are present.	Yes.
1b Resource boundaries	Clear boundaries that separate a specific common-pool resource from a larger social-ecological system are present.	Yes.
2a Congruence with local conditions	Appropriation and provision rules are congruent with local social and environmental conditions.	Partially. The allowance to cut live trees in the CRF is not dependent on the ecological state of the forest resources.
2b Appropriation and provision	Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.	Yes.
3 Collective-choice arrangements	Most individuals affected by a resource regime are authorized to participate in making and modifying its rules.	Partially. Only male adults can participate.
4a Monitoring users	Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.	Partially. Only social control, no employed guards.
4b Monitoring the resource	Individuals who are accountable to or are the users monitor the condition of the resource.	Partially. Only anecdotal observations and traditional knowledge, no employed guards.
5 Graduated sanctions	Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.	Yes.
6 Conflict resolution mechanisms	Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.	Yes.
7 Minimal recognition of rights to organise	The rights of local users to make their own rules are recognized by the government.	Yes.
8 Nested enterprises	When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organised in multiple nested layers.	Currently few cross-level interdependencies (see Section 4.4).

principle 1A specifies that the rule system draws “clear and locally understood boundaries between legitimate users and nonusers” (Ostrom 2010, 13). In Mawlyngbna, user boundaries are clear and locally understood. But as soon as access and withdrawal rights are inequitably distributed among the resource users, clear boundaries imply inequalities in terms of resource benefits. This is the case for benefits from the clearly demarcated private forests in Mawlyngbna. Second, principle 2B refers to a situation in which “appropriation rules are congruent with provision rules; [and] the distribution of costs is proportional to the distribution

of benefits” (Ostrom 2010, 13). This congruence is well given in Mawlyngbna. At the same time, the ability to invest in cultivation, i.e. the ability to incur costs, is inequitably distributed among community members due to specific access rights for private forest patches. In such a situation of exclusive access rights, the congruence principle actually implies inequalities in terms of withdrawal rights and, consequently, resource benefits.

Taken together, the design principles specify conditions under which communities of resource users are likely to avoid free-rider incentives that might have devastating effects on a natural resource system. Hence, the design principles are a major theory to explain the robustness of resource systems. However, if the analytical purposes include not only robustness but also the explanation of the social equity dimension of sustainability, the design principles need to be extended by focusing on the distribution of access and withdrawal rights in resource systems.

5.2. Scale and polycentricity in the governance of natural resources

The Mawlyngbna case study contributes to scholarship about scale and polycentricity in the governance of natural resources. In particular, we discuss our findings with a view to Andersson and Ostrom’s (2008, 73) suggestion for scholars of polycentricity to examine “the extent to which back-up institutions [...] at higher or lower levels of governance [may] offset some of the imperfections of institutions at any one level”. Scale refers here to the spatial, jurisdictional, and temporal dimensions of a governance system that is used to govern a resource system (Gibson et al. 2000; Berkes 2002; Cash et al. 2006). Scaling implies a particular distribution of control over a resource system (Robbins 1998). It shapes whose knowledge and values are brought into governance processes, to whose benefits and costs (Vatn 2005), and how social-ecological interdependences within and across scales are accommodated in a governance system (Lemos and Agrawal 2006; Paavola 2007).

Questions of scale in governing forests and land have been highly contentious in North-East India for generations (Karlsson 2011). Tribal communities in the region have a long and ongoing history of engaging both peacefully and violently for the continued recognition of their self-governing autonomy by state and national governments (Karlsson 2006). Over time, several community-based governance systems in North-East India encountered high degrees of deforestation. They were used as a central argument for intervention by the Indian Supreme Court’s logging ban in the mid-1990s and to establish state-community co-management schemes (Karlsson 2006; Poffenberger et al. 2007; Kumar 2008b). Hence, can back-up institutions at higher levels of governance offset some of the imperfections of community-based institutions?

In the Mawlyngbna case-study, we identified trust across levels as a critical factor for the extent to which a polycentric organisation of forest governance with increased community-state-interactions would be likely to improve social-

ecological outcomes (cf. Section 4.4). The community-based governance of local forests for generations has formed an intimate relationship of tribal communities in all of Meghalaya with their forests (Karlsson 2011). Decades of self-governing their forests have formed deep local ecological knowledge, livelihood dependency, place-based identities, belonging, and self-understanding of Meghalayan tribal communities (Karlsson 2011) – an instance of Agrawal's (2005) notion of environmentality. With regard to forest property rights, tribal communities of Meghalaya have developed a deep sense of ownership for their surrounding forests. The actual forest users perceive the legitimate forest property rights to lie with tribal communities rather than with the state. Hence, activities at higher governance levels that may involve a shift of property rights face serious concerns over the potential encroachment of autonomy of tribal communities. Such mistrust is rooted in memories of historical experiences such as the Supreme Court's timber ban decisions in 1996 and 1998. It was perceived that state authorities would disrespect the autonomy of tribal communities as formally granted in the Sixth Schedule of the Indian Constitution (Nongbri 2001; Karlsson 2006).

In such an environment of deeply rooted forest-bound community identities and cross-level mistrust, a partial relocation of formal property rights from communities to the state, e.g. in co-management schemes, faces the serious risk to be considered illegitimate by the actual forest users. Without legitimacy, however, the transaction costs of forest governance are likely to be substantial because unaccepted constraints on forest use need tight external monitoring and enforcement. This meets constrained financial and staff capacities of state organisations to perform critical governance functions in distant areas. As a consequence, a partial relocation of management rights from forest users to state actors may erode traditional institutions that were crafted and accepted by forest users (Tiwari et al. 2013). Hence, ecological destruction from resource overuse would continue and possibly even increase if the surrogate polycentric institutions are not more effective in organising the critical governance functions of excluding non-authorised users, regulating resource use, cost recovery, monitoring, conflict resolution, and enforcement of rules (Paavola 2007).

In summary, even though any governance system has imperfections (Andersson and Ostrom 2008), it seems unlikely that the creation of "back-up institutions" at higher levels of governance improves social-ecological outcomes if the focal SES is characterised by deep mistrust across governance levels combined with resource-bound identities of forest users.

Interestingly, Robbins (1998) and Robbins et al. (2007) found for Rajasthan that the location of authority over natural resources between state or local levels is less fundamental for ecological outcomes than the breadth and legitimacy of authority. The Mawlyngbna case-study complements this finding by showing that the location, breadth, and legitimacy of authority are deeply intertwined as soon as forest users hold particular views of the acceptable location of the bundle of forest property rights.

5.3. Experiences with the SES framework

As expected in social-ecological systems, data collection and analysis was characterised by substantial diversity and complexity of variables and relations (Ostrom 2009). In this case study, the SES framework fulfilled its purpose of promoting a diagnostic approach to SES analysis. It proved to be a strong tool for both structuring the diversity of data and making findings comparable to other studies in often disparate contexts through a common vocabulary (McGinnis and Ostrom 2014). Furthermore, it provided heuristic devices to elaborate explanations of the observed ecological and social performance of Mawlyngbna's forest governance.

In the course of our deductive-inductive analysis, some modifications of the SES framework were required. First, the provided set of variables was partly insufficient for us to provide a detailed analysis of central natural resource issues such as equity and cross-level interactions. As Table 1 illustrates, additional variables were introduced for specific outcomes (e.g. O1.1. "equity", O4 "outcomes of cross-level interactions"). Second, some original SES variables were not addressed in detail because of their minor relevance for the research questions (e.g. RU6 "distinctive characteristics", ECO2 "pollution patterns", O3 "externalities to other SESs"). Third, the organisation variables were modified. The SES framework's original distinction between government and non-government organisations did not match well with the structure of organisations in Meghalaya's governance system. We found a classification of organisations according to governance levels (variables GS1.1-GS1.6) more insightful.

Most importantly, it proved difficult to use the SES framework to map the interactions between the various governance levels (village, regional, district, state, national) that are conceptually distinct to the interactions within each of these levels. As noted in Section 4.4, the activities of several organisations from higher governance levels may invoke a re-scaling of forest governance implying that the bundle of property rights is altered across governance levels. For this case-specific reason and because polycentricity has been identified as a critical feature in resource governance more generally, we propose the SES framework should be able to map cross-level interactions between adjacent governance arenas explicitly. To make this explicit we distinguished the "interaction" variables (I) into same-level interactions (codes I1 and I1.1–I1.11 in Table 1) and cross-level interactions (codes I2 and I2.1–I2.11).

Finally, the SES framework is an extension of the Institutional Analysis and Development (IAD) framework (Ostrom 2011). The integration of concepts from the IAD framework such as the action situation and its working parts added to the analytical power of the present institutional analysis. However, clear theoretical guidance on how to do this systematically is still missing. Hence, further theoretical research is required at the interfaces of both frameworks. For instance, which SES second-tier variables are related to the particular working parts of the action situation and how are these relations characterised?

6. Conclusion

Mawlyngbna in Meghalaya, India, constitutes a case of remarkably strong traditional institutions in the setting of a state in which communities enjoy major autonomy for their natural resource governance. This study adopted the SES framework (Ostrom 2009) to explain the ecological outcomes and social equity patterns of forest governance in Mawlyngbna. Several lessons may be drawn from this analysis.

First, the study confirms the diagnostic power of Ostrom's design principles (1990, 2010) to explain the ecological status in community reserve forests and private forests in Mawlyngbna (Section 4.2). However, the design principles were less informative in explaining the observed patterns of social equity. To be precise, the design principles should be seen as theoretical propositions to explain the robustness of forest governance. However, Section 5.1 identified several blind spots of the design principles in the explanation of social equity in resource governance.

Second, the SES framework provided the research team with a powerful heuristic tool to gain a detailed understanding of forest governance in Mawlyngbna. At the same time, the framework provides a language that makes findings comparable to studies in other contexts. We seek to advance the analytical usefulness of the SES framework by combining it with the IAD-concepts of action situations and its behavioural rational choice approach to explain ecological outcomes and social equity of community forestry in Mawlyngbna.

As a final note, it was challenging to conceptualise interactions across governance levels with the SES framework. Hence, for purposes of analysing interactions across governance levels in polycentric systems we suggest a conceptual modification. This could be done by distinguishing the "interaction" category into "same-level interactions" and "cross-level interactions" (Section 5.3).

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Appendix

Table A1

General Rules

1. The Executive Committee of the MawsynramSyiemship grants access to use the land of Mawlyngbna.
2. Burning is prohibited on the land of Mawlyngbna.

Community Reserve Forest

1. Only residents of Mawlyngbna are allowed to use the CRF.
2. The following products are allowed to be extracted from the CRF without special permission: firewood, plant parts (including medicinal plants) but not the whole plant, and bay leaf tree seedlings (Cinnamomumtamala).
3. Firewood can only be collected for self use and to sell it in the Mawlyngbna market.
4. Collecting wild flowers is prohibited in the CRF.
5. Hunting of any kind of animal is prohibited in the CRF.
6. Stone mining is prohibited in the CRF.
7. Cattle grazing is permitted in the CRF.
8. Living trees of the CRF can only be cut for personal construction purposes and only after the approval of a written application by the Village Headman.
9. A service charge of Indian Rupees (INR) 50 applies per application to cut living trees of the CRF.

10. Cutting live trees can be only granted to married villagers and to families which have to arrange a funeral.
11. For the construction of wooden houses, an unlimited number of trees can be granted to be cut per person per year.
12. For the construction of cement houses a maximum number of 50 living trees can be granted to be cut per person per year.
13. In case of an emergency, the Village Council can decide to cut and sell live trees from the CRF in order to receive extra funds.
14. Only residents of Mawlyngbna are allowed to carry out the works such as tree cutting in the CRF.
15. CRF resources can only be sold at the market in Mawlyngbna.
16. In case of a fire threatening the CRF, each resident is obliged to help fight the fire.

Private forests

1. Non-CRF land within the area dedicated to the Mawlyngbna residents can be claimed as private forest (PF).
2. If a piece of PF is not cultivated (i.e., no crops such as bay leaf trees or betel nut trees are growing on it) for at least three consecutive years it is open to be claimed by another Mawlyngbna villager.
3. The right of use of a PF patch can only be transferred amongst Mawlyngbna residents.
4. Except for burning, any form of use by the user is permitted in the PF.
5. The Village Council can levy a tax on sold cash crops extracted from PFs.
6. PF users can be expropriated of a certain PF patch if the Village Headman approves the application of another villager for constructing a house there.
7. Cash crop trees have to be compensated (INR 50 per tree).
8. The Village Council can decide to expropriate PF patches for development projects.
9. The Village Council can decide to expropriate PF patches and convert them into CRF.
10. The former user of converted PF is only allowed to harvest remaining crops (e.g., bay leaves or areca nuts) as long as the crop plants live but may not undertake any maintenance.
11. Any villager is allowed to quarry stone in any PF no matter if the villager is the “owner” or not.
12. The elimination of vegetation in PF for stone quarrying is permitted except for the crop trees and only after consultation with the “owner”.