Stockholm Environment Institute

Causal pathways in the political economy of adaptation projects

Experience from mapping the solar electricity system in Turkana, Kenya

SEI working paper
July 2020

Jake Lomax[a]

Vane Aminga[b]

Matthew Osborne

[a] Independent Consultant

[b] Stockholm International Peace Research Institute

Stockholm Environment Institute
Linnégatan 87D 115 23 Stockholm, Sweden
Tel: +46 8 30 80 44 www.sei.org

Author contact: Matthew Osborne
matthew.osborne@sei.org
Editor: Tom Gill / Molly Killeen
Layout: Richard Clay
Cover photo: The Eliye mini-grid, Turkana © Vane Aminga

Stockholm Environment Institute is an international non-profit research and policy organization that tackles environment and development challenges.
We connect science and decision-making to develop solutions for a sustainable future for all.
Our approach is highly collaborative: stakeholder involvement is at the heart of our efforts to build capacity, strengthen institutions, and equip partners for the long term.
Our work spans climate, water, air, and land-use issues, and integrates evidence and perspectives on governance, the economy, gender and human health.
Across our eight centres in Europe, Asia, Africa and the Americas, we engage with policy processes, development action and business practice throughout the world.

Acknowldgement
With thanks for the support and hard work by local field assistants Galgallo Guyo Golompo, Adengo Lorumu Warren and Emase Longor Joseph.
This project is funded by FORMAS grant number 2017-0194

Contents

Key points

- **Sovacool et al.'s (2015) "4E" typology of *enclosure, exclusion, encroachment* and *entrenchment* describes the system dynamics by which winners and losers are produced by adaptation projects.**
- **This paper argues that understandings of system dynamics may be improved if analysed in context of the underlying system structure. And hence that the 4E typology may be usefully set in the context of a detailed map of the system structure in which the adaptation project is being implemented.**
- **Mechanisms of social change (MOSC) (Lomax 2018) is a practitioner-oriented language for mapping systems in terms of their composite actions, actors and resources. MOSC is used here to map the structure of the solar electricity system in Turkana, Kenya.**
- **Mapping this system as a stylized set of actions suggests that we may usefully distinguish between four types of *entrenchment* based on the four distinct actions in the underlying system that may contribute to entrenchment.**
- **Setting out the *sequence* of actions in the solar electricity system shows the range of possible pathways from the adaptation project through to impact on communities. This illustrates the interconnections between the 4Es, demonstrating how "earlier" 4E processes in the sequence influence how "later" 4E processes impact on community members.**

1. Introduction

In response to climate change, significant volumes of aid have been either allocated, re-allocated, or redefined to support developing countries' adaptation efforts (Donner et al. 2016). Just as aid has long created winners and losers (Gibson et al. 2005), the same is true of development aid projects to support climate change adaptation projects. As such it is important to understand the political economy of such projects (see e.g. Sovacool and Linnér 2016, Chu 2016, Chu et al. 2016).

An influential typology for analysing the political economy of adaptation projects was proposed by Sovacool et al. (2015). This sets out four types of change process: enclosure, exclusion, encroachment and entrenchment (4Es hereafter), by which certain groups or actors may benefit from adaptation systems at the expense of others. These all describe processes by which the system changes, and how relative benefits accrued change as a result. The 4E typology is one of the analytical frameworks used by the Conflict Prevention and Low-Carbon Development research project led by SEI.

The argument of this paper is that the analysis of system dynamics is usefully situated in an analysis of the system structure. And hence we should improve our understanding of how frameworks for analysis of systems dynamics, such as the 4Es, may be combined with tools for analysing system structures, such as system mapping. This paper seeks to illustrate how one approach to system mapping can be combined with the 4E typology of processes. This serves to set the 4E processes in the context in the actions, actors and resources that comprise the existing system, and thus helps to connect the 4E processes to observed empirical reality.

This paper describes experience gained from analysis of the solar electricity system in Turkana, Kenya. The social system was mapped to present the sequential set of actions that comprise the social system, then the 4Es were analysed in the context of this system map. An example is provided of how this mapping informs construction of causal pathways from adaptation projects through to impact. The implications for operationalizing the 4Es are discussed alongside possible insights into the nature of the 4E framing.

2. Framing processes of change

We may distinguish between two aspects of systems (Lomax 2020). First is a "snapshot" of the system state at a given point in time which shows how the system operates and performs, what actions, resources and actors are involved and how they are interconnected. For this paper, this will be referred to as the system structure. This is the aspect prioritized in system representations such as value stream mapping (see Hines and Rich 1997), value chains (Porter 1985), and market systems diagrams (Springfield 2015).

The second aspect is system dynamics, which refers to a causal logic of how the system changes from one state to another. This is represented in theories of change (Weiss 1995), logframes (USAID 1970) and systems dynamics (Forrester 1961). Both aspects of systems are about understanding mechanisms of change. The structure of systems shows the processes by which resource states are changed by actions, while system dynamics are about behaviour change: how actions themselves are changed.

The 4E processes refer to dynamic elements of adaptive systems: they describe characteristics of how the system changes over time, rather than only describing how it operates at a given point in time. This is reflected in words such as "worsening", "marginalizing", "expanding", and "aggravating" in Sovacool et al.'s definitions, which are set out in Annex 1. Descriptions of each of the 4Es are set out below, based on the authors' interpretation of definitions provided in Sovacool et al. (2015).

- "Enclosure" refers to the process of resource acquisition. Enclosure implies either existing actors acquiring new resources, or new types of actors acquiring new or existing resources, which particularly refers to the expansion of the role of private actors.

- "Exclusion" refers to formal or informal consultation processes that run alongside adaptation projects. Exclusion implies that information from or about certain groups is not considered in decision making, whether this be through deliberate or incidental failure to provide those groups or their advocates with the opportunity to express their views, or deliberate or incidental failure to seriously consider those views that are provided.

- "Encroachment" refers to destruction of natural resources that occurs as a result of the adaptation project. This includes those natural resources that form a basis for livelihoods of marginalized groups.

- "Entrenchment" refers to worsening of existing resource inequalities between groups that occurs as a result of the adaptation project. This includes political, socio-economic, cultural or gender inequality, and other "intensified inequities", such as damage to disadvantaged community members.

The argument presented in this paper is that system dynamics, including political economy system dynamics such as the 4Es, may better be understood in the light of the underlying system structure. The structure of a system may be thought of in terms of a stylized sequence of actions, and this sequence has causal implications, for changes to earlier actions will have knock-on effects on later actions. The complex, interconnected nature of causal pathways of adaptation projects may thus be explored in more detail if we build our understanding of system dynamics on the structure of the underlying system.

The next section describes a mechanism-based conceptual language for describing both structure and dynamic elements of systems. Building on this language, the 4E system dynamics processes are set within the structure of a stylized system, using an example from the solar electricity system in Turkana County, Kenya.

3. Integration with a typology of action

The Mechanisms of Social Change (MOSC) (Lomax 2018) was developed to support better understand of systems and systemic change amongst practitioners of the "market systems" approach to international development (Springfield 2015, Humphrey 2014). MOSC is a conceptual language for describing systems and system change built around a novel typology of action.

MOSC describes three broad types of action: destruction, exchange and production. These actions are performed by actors, and the subject of actions are resources, conceived broadly to encompass human, social, financial, physical, informational, or natural resources.[1] Production and destruction represent *transformation* of resources from one form to another without a change of ownership, while exchange represents a *transfer* of resources from one actor to another, whether consensually or through appropriation, without a change in its form. Production and destruction may be performed on an actor's own resources, or on the resource of others (see Lomax 2018 for more detail).

This typology permits description of diverse aspects of systems in a conceptually coherent manner. "Positive" actions may be seen alongside "negative" actions, and more complex or "higher level" social concepts disaggregated into their constituent actions. It also allows for the incorporation of a simple representation of nature as a non-sentient actor in the system, which serves two purposes. First, it provides a location for representing natural resources that do not formally belong to any other actor, and that may be subjected to appropriation or destruction by other actors in the system. Second, it allows us to represent the productive and destructive actions by which nature affects the resources of others – for example providing rainfall and sunshine that helps crops grow or destroying homes and infrastructure through natural disasters.

The conception of systems in MOSC is complementary to Sovacool et al.'s typology because of the latter's similar focus on actions and actors, as seen in the 4E descriptions set out above. The table below sets out the connections by translating the 4Es into their composite resources, actors and actions. An important clarification required here is the stylized labelling of the actor types that are implied in the 4E typology. Four actor types are needed.

- Sovacool et al. built the 4E typology around a hypothetical adaptation project, which will necessarily involve an actor to deliver on the project. In line with the case used for mapping here, these will be referred to as *Electricity Producers*. The system parameters are shaped around the important actions of the electricity producers.

- The delivery actor needs to acquire permissions and resources for enclosure, and for the purpose of the mapping the actor providing those permissions and resources will be referred to as *Licensing Authorities*.

- For encroachment we need *Nature* as an actor.

- We need to describe the set of actors that are the subject of concerns about marginalization through the project.[2] Sovacool et al. refer to "stakeholders", "vulnerable members of a community", and "disadvantaged groups". These actors are labelled here as *Community Members*, which importantly includes both potential winners and potential losers from the adaptation project because the actions of both are important.

Having set out the actor types, we may describe the 4E processes in terms of the resources that are the subject of each process, and the actions and actors involved in each process.

1 This is broadly in line with the five asset types of the Sustainable Livelihoods Approach (Bebbington 1999; Leach et al. 1999)
2 It should be noted that actors are defined around the actions they perform. If small scale electricity producers are also part of community groups who use natural resources affected by electricity production, or if they are consumers of electricity as well as producers, then they may be part of both actor sets.

Table 1: 4E processes in terms of resources, and actions and actors

	Resources involved	Actions and actors
Enclosure	The resources allocated as part of the project, be those financial to setting it up, or permissions to act in a certain role and derive corresponding benefits	**Exchange**, especially of information or financial resources, that permits benefit to be derived through delivery of the adaptation. Exchange is between licensing authorities and electricity producers.
Exclusion	Information resources (particularly in the form of representation of interests)	**Exchange** of information through consultation between licensing authorities, electricity producers, and community members. The interests of nature may also be considered.
Encroachment	Natural resources	**Destruction** of natural resources by the electricity producer.
Entrenchment	Any resources that may be influenced directly or indirectly by the adaptation project.	**Exchanges** that supply inputs to the electricity producers, or access outputs from electricity producers. This includes accessing natural resources affected by the adaptation project. It also includes the production of the design of the project that affects what, where, when, how and with whom these exchanges occur.

The Kalobeyei mini-grid battery and control room © DAN ODOYO

4. Lessons from mapping the solar electricity system in Turkana: the 4Es in order

The grid below represents a simplified stylized actions and actors system map (Lomax 2020a) of the Turkana solar electricity system.[3] There are eight basic actions involved, which may be put into an intuitive sequence related to the order of constructing and operating the solar facilities. And there are four sets of actors. First is electricity producers, whose actions are obviously central to the system. The Community Members set includes users or potential users of electricity and users of natural resources that may be impacted by electricity production, as well as providers of inputs needed for electricity production. Licensing Authorities refers to those actors who have the authority to allocate formal or informal licenses to construct and operate electricity production facilities.[4]

Figure 1. Mapping the system structure

MAPPING THE SYSTEM STRUCTURE						SYSTEM DYNAMICS
	Actor sets: / Actions	Nature	Community Members	Electricity Producers	Licensing Authorities	Corresponding 4E processes
8	Use natural resources	↔	↔			Entrenchment D
7	Sell electricity		↔	↔		Entrenchment C
6	Generate electricity	✕		↑		Encroachment
5	Construct and maintain facility	✕		↑		Encroachment
4	Access inputs		↔	↔		Entrenchment B
3	Design and locate			↑		Entrenchment A
2	Acquire license			↔	↔	Enclosure
1	Consultation	↔	↔	↔	↔	Exclusion

Diagram notes:
1. The horizonal gold arrows represent exchanges, where resources are transferred between actors.
2. The upwards grey arrows show productive transformation of resources.
3. The grey cross shows destruction of resources by another actor. Here, this is destruction of natural resources through the production action on the same row of the grid.
4. The sequence of actions runs from the bottom to the top of the grid.

3 Amendments have been made to aggregate some of the actors and actions to simplify the representation and make it more straightforwardly translated to the 4E processes. Annex 2 presents the same map with the explicit inclusion of actors' decisions and resource states that intercede each action.

4 License to operate also includes allocation of finance, subsidies or other resources to permit development.

The column on the right-hand side of the grid represents the 4E process that corresponds to each action. These processes express system dynamics, so for the process to occur, this would require a behaviour change in the corresponding actions. The actions observed in Turkana solar electricity system are now described in turn according to their corresponding 4E processes.

Exclusion actions

1. Consultation

The first action in the sequence is some form of consultation process, which may involve community members, electricity producers, and license providers, and often also considers the environmental impact. This is set out at the start of the process, as was the case in Turkana, where we learned that some form of consultation would happen early on through various actors reviewing possible sites for mini-grids. At this stage government and development actors (that are often also license providers) survey possible sites for mini-grids; a process that involves some consultation. At a later stage, energy committees are set up in selected communities that include representatives from various groups that comprise that community. These committees continue to play a role for two-way communication between the electricity producer and community members as the facility is constructed, and also when it is operational.

Enclosure actions

2. Acquire license

Enclosure happens at the level of energy producers through the action of acquiring a license to construct and to operate electricity generation facilities. This gives the producer the right to generate and sell electricity to a community that is then effectively locked-in to the deal.

There are various mini-grid operating models in Turkana, including private companies owning and operating, state entities owning and operating, and hybrid models. In all cases development actors are heavily involved, with associated financing to subsidize the upfront cost of constructing the facilities. The question of who is given license to construct and operate also involves this allocation of subsidy.

Encroachment actions

5. Construct and maintain facility, 6. Generate electricity

Construction of mini-grids has environmental consequences for the land on which it is built. The extent of damage is not clear from our empirical work so far. While construction of any energy facility without some damage to the immediate environment is unlikely, the environmental impact of larger facilities and the associated larger scale distribution infrastructure is much greater. The mini-grids are also hybrid facilities, with diesel power available alongside the solar. As such there is the issue of potential encroachment through pollution associated with the generation of electricity at times that it is not running on solar power.

Entrenchment actions

3. Design and locate facility, 4. Access inputs, 7. Sell electricity, 8. Use natural resources

As with encroachment, the system mapping draws out multiple actions that correspond to entrenchment. Here though, it is instructive to draw out various categories of entrenchment that correspond to these actions, and that it seems likely would also be found in other adaptation projects.[5] These four types of entrenchment are set out below.

5 It may be interesting to do the same for encroachment, where the analytical focus is more clearly on environmental consequences, and if there are clear distinctions between the type and consequence of destruction from construction versus destruction from generation (or such actions as have environmental consequences in a different system).

- ***Design entrenchment*** occurs in the design and location of adaptation projects, which embeds at an early stage who then wins or loses from the subsequent entrenchment processes.

- ***Input entrenchment*** is reflected in which community members provide inputs to the project. Provision of inputs might be beneficial, for example in the form of employment or contracted service provision (such as a contract to provide fuel to the facility). Or provision of inputs might have negative impacts for the provider, for example if community members are, against their will, subjected to compulsory land purchase orders to provide the site for the facility.

- ***Output entrenchment*** is reflected in which community members are able to access the output of the project. For example, there may be limits to infrastructure for electricity distribution that exclude those living on the edge of a village. Nomadic populations may not own a building that can be connected. Those who lack resources may not be able to afford connection or may not be able to pay for electricity.

- ***Environmental entrenchment*** is reflected in disparity in community members' access to natural resources. Specifically, it is how this access is changed by either (1) differential impact of encroachment on natural resources, and/or (2) changed capacity to exploit natural resources as a result of entrenchment B or C.

4.1 Implications for understanding causal pathways using the 4Es

To build an understanding of how adaptation projects come to impact on community members we need to consider the system-embedded causal structure, or causal pathways, which may be revealed by system mapping. Because if we know the sequence of actions in the system, it is easier to determine how change in one of those actions will cause change in other actions.

But first it is necessary to set out what the impact-level mechanisms are in the context. By impact-level mechanisms we mean those actions in the system which directly involve the actors of concern. Because these actions directly involve these actors, they may directly result in gain or loss of resources for those actors.[6] Looking back at the example above (Figure 1) of actions and actors system mapping, there are four actions that community members are involved in, and hence form potential impact-level mechanisms.

- Consultation [**Exclusion** in 4E typology]

- Supply/access inputs [**Input Entrenchment** in 4E typology]

- Supply/access electricity [**Output Entrenchment** in 4E typology]

- Access natural resources [**Environment Entrenchment** in 4E typology]

The impact for community members is experienced through a change in their resource state that follows a change in these actions. For example, if a new consultation process is launched, then those community members consulted might experience a gain in self-esteem resulting from their having been given the opportunity to express their views, while those community members who are not consulted might experience a corresponding loss as they reframe their social position, and perhaps anticipate further material losses as a result of not having been consulted.

Causal pathways, then, represent a set of interrelated behaviour changes which follows one sequence of boxes and arrows through this structure to impact. We have discussed the *end points* of causal pathways being an impact on community members. The *start points* are in

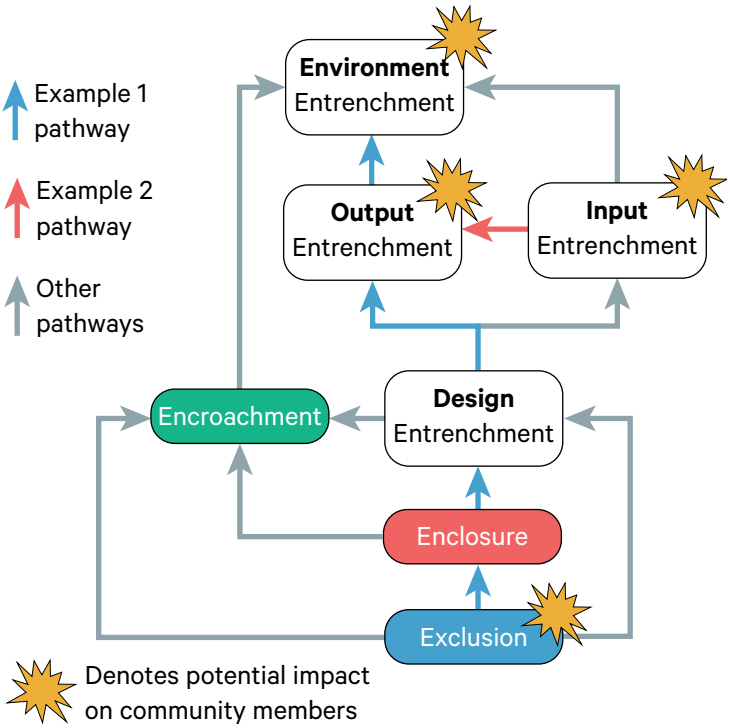
6 See Annex 2 for detailed system mapping showing resource states in relation to actions.

a behaviour change on the part of the adaptation project or other actor in a position of power related to the project. Just as impact-level mechanisms may lie in any action involving the community members, the start of causal pathways may be in any action involving electricity producers or the licensing authorities. This is the case for all of the actions, except for accessing natural resources.

Mapping the system in the way described above helps to reveal this "system-embedded" causal structure in the form of causal pathways. Setting these pathways out explicitly can help us understand how change in one of the 4Es may have knock-on effects for the others, which is illustrated in the arrows in Figure 2. The boxes represent the 4E processes, including the four proposed entrenchment sub-categories. As described above, these represent system dynamics as manifest in behaviour changes in the system actions.[7]

We now describe two hypothetical examples, the pathways for which are also represented in the figure. Their hypothetical nature should be emphasized – the pathways specified do not draw on empirical findings; they only leverage the system-embedded causal structure identified from the case.[8]

Figure 2: System embedded causal structure, which reflects the possible causal pathways through to impact on community members



Example 1: Longer causal pathway

Exclusion -> Enclosure -> Design Entrenchment -> Output Entrenchment -> Environment Entrenchment

Exclusion: Licensing authorities and electricity providers do not consult all communities or community representatives when deciding on the locations of the next tranche of solar hybrid mini-grids. As such they remain unaware of important social inequalities in the communities being considered for electricity access.

Enclosure: As a result, the licensing authorities select sites for which they will grant licenses on a purely technical basis, based on potential revenue to the operator in those locations given the costs, customer base, solar potential, and other such factors. They do not consider the over-representation of marginalized community members in unselected sites. Because these community members are poorer, there are fewer high-demand customers in their villages, and so provision of electricity is a less attractive commercial prospect. The licenses fix electricity prices at what are seen to be reasonable levels, but grant electricity providers the freedom to decide on the extent of their electricity provision within villages and to charge a connection fee per household.

Design entrenchment: The new solar grids are then located in relatively wealthy villages. Also, they are designed to serve those who live in the centre of those villages, as this is where the majority of wealthier community members live and where relatively high-demand businesses are located, while there is a significant cost of running distribution connections to the periphery of

7 This is rooted in a conception of system dynamics that suggests behaviour change follows the actor accessing "change resources", this being a necessary but not sufficient condition (Lomax and Shah 2020).

8 Hypothetical examples are used because, as a result of disruption caused by COVID-19, the data collection had not yet progressed to the stage where it was possible to state with confidence what causal pathways are present.

the village where more marginalized community members live, and there is significant doubt over their ability to pay the connection fee. Transient pastoralist populations may also be excluded at this stage if they do not own relevant fixed property to facilitate connection.

Output entrenchment: In consequence, marginalized villages do not receive electricity connections, and marginalized community members within richer villages also do not receive electricity. These community members are forced to remain reliant on occasional, very expensive electricity supply from *jua kali* (informal) generator operators. Meanwhile, community members with electricity access reduce their costs of access while also gaining various lifestyle and productivity benefits, such as longer business operating hours.

Environment entrenchment: Access to electricity supply permits wealthier community members to power water pumps, which permits them to access more water. This enables them to increase productivity of livestock farming and horticulture. Meanwhile, those without electricity access also find the lowered groundwater levels affect access to water through wells, which reduces their productivity.

Example 2: Short causal pathway

Input entrenchment -> output entrenchment

Input entrenchment: The electricity producer selects workers for the site based on personal recommendation from the village elites, rather than transparent merit-based criteria. This causes resentment amongst those who were unable to access work, as well as having a corresponding financial impact.

Output entrenchment: As a result, the maintenance of the facility is conducted relatively poorly and electricity access suffers as a result. When effort is made to repair and maintain connections, it is based on personal and relationship factors rather than being a universal service. Overall performance of the facility suffers, with regular electricity blackouts for many users.

These hypothetical examples serve to illustrate some of the ways in which the 4Es may be causally interconnected. These pathways may be long or short, and may intersect: in any one adaptation project there may be multiple “start” points, and multiple “end” points, as well as multiple pathways between each. Because of this complexity, using system mapping to set out the range of possible pathways may support improved understanding of exactly how the political economy of adaptation projects comes to impact on community members.

In setting out the causal pathways of the system, we have moved from the mapping of the system structure towards examining how that structure affects the operation of system dynamics. But the utility of mapping goes beyond this purpose. Repeated over time, system mapping provides a format to analyse changes in the system structure, such as relative access to resources between groups, whether this is due to the adaptation project itself or other factors. Lomax (2020) provides more information about how to conduct such an analysis of system change over time.

5. Discussion

Socio-ecological systems are complex and adaptive, characterized by continuous and endogenous change (Levin et al. 2013), and may usefully be conceptualized to reflect this (Hertz et al. 2020). Nevertheless, we may conceive of a directional causality embedded in the structures of the system. Because there is a sequence to the actions that defines the system, change to those earlier actions inevitably affect actions that occur later in the process. That is not the end of the causal story, rather it is only the beginning. For instance, there will be feedback loops by which later changes come to affect earlier actions. But hopefully it remains of some use in understanding complex interrelated changes in the system to break down this first stage of causal pathways, even if more work is required to set out second and subsequent stages.

This stylized sequence of actions was set out in the Actors and Actions system map (Figure 1). The robustness of the causal pathways described in it is clearly dependent on the robustness of that sequence. Some of the choices about sequencing were more subjective than others. While we may reasonably intuit that changes in the production and sale of electricity follows construction of the new electricity generation facility, consolidating all consultation into one action preceding all others was a more subjective choice. Had we wanted to understand how changes to the solar electricity generation system affected local consultation processes, we might have had a second consultation action that followed all the others, and there would be corresponding changes in the pathways. But the choice was also based on empirical evidence gathered in our work in Turkana so far – there are new consultation processes and corresponding community-level institutions set up certainly prior to construction, and some forms of consultation conducted prior to licensing and site selection.

As this example shows, we have discussed the causal pathways within the 4Es on the basis of the context we have observed in Turkana. Whether these same pathways exist within the 4Es in other contexts is an interesting consideration and perhaps merits conducting Actions and Actors systems mapping for other adaptation projects. Relatedly, the pathways set out in this paper also depend on the authors' interpretation of the definitions of the 4Es with respect to the context to which they were applied. There remains scope for alternative interpretations, especially in other adaptation project contexts. One possibility is that *enclosure* could include the action of private seizing of ownership of commonly owned or unowned natural resources (which in the context and definition we have used would fit better under *input entrenchment*). If access is then denied to community members, there could be an arrow directly from *enclosure* to *environment entrenchment*, without the need for destruction of those resources in the form of *encroachment*.

It is hoped that this is not only of use to those researching adaptation projects, but also to those charged with their design and implementation. This relevance may apply whether or not the project follows a systemic approach, for which action and actor system mapping was originally conceived. Whether or not an intervention is following a systemic approach, it is nevertheless having systemic impacts that should be understood. While most programmes undertake some form of political economy analysis to support this understanding, this can be quite focused on macro political structures removed from the practical realities of development programming, which may undermine the ability of political economy analysis to be truly embedded in programme approach and strategy (Hudson and Marquette 2015). Similar problems exist at a higher level, for donors in effective integration of concepts of conflict and climate change into the design of development programmes on the ground (Brodén Gyberg and Mobjörk 2020). The approach used in this paper to represent and analyse the political economy of adaptation projects in terms of actions and actors may support interpretation of their strategic relevance for those implementing projects, as well as their donors.

References

Bebbington, A. (1999). Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty. *World Development,* 27. 2021-2044. DOI: 10.1016/S0305-750X(99)00104-7

Brodén Gyberg, V., and Mobjörk, M. (2020). Framing and Responding to Climate-related Security Risks in Swedish Development Cooperation. *SIPRI Insights on Peace and Security*. No. 2020/1. January 2020

Chu, E. (2016). The political economy of urban climate adaptation and development planning in Surat, India. *Environment and Planning C: Government and Policy,* 34(2). 281-298. DOI: 10.1177/0263774X15614174

Chu, E., Anguelovski, I., and Carmin, J. (2016). Inclusive approaches to urban climate adaptation planning and implementation in the Global South. *Climate Policy*, 16(3). 372-392 DOI: 10.1080/14693062.2015.1019822.

Donner, S. D., Kandlikar, M., and Webber, S. (2016). Measuring and tracking the flow of climate change adaptation aid to the developing world. *Environmental Research Letters,* 11(5). 054006. DOI: 10.1088/1748-9326/11/5/054006

Forrester, J. 1961. *Industrial Dynamics*. Waltham, MA. Pegasus Communications.

Gibson, C. C., Andersson, K., Ostrom, E., and Shivakumar, S. (2005). *The Samaritan's Dilemma: The Political Economy of Development Aid*. Oxford University Press on Demand, Oxford, UK.

Hertz, T., Mancilla Garcia, M., and Schlüter, M. (2020). From nouns to verbs: how process ontologies enhance our understanding of social-ecological systems (SES) understood as complex adaptive systems. *People and Nature,* 2(2). DOI: 10.1002/pan3.10079

Hines, P., and Rich, N. (1997). The seven value stream mapping tools. *International Journal of Operations and Production Management,* 17(1). DOI: 10.1108/01443579710157989

Hudson, D., and Marquette, H. (2015). Mind the gaps: what's missing in political economy analysis and why it matters. *A Governance Practitioner's Notebook*. OECD, Paris.

Humphrey J. (2014). *Market systems approaches: a literature review*. BEAM Exchange. https://beamexchange.org/resources/182/

Leach, M., Mearns, R. Scoones, I. (1999). Environmental entitlements: dynamics and institutions in community-based natural resource management. *World Development*, 27. DOI: 10.1016/S0305-750X(98)00141-7.

Levin, S., Xepapadeas, T., Crépin, A. S., Norberg, J., De Zeeuw, A., Folke, C., ... and Ehrlich, P. (2013). Social-ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, 18(2). 111-132. DOI: 10.1017/S1355770X12000460

Lomax J. (2020a). Actions and Actors Systems Mapping. Work in progress.

Lomax, J. (2020b). *The Antidote to Systemic Change Frameworks: Six Practical Steps to Assess Systemic Change (and improve your strategy)*. Briefing Paper 3. 3sd Research. DOI: 10.13140/RG.2.2.34623.05283/1

Lomax, J. (2018). *Mechanisms of Social Change: Outline of a Conceptual Framework*. Briefing Paper 1. 3sd Research. DOI: 10.13140/RG.2.2.22279.85920/1

Lomax, J., and Shah, R. (2020). *Building Blocks of Programme Theory: How to Get Better at Driving Behaviour Change*. Briefing Paper 5. 3sd Research. DOI: 10.13140/RG.2.2.11379.48166

Porter, M. E., and Advantage, C. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press. New York.

Sovacool, B. K., and Linnér, B. O. (2016). Introduction to the Political Economy of Climate Change Adaptation. In: The Political Economy of Climate Change Adaptation. Palgrave Macmillan, London. DOI: 10.1057/9781137496737_1

Sovacool, B. K., Linnér, B. O., and Goodsite, M. E. (2015). The political economy of climate adaptation. *Nature Climate Change*, 5(7). 616. DOI: 10.1038/nclimate2665

The Springfield Centre for Business in Development (2015). *The Operational Guide for the Making Markets Work for the Poor (M4P) Approach*. 2nd Edition, DFID/SDC. https://www.enterprise-development.org/wp-content/uploads/m4pguide2015.pdf

Weiss, C. (1995). Nothing as practical as good theory: exploring theory-based evaluation for comprehensive community initiatives for children and families. In *New Approaches to Evaluating Community Initiatives*. Connell, J., Kubisch, A., Schorr, L., and Weiss, C. (eds). Washington, DC: Aspen Institute.

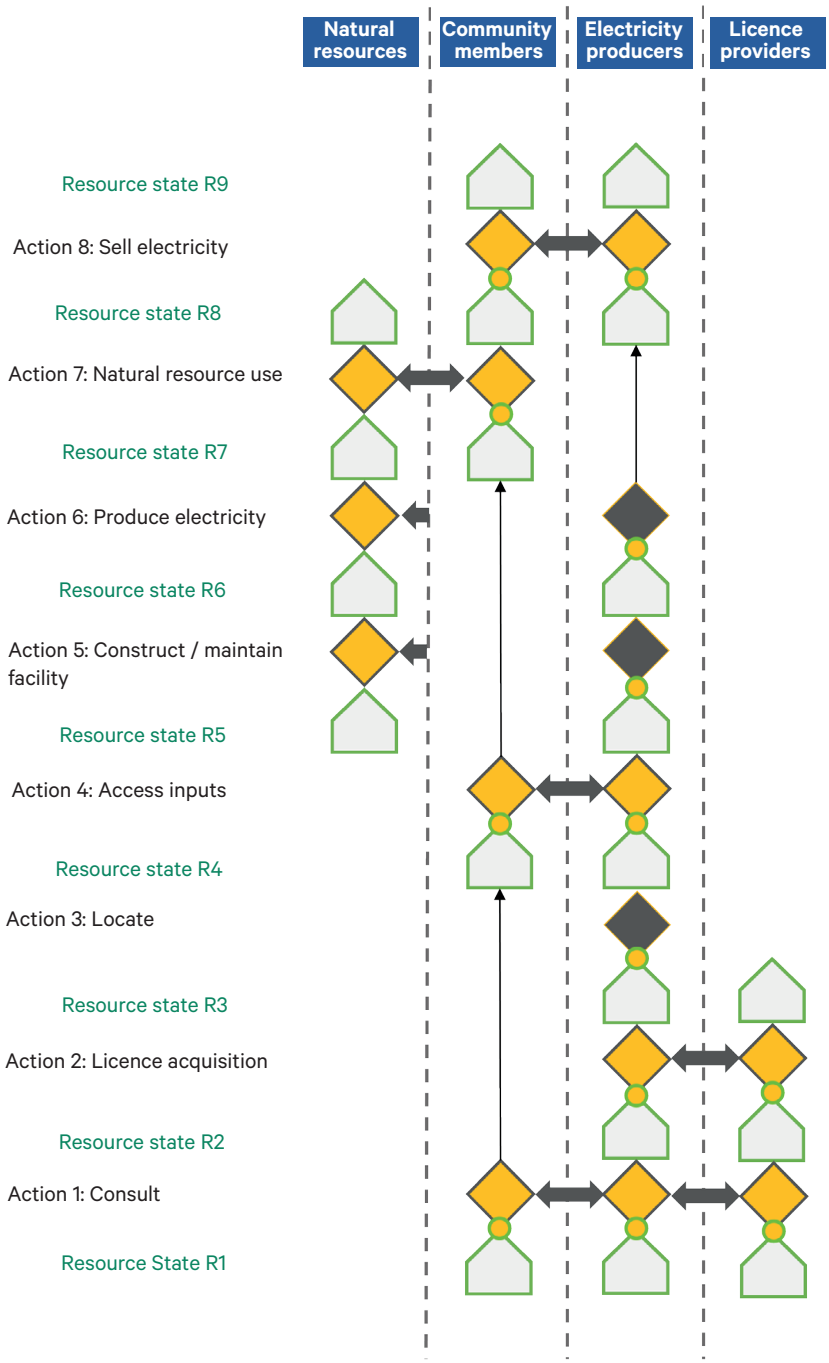
Annex 1

This annex presents the precise definitions of the 4Es from Sovacool et al. (2015, pp.616-617, emphases added).

> "With '**enclosure**', we refer to the process that transfers a public asset into private hands, or extends the role of a private actor into the public sphere. It relates to how private institutions, especially corporations, try to expand into new and potentially profitable activities as a result of an adaptation project. The projects become enclosed as part of the strategy of wealth accumulation that only serves to widen the economic gap between rich and poor, and to convert untapped assets into productive ventures. Enclosure can also refer to adaptation projects that create their own bureaucracy — a new administrative structure that enables them to act with increased autonomy or sovereignty.
>
> "Enclosure seems to go hand in hand with the process of '**exclusion**' by which adaptation projects limit access to resources or marginalize a particular group of stakeholders in the decision-making process. Exclusion amounts to a strategy of containment, a way to prevent other parties from interfering with one's interests so that actor can dominate others with their agenda.
>
> "'**Encroachment**' occurs when adaptation interventions intrude or infringe upon protected areas, national parks, and wildlife reserves, or interfere with the healthy functioning of an ecosystem. As adaptation is primarily concerned with building human resilience, it can involuntarily undermine the conservation of biodiversity and even contribute to environmental degradation — such as seawalls, canals, or bridges destroying wetlands, negatively impacting water quality, or involving the emission of greenhouse gases through their construction.
>
> "Finally, '**entrenchment**' is the process by which adaptation projects aggravate political, socio-economic, or cultural inequalities and the disempowerment of disadvantaged groups. It intensifies inequities by favouring concentration of wealth within a community, or by hurting vulnerable members of a community, such as artisanal fishers, indigenous groups, or ethnic minorities. In extreme cases, adaptation projects can even lead to violence and death."

Annex 2

The figure below sets out a more detailed version of the MOSC system map for the solar electricity system in Turkana, Kenya. While the abbreviated grid in the document shows only actions and actor sets, this version shows the resource states and decisions that intercede the actions. It is in these resource states that changes in welfare, equity, and so on are manifest, along with the impact of environmental destruction, electricity producer profitability, and so on. Decisions are particularly important in understanding behaviour change.



Visit us

SEI Headquarters
Linnégatan 87D Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org

Måns Nilsson
Executive Director

SEI Africa
World Agroforestry Centre
United Nations Avenue
Gigiri P.O. Box 30677
Nairobi 00100 Kenya
Tel: +254 20 722 4886
info-Africa@sei.org

Philip Osano
Centre Director

SEI Asia
10th Floor, Kasem Uttayanin Building,
254 Chulalongkorn University,
Henri Dunant Road, Pathumwan, Bangkok,
10330 Thailand
Tel: +66 2 251 4415
info-Asia@sei.org

Niall O'Connor
Centre Director

SEI Tallinn
Arsenal Centre
Erika 14, 10416
Tallinn, Estonia
Tel: +372 6276 100
info-Tallinn@sei.org

Lauri Tammiste
Centre Director

SEI Oxford
Oxford Eco Centre, Roger House,
Osney Mead, Oxford,
OX2 0ES, UK
Tel: +44 1865 42 6316
info-Oxford@sei.org

Ruth Butterfield
Centre Director

SEI US Main Office
11 Curtis Avenue
Somerville MA 02144-1224 USA
Tel: +1 617 627 3786
info-US@sei.org

Michael Lazarus
Centre Director

SEI US Davis Office
400 F Street
Davis CA 95616 USA
Tel: +1 530 753 3035

SEI US Seattle Office
1402 Third Avenue Suite 900
Seattle WA 98101 USA
Tel: +1 206 547 4000

SEI York
University of York
Heslington York
YO10 5DD UK
Tel: +44 1904 32 2897
info-York@sei.org

Sarah West
Centre Director

SEI Latin America
Calle 71 # 11–10
Oficina 801
Bogota Colombia
Tel: +57 1 6355319
info-LatinAmerica@sei.org

David Purkey
Centre Director

SEI Stockholm Environment Institute

sei.org

@SEIresearch @SEIclimate