Combining Group Model Building and Participatory Rural Appraisal in Southeast Rural India

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Interest in group model building has increased as a means to increase stakeholder involvement in the modeling process. However, most reported efforts have focused on involving policy makers and managers in the modeling process. Extending group model building to include marginalized communities, such as people living in poverty and forest dependent communities, raises a number of methodological issues about the nature of participation and modeling. Addressing these issues is critical to advancing the practice of participatory group model building techniques, and more generally, the application of system dynamics to address problems such as energy, environment, and health across diverse communities. This paper takes up the challenge by drawing on field experiences in rural India to develop a methodological approach that combines participatory rural appraisal development methods with group model building to better understand problems such as declining soil fertility and availability of fuelwood.

Group model building (GMB) has emerged as an important and routine practice in system dynamics. Various definitions for what constitutes group model building exist, but all share the common idea that stakeholders can be involved in the system dynamics modeling process and that there are many benefits from such involvement. These benefits include: increasing the relevance of the model and its recommendations to the problems that stakeholders are facing; allowing stakeholders to develop some of the insights that modelers often gain from the process of building the model; developing a better understanding of the system dynamics and assumptions underlying the model; increasing consensus among actors in the system about the

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nature of the problem and how to address it; and increasing the likelihood that model based interventions will be implemented in the actual system (Vennix 1996; Rouwette, Vennix, and Mullekom 2006).

At the same time, there have also been some fundamental criticisms leveled against group model building. First, system dynamics modeling is hard and it is unrealistic to assume that stakeholders with little or no expertise in modeling will be able to truly participate or gain the same types of insights as trained modelers; therefore it is misleading, if not wrong, to promise this to stakeholders. Second, there is the risk of groupthink as stakeholders settle on what they consider a feasible solution, rather than really using the modeling process to redesign the system to achieve more desirable outcomes. Third, Forrester raises the question of whether it's the modelers or stakeholders' time that is saved through GMB. The process may be a more efficient means of collecting data from the stakeholders than individual key informant interviews and direct observation, but it is not a more efficient process for stakeholders.

Since the mid 1990's, there have been efforts to better describe and evaluate the outcomes of GMB. Most recognize that GMB is team based work with clearly defined roles (Richardson and Andersen 1995) that there are common small group activities that practitioners use that Andersen and Richardson have called "scripts" that need to be documented (Andersen and Richardson 1997), and that there is a need to develop and evaluate group model building projects using some standardized measures (Rouwette, Vennix, and Mullekom 2006). However, the vast majority of the reported work focuses on applications of group model building at the level of policy makers, experts, or managers.

Efforts to involve more direct participation including citizens and marginalized communities have been more limited and mostly focused on environmental planning concerns. These efforts, however, have still been constrained by primarily involving advisory groups as opposed to direct participation, have a small group of experts involved in formulation of the model, or limited participation in the earlier stages of developing scoping models (Stave 2002; Beall and Ford 2007; Costanza and Ruth 1998). An inherent tension appears in this literature between the concepts of modeling and participation. Oftentimes this tension is reflected in the tendency to refer to the two activities as separate or to succeed at one activity and have limited success in the other. What all of these efforts share, especially in environmental modeling, is an aspiration to integrate the modeling and participation more thoroughly because it is generally understood that addressing environmental problems requires cooperation. In the most vulnerable and marginalized communities, this becomes particularly important as people often have few if any alternatives for acting differently in the natural resource system they depend on. At stake then is a conceptual question about how to reconcile what appear to be two competing goals—improving the rigor of the modeling and increasing the participation of people with little or no modeling skills.

This paper takes up these issues by addressing the methodological, political, and philosophical issues that arose in fieldwork in Andhra Pradesh, India and the methods that were developed through collaboration with the Foundation for Ecological Security (FES) in India. This collaboration focused on exploring the potential for integrating system dynamics and systems thinking into the organizational practices of FES. The resulting pilot projects sought to combine the Participatory Rural Appraisal (PRA) methods used by FES staff with the system dynamics modeling and group model building techniques of the research team. Briefly, we argue that the pragmatics of developing collaborations that build capacity over time in the partnering organizations and communities allow for a different type of engagement to evolve; and, this creates a new kind of possibility for reconciling the often conflicting goals of participation vs. modeling. Both projects were conducted with in Southeast India with rural villagers. The first pilot project in 2008 focused on understanding declining soil fertility faced by rural farmers in Andhra Pradesh, while the second project in 2009 focused on understanding the declining availability of fuelwood in the rural community Boyapalle. The details of the actual projects that led us to see this possibility are described in a separate paper presented at the conference. [2]

Our paper is structured around three main concepts. The first is recognizing that different phases of participatory modeling involve different modeling activities with different criteria for evaluating the models and the change sought. The second is that participation by stakeholders is not an either/or, but a *process*. The third insight is that for this participation to happen, capacity building needs to be developed in series of steps whereby the capacity built at one step helps participants design the next step.

Problem Framing

Problem framing refers to the idea that how problems are defined has a lot to do with the solutions being sought. This idea is not new and many have discussed the issue of appropriate problem framing as a key to successful modeling projects, appropriate selection of methods, and theoretical paradigms (e.g., Lane 2001; Jackson 2000; Lane 2001). Problem framing is a conceptual activity and determines what kind of problem is being solved and the nature of the solution, and importantly, the criteria used to evaluate how good a solution to the problem is.

One popular approach is based on Burrell and Morgan's (1979) framework for classifying sociological theories of organizations by their underlying paradigms of social science and society. Their framework organizes theories and methods along two different dimensions. On the vertical axis, theories and methods are distinguished by how society is viewed, with status quo or regulation views along the bottom and radical change views along the top. On the horizontal axis, theories and methods are organized by their view of social science. At the right, are objective views of science that emphasize realism, positivism, determinism, and nomoethic approaches to science. On the left side are subjective views of science that stress nominalism, humanism, voluntarism, and ideographic approaches to science. Between these extremes live a continuum of theories and methods; their location along the horizontal axis determines the relevant criteria for evaluating the theoretical claims or the soundness of a method.

Burrell and Morgan's (1979) framework was used to locate the differences between soft systems methodology and other methods (Checkland 1981), to provide an overview for critically selecting and integrating systems approaches (Jackson 2000), and to show how system dynamics does not fit into any fixed socio-theoretic paradigm (Lane 2001).

As we began integrating PRA methods with group model building, we realized that Burrell and Morgan's basic framework was extremely useful for conceptualizing the framing of problems. Maintaining the axis of 'views of society' and 'views of science,' we renamed the quadrants to apply to problem framing: analysis problems[3], coordination problems, learning

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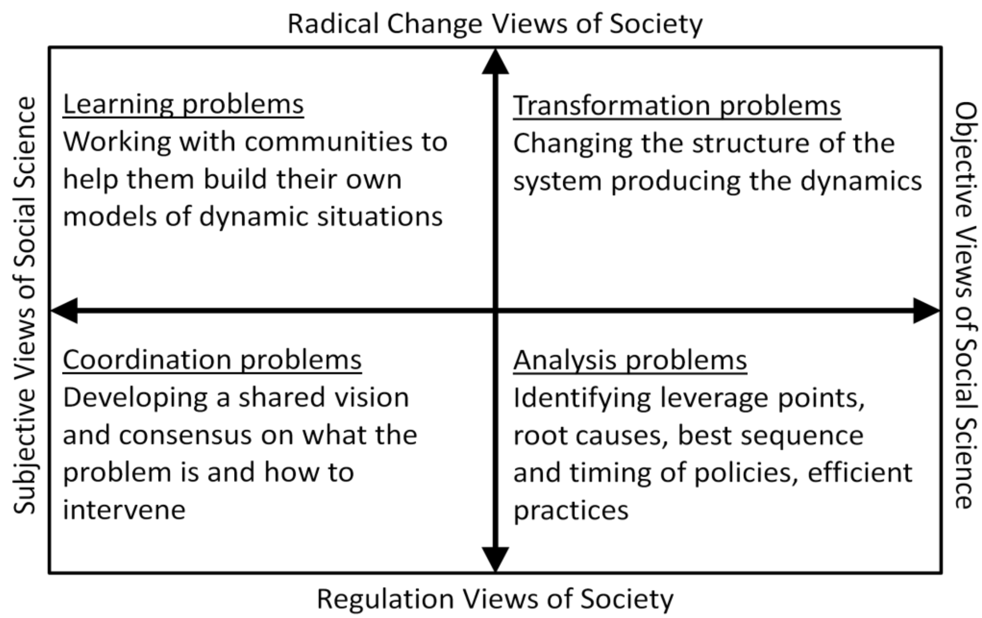
[2] Yadama, Hovmand, Chalise, and Papagni Cell, Foundation for Ecological Security. *Community Driven Modeling of Social-Ecological Systems: Lessons from Andhra Pradesh, India*.

[3] We thank George Richardson (personal communication) for the suggestion of the term 'analysis problems'. Previously, we had referred to this as 'system design' and 'optimization problems', and both terms did not fit. System design arguably happens in all four quadrants and optimization is too narrow of description for what are more generally analysis problems.

problems, and transformation problems. Figure 1 shows our adaption of their framework. In our representation, we view problems that are framed in terms of fixing or maintaining the status quo as residing in the lower quadrants, and problems that are framed as rejecting or replacing the status quo reside in the upper quadrants. The lower quadrants reflect a basic commitment to accepting the structure of the system as it is; whereas the top quadrants are associated with rejecting the current system or seeking to restructure it in some more fundamental ways. Similarly, problems that are framed as having an objective existence independent of human observation and language are in the right quadrants, and problems are the result of a socially constructed view of the world are on the left hand side. The right quadrants reflect a fundamental assumption that the roots of the problem exist in a system that has an objective existence separate from human language and observation; the left quadrants involve a basic understanding that the problem exists through human observation, interaction, and language.

Figure 1 Framing problems and group model building activities across different paradigms of society and social science. Adapted from Burrell, G., & Morgan, G. (1979) and Lane (1999).



Analysis problems focus on finding the "right answer," which is determined by how well the solution objectively improves the existing system. Analysis problems often involve formal modeling and computer simulations, the identification of leverage points and root causes, and decisions about the best ways to implement policies or interventions and find more efficient ways of doing things. Many system dynamics modeling projects fall into this category. There is usually a strong commitment in analysis problems to working with existing and well established measures of a problem. The focus in analysis problems is often on getting the technical analysis correct. The role of modeling and participation in analysis problems is on improving the rigor of the analysis and on accessing more accurate data about stakeholders' perspectives.

In coordination problems, the focus is on developing a shared vision and consensus about how to proceed. For these types of problems, the lack of coordination is a larger determinant of the outcome than accuracy or alignment with the right technical solution; that is, the subjective view of the problem matters more than the objective view. Unfortunately, there have been many cases of scientists and experts framing a problem through analysis when coordination would have been more appropriate. In such cases, scientists and experts settle on what appears to be the right technical solutions through a rigorous analysis, only to have the entire effort rejected because there was not sufficient consensus among stakeholders to implement the solution. Thus for coordination problems, a solution that may be suboptimal or technically flawed but that everyone agrees on and buys into is preferred. The role of a model and participation in the coordination problems is to develop a shared understanding and consensus among all stakeholders.

Both the analysis and coordination problems accept the structure of the system as it is. Learning problems, however, focus on helping stakeholders develop and apply their own models to solve problems by learning about and modifying the system. The goal here is both different in terms of the ontology and epistemology of the model, and the expectation of the types of change that might evolve. The key criteria for a model and participation in a learning problem is not whether the activities generated shared understanding or consensus, nor whether they helped the group arrive at the technically correct answer through rigorous analysis, but whether or not they are using the models and their participation to learn about the system in a way that is helping them solve the problem. Not all models will do this, and models may be technically wrong but still quite beneficial *if* people are learning how to model better and with better modeling comes better insights into improving the system. Concept models as used by Richardson and Anderson are good examples of models that are used for learning problems by helping participants develop an initial understanding of system dynamics (for a good explanation of concept models, see Richardson 2006).

Like learning problems, transformation problems reject the status quo and seek to restructure the system. What differentiates the learning problems from the transformation problems in practice is that they treat facts differently. In a transformation problem, there is an objectively wrong system producing undesired outcomes that needs to be changed. Change happens by restructuring the system through adding or removing feedback loops or changing the stock-flow structure of a model. In contrast, modeling in the learning problem may have little or no commitment to the objective facts of the system.

To further explain how this adapted problem framing framework may be used, let us take the example of a group of friends trying to decide where to eat for dinner. Through an analysis problem lens, the overarching concern for the group is to find the optimal restaurant; the solution might be to maximize some joint utility function and calculate distances to different restaurants. The coordination problem manifests itself when the group argues so long over what is the 'best restaurant' that action is delayed and the entire group becomes hungry and faces a walk to the nearest eatery to everyone's dissatisfaction. Instead of trying to decide on the 'best restaurant,' a coordination problem is solved by developing a shared vision or consensus about how to proceed. This could be through a vote, consensus process, or simply someone taking charge. Framing the question of which restaurant to choose as a learning problem would mean helping the group read the map and navigate their choices so that they might try one eatery one evening and another on a different occasion and thereby learn which restaurants they prefer to eat at. Lastly, in a transformation problem we would re-examine the given structure of the problem (e.g., that the group needs to go out to eat) and might consider options for ordering food and having it delivered to the hotel or conference center.

In our work, we have found it invaluable to be able to frame problems in different ways according to different stages of the project. For example, we might view the initial phase of our work as primarily involving a learning problem, where we would like our participants to become more comfortable using causal loop or stock-flow diagrams in modeling situations. We look for evidence that that they are actively engaged in revising models or spontaneously drawing their own structures. Later, we might frame our work as a coordination problem as we try to work with diverse stakeholders to understand what might be a feasible set of solutions. Then, an analysis problem viewpoint may be more appropriate as we build the simulation model and triangulate the model with survey data and other information. Through the analysis, we might then discover that the problem can only be solved by entirely restructuring the system and so we move into viewing the problem as a transformation problem. In participatory modeling with diverse stakeholders, paying attention to problem framing and how we might sequence activities helps everyone be much more explicit about the goals for each stage of activity, and in particular can be used to help develop capacity early on among participants.

Participation as Process

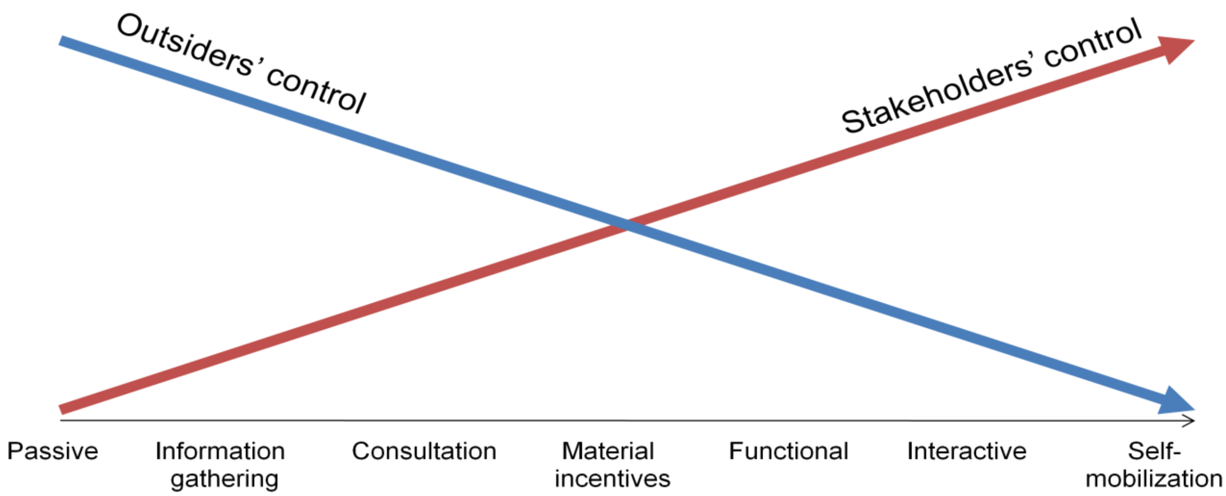
The second major concept that we have found useful in developing, defining, and then describing our approach to group model building is recognizing and emphasizing that participation is a process. It is often easy for people to see how experts with university degrees might plausibly participate in the formulation of a model; however, there is increasing skepticism among both modelers and participatory action researchers that authentic participation occurs when engaging with less educated and more marginalized communities.[4] At the core of this disbelief is actually a question about the extent to which people can really participate in building a model. On one hand, modelers may tend to exaggerate the degree that people are participating by defining participation in relatively weak terms. On the other hand, participatory action researchers may tend to insist on participation as only applying to self-mobilization where participants are defining problems and acting collectively. Both views tend to be flawed, and ignore the fact that participation is not a static but a dynamic process.

In working with FES on integrating PRA methods with GMB, we found Kumar's (2002) classification for different degrees of participation particularly helpful. Kumar lays out a continuum of participation from passive to self-mobilization. *Passive* participation involves just telling people what is going to happen or has happened. In *information giving,* people are only involved to the extent that they answer questions that are asked of them, but they do not have opportunities to influence the process or define what questions get asked. *Consultation* involves people by drawing them more into the process of solving a problem, but participants do not get to define what problems they are consulted on and they do not get to define the solution. Then there are situations where people are involved through *material incentives* where, for example, participants provide information in exchange for food, cash, or other incentives. *Functional* participation happens when people are involved in groups that are organized around predetermined objectives (e.g., panchayats in India or advisory councils). Here participants can have some or a lot of say about what has to happen, but they do not decide on the objectives or purpose for the group. *Interactive* participation involves people in joint analysis and action. This is often what we tend to think about as true collaboration and equal partnership. *Self-mobilization*

[4] We have actually found the opposite to be true, i.e., that is often easier to involve those most directly involved than the experts who may through their education tend to rely more heavily on linear models to manage their abstracted views of reality.

is often described as the highest form of participation and here the individuals or group's activities are self-initiated and result in collective action.

Figure 2 Changing role of participation. Adapated from Kumar (2002, p. 25).



In terms of system dynamics, Vennix (1996) draws a distinction between modeler initiated projects and client initiated projects that map onto Kumar's framework. Modeler initiated group model building projects may be characterized at the lower level of participation, maybe even as low as only information gathering. Whereas client initiated projects and organizational learning may well represent interactive and self-mobilization forms of participation. Therefore, through group model building, system dynamics has the potential to span the entire continuum of participation types as show in Figure 2.

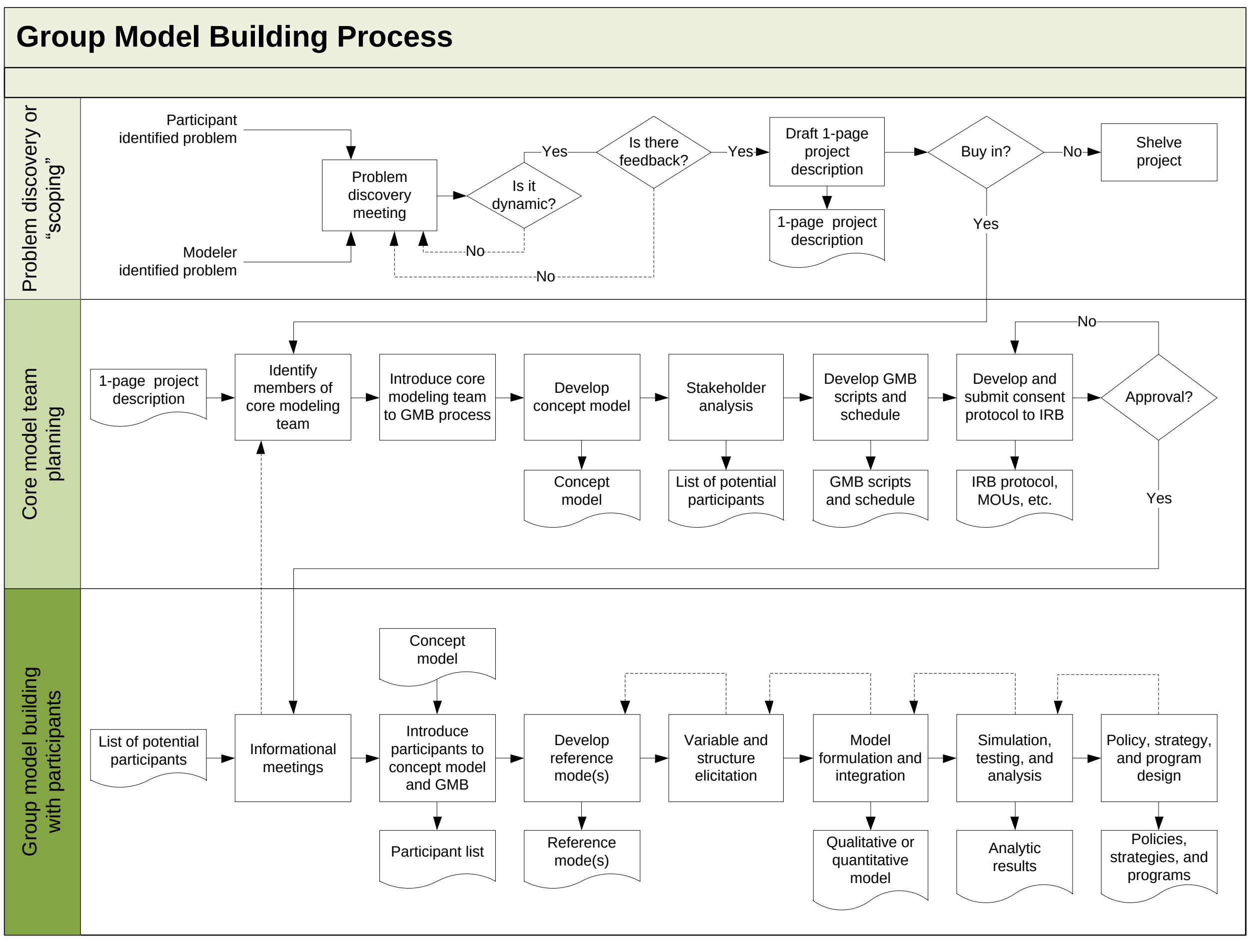
By recognizing that participation is a process that moves along a continuum, we escape the trap of believing that only GMB that involves self-mobilization is truly participatory. Rather, the most important question is not whether all group model building activities are at the interactive or self-mobilization stage, but whether one is making adequate progress along the continuum over the course of a project. For example, one might start at the consultation stage of participation with some initial meetings to understand the kinds of problems that might be relevant to the community, and then over time move up the participation scale until the community has redefined the problem and eventually reached a stage of self-mobilization.

The benefit of viewing participation as a process is that it makes it easier to figure out how one starts the group model building with marginalized communities and makes the long-term intentions more explicit, transparent, and accountable. For example, it is unreasonable to expect that a client organization or community will appear with a well defined system dynamics problem on their own, and so there is a higher degree of control by the modeling team over how the problem is defined. However, over time the participants can learn and develop the capacity for identifying and framing problems. If this happens, then it is now possible to imagine that participants would be able to define their own problems. And with more time, it also becomes possible to imagine that the organization or community will develop their own internal capabilities for pursuing and advancing system dynamics.

Stepped Modeling

The third major concept that developed from our collaborative work in combining GMB with PRA is something we call "stepped modeling"[5] as shown in Figure 3. This stepped modeling approach breaks the modeling project up into three steps or phases: discovery, planning, and group model building. Not without some debate and ongoing discussion, we refer to this entire process as a *group model building process* and the third phase as *group model building*. This signals the recognition that the process of group model building includes distinct steps; the first step identifies and frames a problem at initial stakeholder meetings, while the second step develops capacity through collaboratively designing the group model building sessions of the third step. We believe that dividing a GMB project into steps has two key benefits related to the insights discussed in earlier sections. First, this approach allows for the modeling problem to be framed differently at various points in the project. Second, stepped modeling approaches participation as a process, whereby each step in the project builds the capacity for more participation in future steps.

Figure 3 Overview of stepped group model building process



[5] The term 'stepped' is used in the sense of a "steps in a ladder". Wittgenstein (1974) used the ladder metaphor in his introduction of the *Tractatus logico-philosophicus* to evoke the idea that one might use to ladder to reach some level, and then no longer have a need for the ladder. Here, the use is similar in the sense of capacity building.

One key goal of this stepped modeling process is to introduce and help prepare participants, as much as possible, for the next step. Thus, during the initial discovery step, a small group of stakeholders are introduced to basic concepts of system dynamics, like behavior over time graphs and feedback loops. These discovery conversations lead to a succinct problem description based on which all parties can decide if the project is worth pursuing, and if so, develop the resources needed for the second step. In the second step, the core modeling team is constructed with both modeling experts and substantive experts who need to be involved in the design and facilitation of the third step. The term ‘core modeling team’ as used here differs from others’ use of the term in system dynamics, which typically consists solely of expert modelers. One could refer to this group as the modeler-client team or the leadership team, but the choice of the term ‘core modeling team’ is deliberate in that it signals an expectation that members of this team should be involved in modeling and group process design decisions. A seed structure or concept model is usually developed in this second phase with input from the substantive experts; the expectation is that participants are learning and increasingly participating in modeling decisions. In some cases, participants will be involved in modeling decisions about the best way to formulate an equation or represent the problem in terms of stocks and flows—decisions that are traditionally left to the modelers’ expertise. The third phase involves the actual group model building sessions as usually discussed in the system dynamics literature.

The key insight from our collaborative work that led to this diagram is the importance of focusing on team development at each step and developing capacity, as well as laying out the expectations of when certain decisions need to be made and who should make them. Importantly, the group model building *process* begins at the first meeting with a potential group of stakeholders and develops capacity throughout each step in preparation for the ultimately the third step that represents that actual group model building sessions with participants. In stressing the process, it also counters a view that the outcome of the group model building process is just the group model building sessions in the third step. Good collaboration is not by accident, but something that can happen consistently through good design of a collaborative process (Straus 2002). It is worth noting that the process is depicted as a linear sequence of steps. In reality, the end of the process may lead to other projects and therefore become iterative over time. However, many potential participants may have a hard time evaluating or buying into a process that appears unending in a cyclic depiction. For these potential participants and for the modelers, facilitators and other experts involved with a project, it is important to be explicit about the activities at each step, i.e., when they begin and when they end with a clear end goal for each step in mind.

Conclusion

In this paper, we have described three concepts that have developed out of our work and collaboration in rural India and efforts to combine PRA methods with GMB. The details of the actual projects resulting from these efforts are described a second paper submitted to the conference. Here, our primary purpose was to explicate the three concepts that we found most useful in our work and have opened up new possibilities in our thinking about how to bridge modeling with participation in marginalized communities. Although the work in India focused on environmental and development issues, we have applied our framing the problem framework and stepped modeling approach in other settings and with other issues, such as domestic violence, childhood obesity, and mental health.

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