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Policy responses to environmental threats and crises like climate disruption and non-sustainability can result in creative technological innovations that solve some problems in the short term. However, assumptions about humans and ecosystems that are built into environmental public policy making, especially rational-comprehensive approaches and engineered technological policy solutions, are often inadequate in the longer term when applied to complex social-ecological systems like local creekshed communities. Policy failures are rooted in political conflict, administrative limitations, and human cognition limitations of narratives. Interdisciplinary dialogue can help to integrate important research from relevant disciplines that have implications for environmental policy making. Contributions from some of these fields, complex systems theory, climate change science, and especially human cognition and narrative studies, will be considered for impacts on improved environmental policy making and governance. The implications of the narrative nature of human cognition in environmental decision making will be explored. Practical implications for environmental policy making within local creekshed communities will be discussed, along with recommendations for environmental democracy and environmental governance through community-based ecosystem management.

The Role of Narrative in Environmental Policy and Governance in Local Creekshed Communities

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Human communities facing environmental or ecosystem threats, like climate disruption and non-sustainability, can respond with engineered technological innovations in their policies. This may include dams and levies for flood control, canals and pipelines for water redistribution, dredging and channelizing rivers to facilitate shipping. Environmental policy scholars have identified many failures of environmental policy making, however, and the failure of many technological policy innovations can cause subsequent unexpected environmental problems that in many cases are worse than the original problem that was addressed (Freudenburg et al. 2008). When policy-making processes are limited to top-down, narrowly-focused, non-interdisciplinary, over-simplified prioritizing strategies relying on the linear thinking of engineered technological policy solutions, they are especially prone to fail when applied within complex social-ecological systems like local watershed or creekshed communities.[1] These policy failures may be due to political conflicts, administrative limitations or inadequate paradigms and narratives.

This article contends that inadequate paradigms and narratives is a primary cause of many environmental policy failures. This is because deeply embedded in environmental policy failures are inadequate understandings and inaccurate paradigms. In the case of local watershed communities, this includes lack of integration of research findings from and assumptions of complex systems, climate change science, and human cognition. To begin to address some of these environmental policy failures, there is a need for true interdisciplinary research and dialogue, which will result in adoption of new paradigms for social-ecological problem solving and the integration of new policy analysis tools. A very promising policy innovation includes the development and application of narrative analysis tools within local watershed communities for improved community-based ecosystem management[2] (or what Weber (2003) calls "grassroots ecosystem management" or GREM) and environmental democracy[3] and governance. This article will explore the three types of policy failures, focusing on failures rooted in paradigmatic processes and narratives, and then will examine how the contributions of interdisciplinary research and narrative policy analysis tools can help to reduce environmental policy failures when applied to sustainability and climate disruption within local watershed communities.

[1] A creekshed community or watershed community is a unit of analysis for social-ecological research that combines socio-economic aspects of the human community living in context of and in interdependent relationship with the watershed ecosystem. It is also simply the human community living within a particular watershed boundary.

[2] Community-based ecosystem management is an approach that delegates authority and responsibility to local community members to maintain the local ecosystem for sustainability, adaptability and resilience and manage human interactions with the ecosystem in order to provide continuous goods and services. CBEM sees humans as an integral, interdependent part of ecosystems, works within natural ecological boundaries and applies a complex systems approach to integrate ecological, socio-economic, and institutional considerations.

[3] Environmental democracy is concerned with the politics and governance of the humans-nature-other humans relationships, the allocation of community values, and the equitable distribution of environmental benefits, costs, burdens and risks between different segments of the community. It includes environmental justice, but also includes intergenerational justice, and the processes of public participation and deliberation.

Policy Failure of Engineered Technological Solutions

Two major ecological concerns for environmental policy making today are non-sustainability of human communities and threats from global climate disruption at every spatial scale from local creeksheds to the global biosphere. Non-sustainability is concerned with the human actions that seriously degrade ecosystems, often causing related environmental injustices from the inequitable shift of benefits, costs, and risks, and with the failures of policy to prevent threats to sustainability. Climate disruption threats arise from the limited capacity of communities to respond to needs for mitigation to minimize greenhouse gas emissions and to develop community resilience in order to adapt to the already inevitable effects of climate disruption. Human communities facing environmental threats often respond with engineered technological innovations. This can be very inappropriate. Engineered technological policy solutions follow the predominant rational-comprehensive policy process,[4] and by defining the problem as a single, focused, simplified, linear problem, a solution can be engineered using the latest science, technology, and construction techniques. Using technological and administrative experts. policy is made in a top-down, narrowly-focused, non-interdisciplinary, overly-simplified, prioritizing, and linear way. This is the case with engineered agricultural technological innovations of the Green Revolution in response to inadequate soil productivity and food insecurity, with the construction of flood levies in coastal New Orleans, and with the construction of dams, locks, and floodways to reduce flooding along the Mississippi River.

It often happens that environmental policies based on engineered technological solutions ultimately fail, resulting in unforeseen consequences that compound problems. For example, the Green Revolution resulted in the increased use of harmful chemical fertilizers and pesticides, reduced nutritional value of some new genetically engineered crops, increased water demands and unsustainable withdrawals for water-intensive farming, and increased class disparities and conflicts as poor farmers could not afford to transition to capital-intensive technologies (Singh 2000). In New Orleans, the U.S. Army Corps of Engineers designed and installed levies that were then breached during Hurricane Katrina (ASCE 2007). Engineered flood control devices on the Mississippi River have not prevented and may even have exacerbated devastating flooding in some communities (NWF 2011; Chagnon 2005). Environmental policy scholars have engaged in ongoing research to understand the many challenges and failures of environmental policy making, including policies that rely on engineered technological solutions. Two primary reasons suggested for policy failures include political conflict and administrative limitations.

[4] A rational-comprehensive policy process would include some variation of the following steps: identify the policy problem; establish acceptable criteria that must be met by any policy solution; generate policy alternatives; evaluate the various alternatives and select the best one; implement and evaluate the chosen policy.

Environmental Policy Failure: Political Conflict and Administrative Limitations

In general, political conflict in policy making arises because there is a political system of competing interest groups with different values, and this political system often produces environmental policies that favor the values of the powerful or influential and yet can simultaneously result in degraded ecosystems and environmental injustice. An example of failure due to political conflict is the inability of the 111th Congress to pass meaningful climate change legislation in 2010, even with supporting Democrats in majority control of both houses of Congress and the White House (Lizza 2010). Pushing climate change legislation could cost Democrats additional Congressional seats and power and possible loss of the White House in 2012, due to the discontent of voters in the midst of an economic recession concerned that any new climate change policies would lead to job losses and increased energy costs for consumers. The climate change legislation failure has been blamed on politics, and indeed, the Democrats did lose Congressional seats in the 2010 elections. Doing "the right thing" at the expense of losing political power is a rarity in Congress. This is a classic case of policy failure due to political conflict.

A second category of environmental policy failure comes from administrative limitations. Administrative limitations in environmental policy making arise from the constraints of what Herbert Simon (1957) called "bounded rationality." These are the constraints faced by public administrators and other policy makers generating somewhat rational decisions, but limited by cognitive capabilities, available information, and limited time for processing information before making decisions. Since attempts at "rational policymaking" by administrative agencies almost always includes some variation of the rational-comprehensive policy process, and since engineered technological solutions presume rational capabilities, any claim that human decision-making is fundamentally non-rational undermines credibility and validity of much policy analysis.

Bounded rationality also implies organizational or structural limitations from legal and regulatory constraints and pressures and inadequate financial and human resources available to administrators to develop, improve and implement policies. Very rarely do agency staff have the time to fully research all scientific aspects of policy alternatives, consider and evaluate all possible impacts on human communities and ecosystems, and engage all stakeholders possibly affected by the policy in order to get diverse public input. For example, in New York State, although the Department of Environmental Conservation is authorized to issue and monitor permits regulating discharge of pollutants into waterways, the agency had undergone such severe agency funding cutbacks and staff reductions that it had almost no capacity to monitor and regulate any discharge activities, other than quickly reviewing permit applications and reports for completion (Nadeau 2008).

There is plenty of evidence to support both of these conclusions, that political conflict and administrative limitations are indeed sources of policy failure. However, these explanations do not account for all policy failures. Even by "cleaning up politics as usual" within political conflicts using increased democratic processes to increase accountability and reflect the will of the people, putting the common good before the politicians' good, policy failures would still exist. Furthermore, even increasing the resources of government administrators to improve

rational-comprehensive policy making and decision making would still not ensure sustainability nor adaptation and resilience in the face of climate disruption. There is another set of factors that contributes to environmental policy failure. These factors arise from the human paradigm process and social narratives.

Environmental Policy Failure: Inadequate Paradigms and Narratives

The third source of policy failure, and the one most important to the development of the main points of this article, comes from paradigmatic perception processes and human narrative processes. Paradigms are the deeply embedded, usually subconscious mental constructs and epistemological frames that shape humans' fundamental worldviews. Kuhn (1996) analyzed the role paradigms play in the development (especially the hindrance) of scientific research and revolutionary scientific discoveries. Narratives are the stories all humans create to make sense of the world, and to imbue perceptions of empirical reality with meaning. Narratives are built upon one's foundational paradigms.

Developing a preliminary model of how paradigms and narratives work together is helpful. Although this is not an attempt to advance neuroscience or build theories of symbolic cognition, it is important to at least describe a basic model of paradigms and narratives that can help inform environmental policy making. This type of synthesis that results from interdisciplinary dialogue is the promise of sharing conceptual discoveries across disciplinary boundaries in order to illuminate implications and generate insights for current social problems and scholarly research. A preliminary model of how paradigms and narratives work together might look like the following.

Early on, humans form basic, foundational paradigms of biophysical reality, including ones to conceptualize the fundamental human-nature relationships and human-nature-other humans relationships. This latter category is relevant because of concerns of social inequity of environmental decisions and issues of environmental justice. Much of this formulation of paradigms is stored subconsciously, and may be very difficult for an individual person to articulate. On top of foundational paradigms, humans construct more elaborate and detailed myths (similar to what Schank (1999) calls "scripts"), made up of pieces of information from observations and assumptions grouped together according to a similar theme. Narratives are then constructed by weaving together myths to ensure some level of coherence to help make sense of the world, to store important information in long term memory, and to recall it in order to communicate with others (Gamson 1992; McAdams 1996).

Humans cannot see, grasp, or analyze until perceptions of reality are converted into or assimilated into a narrative. Since humans perceive empirical reality indirectly, narratives prepare and equip people for dealing with empirical reality. Human narratives are also bound to an individual's identity, meaning and purpose in life, and are reflect interpersonal and community relationships (McAdams 1996). Narratives are linked to one's social roles, status, and power and influence within the community.

This narrative nature of human cognition contradicts the models and assumptions most often used in public policy and political science (homo politicus) and economics (homo economicus), including the assumptions that drive engineered technological policy solutions. Fisher (1989) presents a model of the human actor as "homo narrans" (narrative human), which assumes that humans are inherently subjective story tellers, not rational thinkers. The rational, self-interested, competitive individual of homo politicus and homo economicus does not exist in any natural or hard-wired way; rather, these assumptions are only accurate of people who adhere to these models as their preferred narratives and who adopt consistent behaviors as self-fulfilled prophesies. Since paradigms, myths, and narratives work together to shape how humans see social and biophysical reality, understanding how that reality is interpreted, and how to respond with outward individual and collective behaviors is critical to understanding failures in environmental policy.

There is also strong evidence that the human brain is structurally hard-wired for symbolic thinking, language, narrative perception and cognition (Abbot 2008; Young and Saver 2001). Human narrative capacity seems ubiquitous, and there is mounting evidence that humans with narratives have evolved in context of their ecosystems (Polkinghorne 1988; Deacon 1997). Indeed, small children undergoing normal cognitive development develop the capacity for narrative around age three or four, and it is only at this point that adults are able to recall their first life memories, stored in their brains as narratives (Abbot 2008). Young and Saver (2001) identify the mental health condition dysnarrativia, or "narrative impairment" wherein people with brain damage are not able to create narratives and subsequently lose their self-identity. Research suggests that the paradigmatic perception process and narrative cognition feature is an evolutionary adaptation that allows humans to: simplify complex ecosocial systems so that the human brain is not overwhelmed with outside information; conceptualize the past, present and future in order to plan for survival and adaptation; communicate through language and storytelling all essential knowledge to ones' peers and to successive generations long after an individual or generation of individuals is gone (Deacon 1997).

While paradigm processes and narrative capacities have evolved in humans as strategic genetic advantages, they also create some important limitations for human communities. Because paradigmatic seeing is selective, it produces blind spots of information that are not considered (Kuhn 1996). What paradigms and narratives might overlook or disregard as irrelevant ("anomalies"), the ecosystem may determine is essential for maintenance, adaptation and resilience of life. For example, earlier policies allowed and even encouraged the draining of wetlands to convert land to productive agricultural and development use. Ecosystems, however, require healthy, functioning wetlands. Current policies based on new paradigms of sustainable social-ecological systems recognize the value, functions, and ecological services of wetlands.

Since paradigms, myths and narratives are so deeply rooted in the very synapses of the human brain, in the human psyches, and individuals' very identities, there is a deep resistance to new information that requires paradigm change. Paradigm change in a person is very rare after the mid 20's, probably when paradigms and myths finally find some level of internal consistency and cohesive meaning. Of paradigms, myths, and narratives,

narratives may have the greatest capacity for modification, since the lifelong process of formal and informal learning requires that narratives have some level of malleability and adaptability. However, there is a strong human tendency to hold firmly onto established narratives even when people are faced with overwhelming contrary facts and scientific evidence (Westen 2007; Lakoff 2008; Kuhn 1996). This is especially relevant for conflicts over the use of engineered technological policy solutions, climate change and sustainability, where unwavering commitment to assumptions and refusal to listen to contradictory information can be politically polarizing, and can severely limit policy options, and can result in serious policy failure.

Competing paradigms often result in conflict, because people have only a very limited ability to truly "step into another's paradigm shoes." The strong tendency is to recognize the other's paradigm as different, and then dismiss the other as a radical, extremist, doomsayer, outsider, hoaxster, fear monger or as evil. This happens frequently during political campaigns where partisan messages are communicated to the public using simplified imagery and narratives. While public policies reflect the politician's or party's basic paradigms (including the "dominant social paradigm" or DSP), the simplistic messages communicated to the public are thinly veiled false dichotomies playing off the fears and narratives of the public. This implies, of course, that many policy failures attributed to political conflict are essentially the result of conflicts between people with different paradigms.

In the diagram below (figure 1), three groups hold three separate sets of paradigms of reality. This is their worldview. Note that none of the paradigms authentically represents all of biophysical reality; paradigms draw out essential perceptions, and rearrange them into simpler, meaningful representations to model reality. As these three groups mobilize politically, their policies simply reflect their pre-existing paradigms and narratives. Since each group's narratives are also connected to social status, there is a difference in resources, power and money available. Each group then spins a strategic but simplified political narrative to voters, usually in the form of a false dichotomy or choice (what Margaret Thatcher, former prime minister of the UK, called "TINA" or "There is no alternative.") That might be "freedom or terrorism," "peace or fascism," or "global environmental justice or global poverty." The political winner would be the group with the most effective (appealing) political narrative and the most financial resources to publicly convey that narrative.

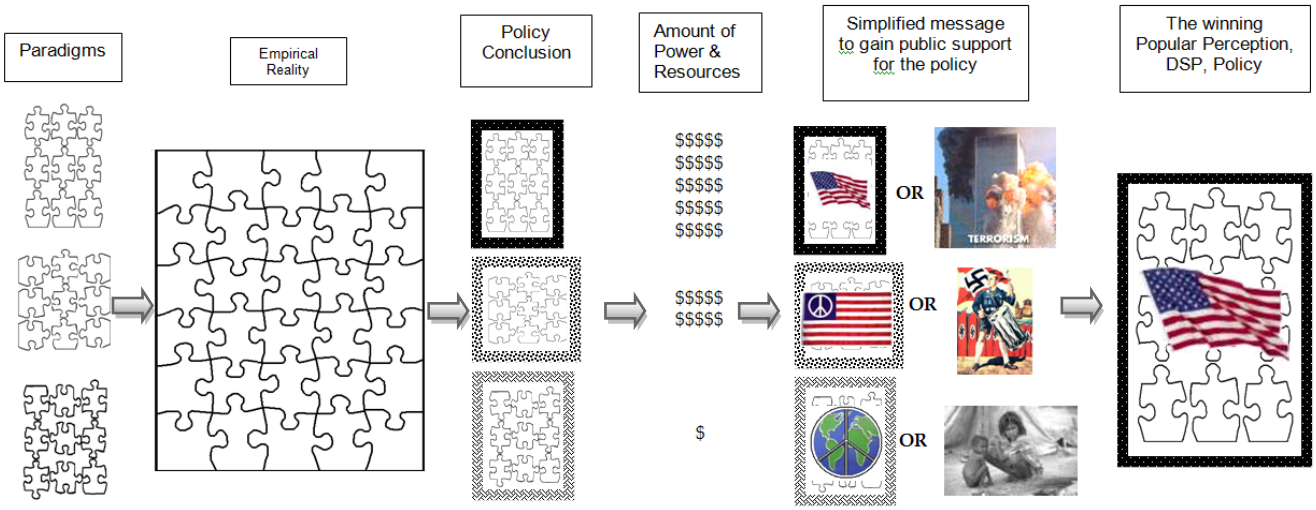

Figure 1: A narrative policy process based on paradigms

Because narratives are subjective, humans have a strong tendency toward rationalizing rather than rationality. Humans are not very logical and rational decision makers, even after considerable academic training (Lakoff 2008). These limitations of human cognitive capacities have implications for and require adjustments to environmental policy making and decision making. The currently prevalent rational-comprehensive environmental policy making approach, including engineered technological policy solutions, does not adequately integrate interdisciplinary research that would help to reduce environmental policy failures. This is not only because of political conflict or administrative limitations, although both of these play some role. Another primary reason why environmental policy making fails is due to inadequate paradigms and narratives held by policy makers. Existing paradigms and narratives limit the role of interdisciplinary dialogue, and do not adequately incorporate insights from narrative studies, complex systems science and climate science. The next sections will explain the scholarly contributions from these two disciplines, and how and why they contradict existing paradigms and narratives of policy makers and contribute to policy failures.

Complex Systems Science and Climate Science

Complex systems theory emerged in response to research on non-linear, unpredictable systems behavior. Complex systems theory (also called complex adaptive systems, social-ecological systems, or complex ecosocial systems when applied to human-ecosystem relationships) assumes that human and ecological systems are interdependent, have many unknowns, and have dynamic feedback loops that make the system mostly unpredictable. For example, in a large forest wildfire, the simultaneous burning of thousands of hectares of trees can create a local micro-weather pattern that creates local clouds, lightning, and rain. Clouds can hold the heat in,

increase winds to create hotter flames, and additional lightning strikes can ignite even more forest fires, all while the rain can produce a cooling effect and put out some flames. These interactive and dynamic feedback loops (ripple effects) complicate the cause and effect relationships, making the complex wildfire system full of uncertainties and almost impossible to predict.

Complex systems also exhibit emergent, synergistic properties so that the whole is more than the sum of its parts (or when 1+ 1 = 3). Rather than displaying slow, gradual change, complex systems are also capable of rapidly transforming or flipping to a completely new state or balance as the result of a major disturbance called a bifurcation event. The result of too much disturbance or change is that the system rapidly switches to a new state and a new dynamic that is better able to accommodate the stress from massive change or disturbance. In Yellowstone National Park, the removal of wolves resulted in a rapid deterioration of the entire park ecosystem, and a reintroduction of the wolf years later resulted in a similarly rapid transformation into a healthier ecosystem. Ocean "dead zones," large wildfires, and the Dust Bowl are other examples of ecological bifurcation events. Climate change is also expected to usher in any number of bifurcation events.

Similarly, in a complex ecosocial system, if one aspect is changed, the feedback loops or ripple effects also result in everything being affected. Every change changes other changes. These bifurcation events make the future of the system unpredictable. Socio-political bifurcation events include the falling of the Berlin Wall, the terrorist attacks of September 11th, and the economic collapse and recession of 2008-2011. These insights of complex systems are especially helpful to counteract the limitations of simple, linear thinking of rational-comprehensive approaches that are drivers of engineered technological solutions to environmental policy making. A rational-comprehensive approach assumes that the underlying system is understood, simple and linear cause-effect relationships can be clearly established, change is slow and gradual, adequate data are available, and the system is predictable. If the policy concerns ecosystems or social-ecological systems, these assumptions are not accurate.

The findings of climate change science are also important. The latest climate change science explains what is already happening in the atmosphere, and the trends toward possible and probable future conditions. Unpredictability, however, breeds uncertainty. Advocates and activists around the globe are calling for climate change mitigation (limiting or stopping green house gas emissions) and adaptation, preparing communities for likely ecological changes ushered in through global climate disruption. This includes heat waves, increased precipitation, flooding, desertification, rising sea levels, loss of species, increase in disease, droughts, food crop losses, and violent conflicts over use of diminishing natural resources, especially water. Most environmental policy making does not yet incorporate contributions from the field of complex ecosocial systems, nor does it anticipate and account for the research findings on current and future climate change impacts. Furthermore, a critical mass of the American public holds narratives that doubt the existence of climate change, and a significant percentage accept climate change science, but see no urgent need to make it a priority to address now (Pooley 2010; Rahm 2010; Hoggan 2009). This reflects inadequate paradigms and narratives.

There is only limited political and public pressure on policy makers to incorporate this interdisciplinary work. At the federal and especially local level of policy making, economic development and environmental and land use policies are not being developed consistent with the current and future effects of climate change. Housing development in flood zones, the ongoing construction of dams and flood structures, and transportation systems for agricultural commodities and other goods are not adequately integrating climate change science. Policies are not developed to address the interdependent problems of complex social-ecological systems. The next section and storytelling and storytelling and storytelling and storytelling will look at a case study of a creekshed community and the implications of local policy making.

The Local Creekshed Community Case Study: The Kromma Kill Creekshed Community

Environmental policy failures are having significant impacts on local watershed communities. One of these ecosocial communities is the Kromma Kill Creekshed community. This local watershed is a subwatershed of the greater Hudson River Watershed in upstate Albany County, New York. The Kromma Kill ("kill" is Dutch for "creek") is a small urban-suburban creek with headwaters that begin on the campus of Siena College. The creekshed community is divided into upstream and downstream populations. Upstream is characterized by wealthy estates, a private college, and upper-middle class homes, while downstream is characterized by lower middle-class and working class homes, small businesses and industry, and former industrial sites. The creek meanders through Siena's wetlands and through a private golf course, a pristine forested ravine and other urban wetlands, and flows through an upper middle-class housing development. It then flows downstream through a former industrial dumpsite, an industrial district with a closed steel plant classified as a hazardous waste site, a working class neighborhood and small business district, and finally empties into the Hudson River. The creek's tributaries that make up the other surface waters of the creekshed flow from the state police barracks across the street from Siena College, through three cemeteries, and eventually join the main waters of the creek downstream. The Kromma Kill provides habitat for benthic macroinvertebrates, fish, insects, water fowl and other birds, and small mammals like beavers. The Kromma Kill carries away the Siena campus' normal surface runoff water and runoff from the golf course and private homes and estates. Downstream, the Kromma Kill also carries suspended toxics like heavy metals, PCBs, and mercury from the former Al Tech steel plant. The creek, a tributary to the tidal Hudson River estuary, flows backward (upstream) twice a day, and then also routinely floods in the working class neighborhoods located in a flood plain. The children living downstream attend an urban school district with higher rates of poverty and higher rates of learning disabilities.

The Kromma Kill Creekshed community is facing environmental degradation as a result of point source and nonpoint source pollution and periodic flooding. Policy solutions to address some of the point source pollution were presented to the local town government as problems of engineering. Decision makers gathered information on the chemical composition and characteristics of the pollutants, dispersion patterns within the

ecosystem, floodwater flow dynamics, and available technologies to capture, contain and monitor pollution. With adequate access to funding, authority, experts and political will, the point source pollution problem has been officially considered solved. Water filtration units and pollution control devices have been installed at the steel plant and at the industrial dumpsite. The engineered technology solutions for environmental policy making have limitations, however. Point and non-point source pollution continues to flow into the creek, the soil remains contaminated, the contaminated industrial sites remain unutilized for economic activity and job creation, and the flooding in the working class community continues.

Local environmental problems that become big enough to attract federal or state government attention and resources have a fair chance of getting addressed through formal policies and agency action, and these are often addressed through engineered technological solutions. In the Hudson River watershed, major PCB spills by industry are being addressed by federal and state agencies, and the EPA did install pollution prevention units within the Kromma Kill creekshed. However, officially acceptable quantities of source pollution and almost all non-point source pollution continues to seep into the local creekshed, and this concern is de-prioritized so low by government, it is simply not addressed. This is a dominant paradigm and narrative for government policy makers faced with administrative limitations who must prioritize problems. This is the case in the Kromma Kill creekshed community. While these issues may be officially classified as low priorities because this is how they are perceived by decision makers, the local problem is still an important problem to the people who live and work within the affected creekshed community.

In the Kromma Kill creekshed community case, there was no incorporation of the latest interdisciplinary research from climate change science or complex social-ecological systems, and the engineered technological solutions are policy failures. Does narrative policy analysis offer an alternative? Narrative policy analysis that identifies the community's paradigms and narratives and incorporates interdisciplinary research could hold promise for the Kromma Kill creekshed community. Better paradigms and narratives leading to new models of environmental governance based on community-based ecosystem management, and improved policymaking to address the failure of engineered technological solutions could all be part of the comprehensive strategy to address the entire social-ecological system for this creekshed community. The next section will describe how a narrative policy analysis might be applied within a local creekshed community.

Applied Narrative Policy Analysis for the Kromma Kill Creekshed Community

In the Kromma Kill Creekshed community, there is preliminary evidence that narratives play a role in local environmental decision making. For example, the Kromma Kill is often not even labeled on regional maps, some key local government employees are unaware of its location, condition or name, and residents in different parts of the creekshed community tell different stories about the creek's functions, purpose and ecological status. Homeowners with land parcels bordering the creek who espouse environmental values are not able to identify the link between the use of lawn fertilizers and chemical pesticides and the level of pollution in the creek. No one

seems to be able to make the connections between flooded neighborhoods, water dispersion of toxic chemicals, the levels of toxic substances in the creekshed soils and human bodies, high rates of learning disabilities in young students, and the increasing cost of special education in the local school district along with corresponding local property tax increases. The existing narratives do not facilitate connecting the dots, even when the scientific and social science data are made readily available.

Applying a narrative policy analysis for the Kromma Kill creekshed community can be helpful in several ways:

1. It can identify where human paradigms and narratives are inconsistent with or in conflict with biophysical reality. If the ecological science that emerges from the creekshed ecosystem contradicts the predominant community paradigms and narratives, policy makers can anticipate potential policy failures that are rooted in false assumptions. In the Kromma Kill, the hydrological interconnections are not well understood by the community, nor are pollution dispersion patterns.

2. It can identify where there are paradigm and narrative conflicts between groups within the community. This might be most prevalent when comparing upstream and downstream residents. If the conflict exists, it will be essential to identify the competing narratives as a potential source of conflict. There are class differences between the upstream and downstream areas of the Kromma Kill creekshed community, and pollution costs and risks are inequitably distributed. Conflicts over perceptions of the problem, fairness, and appropriate policy responses will be rooted in different paradigms and narratives of each side.

3. It can help identify what Roe (1994) calls an overarching "metanarrative" that finds the commonality between or among different community narratives, and enable a community to find unity. Holding a common metanarrative might allow a mutual path to pursue problem solving within the watershed (Roe 1994). The health of the Kromma Kill itself could be the metanarrative that all members of the community could rally behind. Restoring and protecting its cleanliness, beauty and use for recreation by all could be a unifying story.

4. It can help the community to create better and more accurate paradigms and narratives that are more consistent with biophysical reality. Research on the creek ecology will probably surprise most members of the community, since the Kromma Kill actually looks beautiful in many places most accessible to the public. If the community narrative is that the creek is very healthy, there will be no political will to restore it or protect it.

5. By understanding narrative processes, leaders can actually publicly disseminate or promote more accurate paradigms and narratives. On the Kromma Kill, the strategy might include fostering completely new fundamental paradigms and corresponding narratives with youth and children, while helping adults adapt only their narratives (since paradigms are already well established). If done correctly, these can foster behavior change to move toward

sustainability. This process normally happens with effective place-based environmental education and outdoor education within the creekshed.

6. It can be adapted to use in simulations and future scenario construction to help people imagine uncertain but possible futures. If humans cannot first imagine it, they cannot create plans to deal with it. In the Kromma Kill, future scenarios based on climate disruption models can be developed and customized to the Kromma Kill creekshed. After participating in creative future scenario simulations anticipating climate disruption, community members can then identify possible problems and develop strategies and policies to cope. This could be the Kromma Kill Creekshed community climate change adaptation strategy.

7. It can incorporate insights from other disciplinary fields. In the Kromma Kill community, research from biological and ecological sciences, geology, hydrology, political science, economics, history, geography, and sociology have contributed to a better understanding of the systemic policy needs of the community. Developing a community history and a community story, complete with GIS maps, can help the community better understand the social and natural world of the creekshed. Narrative policy processes can be used to integrate these new discoveries into better paradigms and narratives.

8. It can identify the "ecocivic" narratives of the community, too. Under the assumptions of social-ecological systems, political and governance systems are part of the dynamics affecting the ecosystem. In the Kromma Kill creekshed community, narrative policy analysis would identify the lack of government involvement in this "low priority" watershed. Since environmental policy failure here includes the limited engagement of government and the lack of a public participation process, environmental democracy insights from community-based ecosystem management (CBEM) would be very appropriate within the Kromma Kill creekshed community. CBEM is an appropriate approach because the creekshed community is local; the geographic parameters of a neighborhood creekshed are small enough for residents to conceptually grasp; it can physically link people to their neighborhood ecosystems; it allows better community stories and histories to be developed together and shared.

Policy solutions are not limited to engineered technological solutions. In the Kromma Kill, one solution could be the creation of an elected community environmental council that makes some environmental decisions and considers non- technological policy options, including behavioral and lifestyle changes or changes in codes, zoning, and ordinances. For example, rather than build dams or levies to prevent flooding, the community could replace impervious surfaces with permeable surfaces, build rain gardens in yards, protect wetlands, and install rain barrels. Another option is to encouraging all community members to enter into voluntary "green neighbor agreements" which use friendly peer pressure to hold neighbors accountable to adopting sustainable living practices. Including a role for youth and marginalized groups at regular town hall meetings will ensure that all

narratives are heard. Multi-cultural and intergenerational dialogue increases the diversity of available paradigms and narratives, making more insights available and reducing paradigmatic blind spots that contribute to policy failures. Using a community environmental council, green neighbor agreements, and inclusive town hall participation processes can be a way that governance shifts from top-down government to community-based governance in response to new paradigms and narratives.

Limitations of Narrative Policy Analysis

A narrative policy analysis process for a creekshed community produces different results than the rational-comprehensive and engineered technological process. Most policy analysis within the Kromma Kill creekshed has been economic development along the business corridor, and this analysis did not consider environmental aspects. The only environmental policy analysis that occurred within the Kromma Kill creekshed was an engineered technological solution spearheaded by technical and administrative experts to address only the mitigation of point source water pollution from the steel factory and the industrial waste dump. However, a narrative policy analysis process also has some flaws.

Narrative policy analysis is not always necessary and appropriate. When the policy problem is relatively simple, straightforward, and policy solutions have not experienced failures in the past, narrative policy analysis might not be appropriate to use. Furthermore, no researcher is immune to paradigm blind spots, even when attempting to reveal the facts of biophysical reality, so the best efforts will always only ever be a close approximation model of nature. When narrative policy analysis identifies paradigms and narratives that are more consistent with biophysical reality and social-ecological systems, they are still imperfect.

Sometimes people's paradigms just do not change, and there is not a way to resolve a paradigm conflict until one generation dies out and a younger generation with a new paradigm succeeds it. In this case narrative policy analysis would be of limited utility. Another limitation of narrative policy analysis is obsolescence. Since discoveries from scientific research are ongoing, a narrative process could be employed just in time to become obsolete. There is no guarantee that the results of a narrative policy analysis are going to get it right, and if it does not, there can still be a policy failure due to inadequate paradigms. Accuracy is very important, but flexibility and adaptability to ever-changing discoveries from research will also be critical.

Conclusion

There are environmental policy failures due to political conflict and administrative limitations. However, some of these conflicts have their roots in conflicts of paradigms and narratives, where opposing sides may actually perceive and interpret a different reality; people may see the world in a fundamentally different way. Engineered technological solutions that rely on the inadequate paradigms and narratives often found in the rational-comprehensive policy analysis process can also result in environmental policy failures. In general, the

persistence of ubiquitous paradigms of human rationality, like homo economicus and homo politicus, in the face of contradictory evidence of contemporary cognitive neuroscience demonstrates that deep-seeded paradigms resist change. Because humans are much more similar to homo narrans, narrative policy analysis tools applied in conjunction with interdisciplinary research can be very effective in developing successful policies within complex social-ecological systems like local watershed communities. This can also result in adoption of new processes for environmental democracy and environmental governance, including community-based ecosystem management approaches.

An alternative working model for use in environmental decision making and policy making could be *homo habitatus*. Homo habitatus represents humans in community from different cultures who are evolving biologically and culturally over the centuries in context of their various ecosystems. Homo habitatus use their natural narrative capacities to create stories that guide their collective behaviors to build hospitable and sustainable human habitats, raise resilient children, and transmit successful narratives to new generation. Successful narratives foster social capital, survival and resilience skills, and successful adaptation to ongoing ecological changes and bifurcation events. If deep-seeded paradigms were based on homo habitatus, environmental sustainability policies, climate disruption adaptation plans, and local watershed communities would tell a very different story. In communicating homo habitatus broadly to the public, it is important to remember that data does not change people, communities sharing stories changes people.

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