



Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management

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Abstract

The modern environmental management literature stresses the need for community involvement to identify indicators to monitor progress towards sustainable development and environmental management goals. The purpose of this paper is to assess the impact of participatory processes on sustainability indicator identification and environmental management in three disparate case studies. The first is a process of developing partnerships between First Nations communities, environmental groups, and forestry companies to resolve conflicts over forest management in Western Canada. The second describes a situation in Botswana where local pastoral communities worked with development researchers to reduce desertification. The third case study details an on-going government led process of developing sustainability indicators in Guernsey, UK, that was designed to monitor the environmental, social, and economic impacts of changes in the economy. The comparative assessment between case studies allows us to draw three primary conclusions. (1) The identification and collection of sustainability indicators not only provide valuable databases for making management decisions, but the process of engaging people to select indicators also provides an opportunity for community empowerment that conventional development approaches have failed to provide. (2) Multi-stakeholder processes must formally feed into decision-making forums or they risk being viewed as irrelevant by policy-makers and stakeholders. (3) Since ecological boundaries rarely meet up with political jurisdictions, it is necessary to be flexible when choosing the scale at which monitoring and decision-making occurs. This requires an awareness of major environmental pathways that run through landscapes to understand how seemingly remote areas may be connected in ways that are not immediately apparent.

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Keywords: Sustainability indicators; Participatory processes; Case study methodology; British Columbia, Canada; Botswana; Guernsey, United Kingdom

1. Introduction

Methods for choosing ‘sustainability indicators’ to measure progress towards (or away from) social and

environmental goals abound in both the academic and practitioner literature (See: Bell and Morse, 1999, 2003). These range from situations where development experts and environmental managers simply choose what they see as the most relevant indicators, to participatory processes to help communities identify their own indicators. The formalisation of ‘bottom-up’ community involvement in environmental management projects has been driven by past failings of ‘top-down’ approaches. This shift in emphasis still requires careful analysis of diverse case studies where there has been a move to involve communities in proposing and measuring sustainability indicators, to analyse the extra benefits that the integration of top-down and bottom-up approaches achieve. This paper analyses the findings from three, purposefully different, case study settings where there has been a move from top-down initiatives towards greater

Abbreviations CIDA, Canadian International Development Agency; CIT, Coast Information Team; DFID, Department for International Development; EM, Ecosystem Management; IVP, Indigenous Vegetation Project; SLA, Sustainable Livelihoods Assessment; UNDP, United Nations Development Project; UNEP, United Nations Environment Project; WA, Wellbeing Assessment.

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113 community involvement as the basis for improving
114 environmental monitoring and management.

115 The rationale for this is simple: despite the push for
116 community participation in sustainable development initiat-
117 ives, development research and projects remain constrained
118 by the need for quantifiable and ‘objectively verifiable
119 indicators’ that allow regions to be compared (Bell and
120 Morse, 2003). These indicators form a key element of
121 Logical Framework Analyses that are now required by all
122 the major national and international funding agencies (e.g.
123 CIDA, DFID, World Bank and UNEP). However, if
124 development experts choose indicators simply to comply
125 with the requirements of funding agencies, then this top-
126 down process may alienate local community members and
127 fail to capture locally important factors. Although this sort
128 of ‘results-based management’ reduces the chance for
129 corruption, projects designed using this model do not
130 necessarily engage community members or ensure that
131 indicators are relevant at the local level. Alternatively,
132 individuals from the community may be engaged to select
133 relevant indicators, thus ensuring that locally important
134 factors are assessed (See: Chambers, 1994a,b). Such a
135 bottom-up approach matches the wider recognition of the
136 need for active community participation in development
137 projects capable of sustainable environmental management
138 (Chambers, 1997; Pound et al., 2003). However, these
139 processes run the risk of being time and resource intensive
140 and may create non-standardized data that prevents regions
141 from being compared. To explore this tension, and assess
142 the impact that community participation is having on
143 environmental management projects, this paper critically
144 examines three situations where external agencies brought
145 stakeholders together to select and choose sustainability
146 indicators. Although the socio-economic and environmental
147 settings of the three case studies differ greatly, each
148 demonstrates a shift towards integrating participatory
149 ‘bottom-up’ approaches with conventional ‘top-down’
150 systems that had failed to realise sustainable environmental
151 management in the past.

152 2. Background

153
154
155
156
157 The literature proposes a bewildering array of tools and
158 processes to help measure progress towards sustainability.
159 These range from highly aggregated top down indices such
160 as the Environmental Sustainability Index, designed to
161 facilitate cross country comparisons of environmental
162 performance (Global Leaders of Tomorrow Environment
163 Task Force, 2002), to smaller scale efforts such as the
164 ecological footprint designed to help individuals understand
165 their impact on the biosphere (Redefining Progress, 2004).
166 Increasingly, the highly aggregated indexes, which are the
167 most common, have come under attack for failing to engage
168 local communities and in so doing, reinforcing the biases of

169 donor and development agencies (Morse, 2004; The
170 Ecologist, 2001).

171 Using community participation as a way of selecting
172 relevant indicators is proposed to provide a number of key
173 benefits (Bell and Morse, 1999; Pretty, 1995). The first
174 benefit is pragmatic: since it is impossible to ensure that
175 indicators chosen by ‘development experts’ will be relevant
176 to local situations, local input is necessary to make sure
177 indicators accurately measure what is locally important.
178 Regular community input should also ensure indicators
179 evolve over time as circumstances change (Carruthers and
180 Tinning, 2003) and help allow projects to continue after
181 funding stops (Freebairn and King, 2003). The second
182 reason is that preliminary research shows local engagement
183 may help build community capacity to address future
184 problems, and that this may be more significant than the
185 results of the actual development projects. For example, in
186 community-based environmental management work in
187 Bangkok, the act of inventorying land and identifying
188 problems played a key educational role in the community
189 (Fraser, 2002). This goes beyond simply identifying
190 community relevant indicators; the methods used to collect,
191 interpret and display data must be easily and effectively
192 used by local communities so all stakeholders can
193 participate in the process.

194 To assess the impact of participatory processes on
195 environmental management projects, this paper critically
196 examines three case studies where community input has been
197 used to identify sustainability indicators. The recent move to
198 community participation was common in all three case studies
199 and offers interesting comparability despite each coming from
200 radically different social, economic and environmental
201 contexts. The first, based on forest management in Coastal
202 British Columbia, Canada, involves a process of engaging
203 stakeholders to identify sustainability indicators after an
204 extended period of conflict over perceived mismanagement of
205 local resources. The process of selecting indicators was
206 designed to create a baseline of information so that the impact
207 of new and improved forest management practices could be
208 monitored. The second case study is in Botswana where the
209 United Nations Environment Programme and Western-
210 trained academics worked with Kalahari pastoralist commu-
211 nities to better understand desertification by identifying key
212 indicators of sustainable rangeland management. In this case,
213 there was little tension between stakeholders (compared with
214 the Canadian situation); however, poverty and environmental
215 degradation were more acute. The final case study comes from
216 the States of Guernsey, in the United Kingdom’s Channel
217 Islands, where the government decided to establish key
218 indicators to monitor the overall effect of economic transition
219 and globalisation in a small and relatively homogenous
220 community.

221 Although there are many differences between the case
222 studies, comparison and analysis of such different regions is
223 appropriate because local issues such as poverty (are people
224 too poor to engage in long-term management?), biophysical

issues (what are the major environmental issues in a region?) and the structure of the society (do some groups depend on the environment for different resources?) will affect the manner in which local residents engage in the integration of past top-down and participatory approaches. As a result, the three case studies represent a wide range of experiences in how participatory processes structured around identifying and monitoring sustainability indicators may affect environmental management.

3. Case studies

3.1. Case study one: Coastal British Columbia, Canada

The Coast Temperate Rain Forest, which extends throughout the Pacific coastal region of British Columbia, Canada, is rich in biodiversity, cultural and natural resources. Trees grow well in this mild wet region, helped by a lack of major natural disturbances such as insect outbreaks and wildfires. The size and quality of the trees in coastal rain forests supported the development of a thriving forest industry, which has played an important role in the economic development of the region for the past century. Ongoing harvesting activities in the Sound, planned in a top-down manner by forestry companies and involving extensive clearcutting, were observed over time to be associated with environmental problems. For example, it has been shown that the frequency of landslides is nine times greater on harvested sites than in undisturbed forest areas in the region (Jacob, 2000). The failure of the top-down approach to prevent significant erosion and degradation on clearcut areas spurred experimentation with alternative planning approaches that involved greater community participation. These failures also attracted the attention of eco-tourists and environmental groups, who have fought to protect the remaining old-growth forests from continued logging. The coastal rain forests of BC are also the traditional territory of a number of aboriginal bands or First Nations, who have historic, spiritual, and cultural ties to the land. These three stakeholder groups presented all necessary elements for the serious conflict that erupted over the use of forest resources in the early 1990s. Known as ‘the War in the Woods’, the conflict began when environmental groups and First Nations communities blocked logging roads to prevent clearcutting in the old-growth rainforests of Clayoquot Sound, on the west coast of Vancouver Island. Years of acrimony led the provincial government to negotiate a process explicitly recognizing that community input and scientific expertise needed to come together to develop long-range management plans that would meet both economic and environmental goals. To do this, a new group called the Clayoquot Sound Scientific Panel was established to make land use recommendations.

To develop a new strategy for land and resource management in Clayoquot Sound (and ultimately for the

rest of British Columbia), the Scientific Panel worked closely with various stakeholder groups including local populations (both First Nations and non-aboriginal), industry, and government, as well as international environmental groups such as Greenpeace. To a large extent, these stakeholders were self-identified through their participation in the conflict. To bring stakeholders together, the Scientific Panel decided to utilize ‘Ecosystem Management’ (EM) as a common basis for resource planning exercises (for a brief introduction to the concept of EM see: Ecological Society of America, 2000). Ecosystem management has been described by Grumbine (1994) as a concept that balances ecosystem functions and human requirements in the stewardship and utilization of natural resources (Yibarbuk et al., 2001). EM, therefore, represents a shift from a single-species management, which focuses primarily on economic demand for specific resources such as timber, towards a more holistic approach that recognizes the intrinsic values and interconnected nature of ecosystem function and human needs (Blockstein, 1999).

To apply EM, stakeholders needed access to large amounts of information to make locally-relevant, science-based decisions, thereby preventing further conflict. To do this, the Coast Information Team (CIT) was established as an independent, peer-reviewed scientific body that would collect, collate and analyse data in conjunction with local stakeholders. Among the tools that the CIT employed was the ‘Wellbeing Assessment’ methodology, pioneered by Prescott-Allen (2001). This combines ten categories of social and environmental indicators (five of each) into a single matrix to provide a rating of community, regional or national wellbeing (a graphical representation of the process used to conduct the wellbeing assessment is provided in Fig. 1). This tool balances and contrasts social and ecological factors by informing resource planners about the environmental implications of human needs and the impact of land-use decisions on human populations. The wellbeing assessment is designed to actively work within the principles of EM by determining the goals for resource management, and to provide the necessary mechanism for local-level involvement.

To conduct this wellbeing assessment, the CIT established a process that brought together scientific experts and community members to agree on what data to collect and how data should be interpreted. This consultative process was designed to allow stakeholders the opportunity to comment on and shape each phase of the assessment, including indicator selection and analysis. The first step was for members of the CIT to meet formally with ‘technical committees’ that were drawn from the resource planning bodies (such as government departments) and made up of representatives from First Nations, other local communities, government, and forestry companies. The purpose of these initial meetings was to decide on relevant variables that would be inputted into the various categories that make up human and environmental wellbeing. From the end of 2002

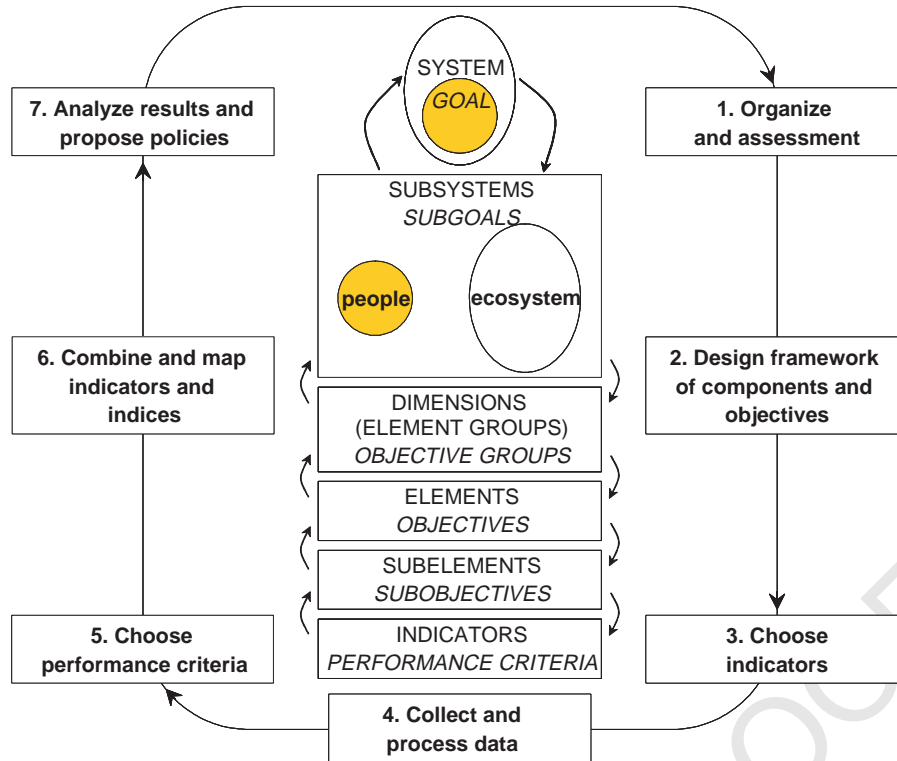


Fig. 1. Outline of the ‘Wellbeing Assessment’ used to engage communities in forestry planning in Western Canada. Steps 1-7 (listed on the outside of the figure) identify the steps in the community consultation process. The figure inside the diagram outlines how indicators are aggregated into a final overall assessment. Adapted from (Prescott-Allen, 2001).

until the spring of 2003, the Coast Information Team held a series of 25 meetings with different stakeholder groups across the coastal region of British Columbia. Based on this input, the CIT then hired students and researchers to collect data on the indicators chosen. After data had been collected and inputted into a database, the CIT returned to the technical committees, who reviewed the information to determine what specific indicators they felt represented environmental and human wellbeing in their regions. By comparing each of these indicators against the provincial, national, and international averages, the technical committees were able to assign scores for each indicator, categorizing each from excellent (given a score of 100%) to poor (0%). These scores were then averaged across the five human wellbeing categories (health and population, wealth, knowledge and culture, community, and equity) and five ecosystem wellbeing categories (included land, water, air, species and genes, and resource use) to make up the final wellbeing assessment.

In many cases, the technical committees initially selected indicators that could not be measured (due to issues like restricted data availability). Instead of ignoring these indicators, the CIT decided to maintain them within the Wellbeing Assessment as a way of highlighting key knowledge gaps. For example, out of 141 social indicators that the technical committee selected, 15 could not be quantified. Thus, over ten percent of the indicators that key

stakeholders deemed important were unavailable to policy makers. Table 1 shows the distribution of these data gaps. This illustrates that health, wealth, and education had the best data to support them. On the other hand, within ‘culture,’ almost half of the desired indicators could not be assessed. These gaps seem to have had a mixed impact on the outcome of the wellbeing assessment. Although they reduce the overall quality of the final assessment, this provide a clear signal to policy makers that valuable data is missing and needs to be collected.

Overall, the role of public participation in this exercise was a mixed success. Ostensibly, the wellbeing assessment was intended to provide a realistic measure of the wellbeing of communities and ecosystems on the coast of BC that would provide concrete guidance to policy makers. Given the significant data gaps, it is not clear how useful the final output actually is. In addition, the involved process of community consultation proved extremely time-consuming and expensive. The Wellbeing Assessment took significantly longer than originally expected, with the final report being submitted almost one year late. The missed deadlines led to cost overruns; this, combined with unwieldy data tables and skewed results meant that by the time work on the assessment was complete, the utility of this tool was diminished. Towards the end of the process, there was also a significant shift in political power with the left-leaning New Democratic Party decimated in a provincial election in the

Table 1

Breakdown of categories that make up the ‘Human Wellbeing’ of Prescott-Allen’s Wellbeing assessment, showing the number of indicators community members chose for each category, the number of indicators for which data could not be collected, and a sample of selected indicators provides for illustrative purposes

Category/Dimension	# of indicators	Gaps (% total ind.)	Selected examples
Health and Population	35	0 (0%)	Life expectancy at birth, mortality by cardiovascular disease, population fluctuations (migration)
Wealth	53	1 (2%)	# businesses with employees, aggregate total income, <i>access to economic opportunity</i> ^a
Knowledge and Culture	32	5 (16%)	% attending school full-time, % employed in arts and culture, # of <i>cultural spaces at risk</i> ^a
Community	21	9 (43%)	% of volunteers, # of homicides/attempted murders, total women in government, <i>corruption of local officials</i> ^a
Equity ^b	63	1 (<1%)	Aboriginal life expectancy at birth, female aggregate total income, % of non-aboriginal population attending school full-time, total women in government

^a Indicates a data gap.

^b As the data was collected, it became evident that some data measured health and population, but could also be broken down by gender and/or aboriginal status. Thus, some indicators were used twice: once in the context of the entire population, and once for an examination of equity issues. The total number of indicators therefore reflects a summation of the first four categories, while the equity category reflects a selection of indicators from these categories rather than new indicators.

spring of 2002, being replaced by a fiscally conservative right wing government. In all likelihood (though this is difficult to prove at the present), this change also undermined the influence that the wellbeing assessment might have had.

Despite these problems, the CIT’s efforts on the coast of British Columbia cannot be considered a failure. The process of engaging local residents on the technical committee alongside experts in the fields of social science and ecology resulted in a two-way learning experience that was highly beneficial to both parties. The technical committees served as a neutral forum, in which normally disparate groups, such as the forest and the tourist industry, might come together and discuss issues. This allowed ecosystem management goals to be determined in full light of the local human requirements. The wide variety of interests that were present on these committees also served to broaden the perspective of individual participants. Thus, the process that was undertaken leading up to the wellbeing assessment itself was a highly valuable contribution to the planning process. The mechanism of independent, peer-reviewed data collection combined with multi-stakeholder dialogue proved fruitful, and provided community members a level of confidence they did not have before the process began. In addition, it provided a forum to allow traditionally disenfranchised residents (specifically some of the First Nations communities) a direct forum through which to engage policy makers. Therefore, the process that involved selecting and analysing indicators was an effective method of introducing the informal desires of local stakeholders into the formalized planning process.

3.2. Case study two: Kalahari Rangelands, Botswana

Since independence in 1966, the Government of Botswana has privatised large areas of communal grazing

land in the Kalahari by fencing off land for use by commercial cattle producers. Many environmental assessments show that this top-down policy, partly designed to reduce degradation concerns associated with overgrazing of communal rangelands (Tsimako, 1991), has actually resulted in increased degradation problems on both commercial ranches (e.g. Dougill et al., 1999; Perkins and Thomas, 1993) and in the remaining communal lands (See: Cooke, 1985; Thomas et al., 2000; White, 1993). Problems have emerged as wealthy private landowners increase cattle stocking densities by drilling more deep boreholes to tap groundwater reserves giving cattle greater access to drinking water. This land-use intensification has increased ‘bush encroached ecosystems’ found close to waterpoints, where thorny shrubs such as *Acacia mellifera* out-compete grass species through a combination of intense grazing, drought and a reduction in the frequency and intensity of fires that traditionally maintain grass dominance (Dougill et al., 1999). Since these bush encroached ecosystems have low biodiversity and provide little in the way of fodder for cattle, this presents a disturbing trend. There is a real concern that a positive feedback cycle exists whereby privatisation leads to more boreholes, which leads to bush encroachment, leading to a loss of productive rangeland for cattle, leading landowners to drill additional boreholes in remaining grass dominant areas that then rapidly become bush encroached. This is especially troubling since the ecological literature suggests that a dryland’s ability to support livestock depends on maintaining a diverse and heterogeneous landscape in terms of fodder resources (Scoones, 1995) and that bush encroachment can only be checked by fire events when a continuous grass cover remains to sustain the spread of fires (Scholes and Walker, 1993).

In light of these trends, and the limited impact that ecological research has had at the community and policy

level, both ecological and social development researchers in the region have started using community participation to help analyse these issues and to suggest land use policy advice (e.g. Chanda et al., 2003; Phuthego and Chanda, 2004; Reed and Dougill, 2002; Sporton and Thomas, 2002; Thomas et al., 2000; Twyman, 2000). Increased levels of community participation in environmental monitoring is also supported by the Government of Botswana since this is a requirement of both the UN Convention to Combat Desertification and the UN Convention on Biological Diversity, which Botswana ratified in 1996 and 1995 respectively. This support for bottom-up participatory initiatives is also prevalent throughout the Ministry of Agriculture where seminars have openly discussed the past failings of top-down, rangeland fencing and commercialisation focused policies. To support community participation, the Botswana Ministry of Agriculture is now home to the UNEP-funded Indigenous Vegetation Project (IVP) that aims to develop models for the conservation of biodiversity and rehabilitation of degraded rangelands, and to develop sustainable management systems using indigenous knowledge. To accomplish this goal, researchers have worked with local community members to develop sustainability indicators in three sub-Districts identified as severely degraded.

The process used to harness community participation is summarized in Fig. 2 and uses community volunteers to develop a series of indicators that identify environmental degradation so that communities can then monitor environmental change. Initially, this model was developed in study sites in the southern Kgalagadi District where scholars used community participation to study the process of bush

encroachment with communities along a 100 km transect between Tshabong and Bray (Reed and Dougill, 2002). More recently, this approach has been applied to the Indigenous Vegetation Project study sites in the Bokspits region of South West Kgalagadi District and the mid-Boteti region of Central District.

The methodological approach starts with household-scale livelihood analyses in which livelihood constraints and opportunities are identified and discussed. Changes in natural capital (or environmental resources) form a key part of such discussions and respondents in all areas identified threats caused by both long-term rangeland ecological change and from recent drought events. The approach was based on a ‘sustainable livelihoods analysis’ (SLA) that involved semi-structured interviews to examine social, financial, physical, human and natural capital assets used by households to ensure livelihood security (Scoones, 1998). SLA analyses have been used widely throughout Southern Africa to examine the links between land use decisions and ecological changes (see Scoones and Wolmer (2003) for a recent review). The SLA approach provides a mechanism to facilitate an extended discussion between experts and community members of rangeland degradation indicators and how these indicators have changed through time, specifically in association to rainfall variations, policy changes and market shocks. These iterative discussions between the researcher (who has both ecological and social science training) and local residents provide a range of sustainability indicators and management strategies that are then discussed further in community focus groups and with agricultural extension workers from across a district. It is the iterative nature of the community-science dialogue that is

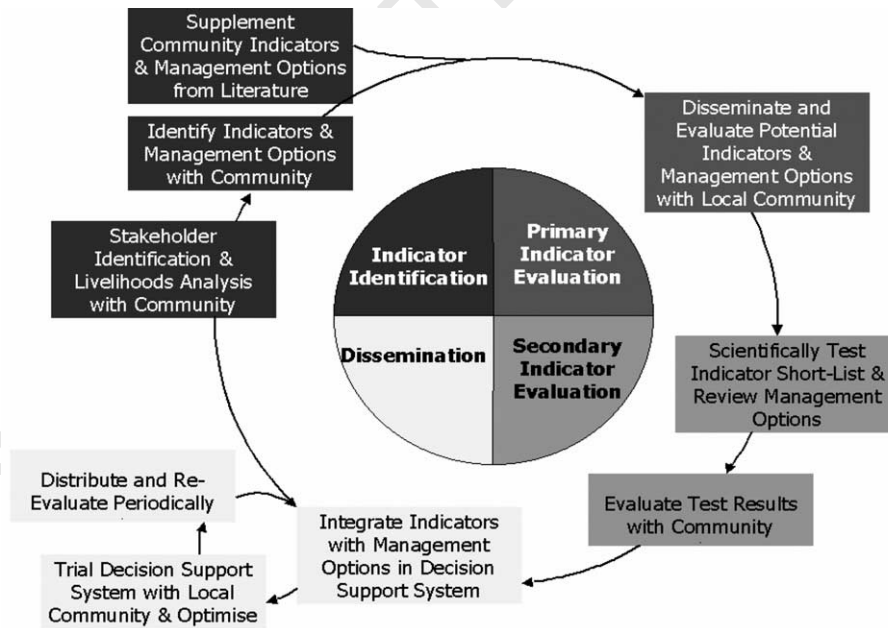


Fig. 2. Outline of the steps to engage community members in developing indicators of rangeland degradation in the Kalahari region of Botswana. The circle in the centre identifies key stages in the process, while the major steps in the process are identified in the outside circle.

central to establishing a more diversified understanding that combines scientific and local knowledge. The framework outlined in Fig. 2 builds on the view that community empowerment can be enabled by using local knowledge as the starting point in research and then using western scientific tools as a means of extending the local findings to wider areas for environmental management (Forsyth, 1996; Nygren, 1999). The process was developed over an 18 month timeframe initially in South Kgalagadi sites, however the framework shown in Fig. 2 has then been applied in a two week timeframe at the other two study sites with the use of the lead researcher, but also Government extension service staff who conducted interviews after an initial training session. This ensures widespread community participation (over 50 interviews in each region) in a relatively short timeframe.

The initial semi-structured interview stage of the research produced long lists of indicators based on local knowledge in each of the three study sites (83 indicators provided in South Kgalagadi; 57 in South West Kgalagadi; and 75 in mid-Boteti). This displays the wealth of information available in pastoral communities and also the breadth of this information with indicators covering vegetation changes, soil attributes, livestock condition, wild animal and insect communities and socio-economic conditions (Table 2). Evaluations of the utility of each of the different indicators was then conducted in two stages (right hand side of Fig. 2): (1) with communities in focus group meetings; and (2) in scientifically led appraisals based on field monitoring at sites of different degradation status and in discussion between ecological researchers and agricultural trained extension workers. This two-stage process was designed to examine the ‘accuracy’ and ‘ease of use’ of each of the indicators proposed before testing them empirically. Focus group meetings were held in three communities within each site and ranked indicators on matrixes to assess each indicator in terms of its perceived accuracy and ease of use. Group discussions were also initiated in these meetings on what communities perceived as ‘early warning indicators’ that were defined as ‘the first signs that land is going to lose its productive potential due to human use.’ Discussion on these early warning indicators proved

valuable in linking environmental monitoring to the management decision-making process. This process produced significantly shorter lists of agreed early warning indicators at each site (9 indicators agreed as useful by at least 2 focus group meetings in South Kgalagadi; 12 in South West Kgalagadi and 14 in mid-Boteti).

Early warning indicators were evaluated using appropriate scientific sampling at sites of different degradation status assigned by using a grazing gradient sampling approach with degraded sites sampled close to boreholes and with degradation viewed as declining exponentially with distance from borehole (Perkins and Thomas, 1993). The involvement of key informants from communities and extension workers in the ecological sampling process enabled a greater depth of management information to be obtained from land users in terms of their use of different ecological habitats at different times of a year, and between years. This research, in a similar vein to previous studies elsewhere in the Kalahari (Thomas and Twyman, 2004; Twyman et al., 2002), highlights that communities have spatial and temporal awareness of the environmental variability that typifies dryland environments. It also supports the conclusion that conventional expert-led indicators of degradation (e.g. % cover of palatable perennial grasses) over-simplify degradation assessment by leading to polarised views of either ‘good or bad’ rangeland (Thomas and Twyman, 2004), rather than focusing on the management adaptations to ecological changes that retain overall pastoral system productivity. Our research highlights the need for the process of integration of local knowledge, scientific research and policy support to be initiated from the bottom-up (i.e. putting the pastoralist first). This is particularly true as regional scientific views of grass fodder nutritional value (e.g. van Oudtshoorn, 1999) provide only a single value for any single grass species, compared to the more detailed views of pastoralists on the need to retain a suite of grasses in rangelands that can provide benefits at different times in local management decision-making. Our findings also display that setting a project goal of an agreed list of scientifically applicable and policy relevant indicators offers a mechanism to involve researchers and policy-makers in indicator evaluation and

Table 2
Breakdown of types of indicators identified by communities in initial semi-structured interviews in three Botswana study sites (full findings reported in Reed and Dougill, 2002 and Reed, 2004)

Category/Dimension	% of indicators in South Kgalagadi	% of indicators in South West Kgalagadi	% of indicators in mid-Boteti	Selected Examples
Vegetation	54	58	39	Decreased grass cover; Increased <i>Acacia mellifera</i> cover; Increased weed/creeper cover
Soil	16	9	19	Soil becomes ‘softer’; increased incidence of dust storms
Livestock	21	11	19	Declining livestock weight; increased rates of botulism
Wild animal and insects	5	14	17	Decreased abundance of small antelope species; decreased abundance of harvester termites
Socio-economic	4	9	7	Increased household expenditure on food; increased out-migration

785 thus to achieve the hybrid knowledge conceptualised in
 786 academic debates (e.g. Thomas and Twyman, 2004). The
 787 scientific evaluation stage successfully tied each of the
 788 agreed early warning indicators to management suggestions
 789 for the specific region and guided the production of
 790 rangeland assessment guides that will facilitate community
 791 monitoring of rangeland condition. The rangeland assess-
 792 ment guides produced in the selected communities in each
 793 region will be distributed more widely by the Ministry of
 794 Agriculture to attempt District-scale adoption of participa-
 795 tory rangeland monitoring and management.

796 The participatory methodological framework developed
 797 in this case study (Fig. 2) has successfully engaged a wide
 798 range of stakeholders (communal and commercial pastor-
 799 alists, rich and poor, extension workers, researchers and
 800 policy-makers) in the identification and evaluation of
 801 degradation indicators, resulting in the production of three
 802 sub-District level rangeland assessment guides. The
 803 differences in the lists of key ‘early warning degradation
 804 indicators’ between the three sub-District regions (Table 3),
 805 and between conventional scientific indicators (Field, 1978;
 806 van Oudtshoorn, 1999), displays that the bottom up
 807 indicator development process can be usefully integrated
 808 with participatory, expert and scientific evaluation to
 809 provide shorter, sub-District specific lists of indicators that
 810 can then guide wider community-based rangeland monitor-
 811 ing and management. The impact of assessment guides on
 812 longer-term livelihood and environmental sustainability
 813 remains to be seen. However, preliminary indications
 814 suggest that the process has aided community empower-
 815 ment and provided a formal framework that the Ministry of

816 Table 3
 817 Early warning degradation indicators agreed by community focus groups in Botswana study sites

818	819	820	821
	South Kgalagadi	South West Kgalagadi	Mid-Boteti
820	<i>Vegetation indicators</i>		
821	Decreased grass cover	Decreased grass cover	Decreased grass cover
822	Increased proportion of trees dropping leaves	Trees and bushes stunted	Trees and bushes stunted
823	Decreased abundance of trees	Decreased abundance of trees	Decreased abundance of trees
824	Increased abundance of unpalatable grasses	Decreased abundance of palatable creepers	Increased quantity of dead trees
825	Decreased abundance of palatable grasses	Decreased abundance of veld fruits	Decreased rain use efficiency of vegetation
826	Increased abundance of unpalatable forbs	Increased abundance of <i>Rhigozum trichotomum</i> bush species cover	Increased ability to see through vegetation stands
827	<i>Decreased availability of thatching grass</i>		
828			Decreased grass height
829	<i>Soil Indicators</i>		
830	Increased soil looseness	Active unvegetated dunes	Softer, more powdery, appearance
831		Increased soil looseness	Increased incidence of dust storms
832		Reduced soil moisture retention (soil dries out faster)	Reduced soil moisture retention (soil dries out faster)
833			Increased water infiltration rate
834	<i>Livestock indicators</i>		
835	Reduced livestock weight	Livestock walk further from water	
836	Increased incidence of botulism		
837	<i>Wild Animal and Insect Indicators</i>		
838		Decreased abundance of game and predators	Decreased abundance of game and predators
839		Decreased abundance of grasshoppers	
840		Increased abundance of harvester termites	
		Increased abundance of ‘malelekatou’ ants	

Agriculture could use to move to the participatory methods
 of environmental monitoring and management advice
 recommended by international environmental conventions.

3.3. Case study three: The states of Guernsey

The Island of Guernsey is a British Crown Dependency,
 located 30 miles north west of France in the Bay of St. Malo.
 It has a land surface area of 63 km² and a population of
 approximately 60,000. In the last fifty years, Guernsey has
 undergone a series of socio-economic transitions beginning
 after the Second World War when the traditional fishing
 industry began declining and the Island established a
 successful horticulture and floriculture industry. These
 industries lost their competitive advantage after the UK
 joined the European Union in 1972 when cheap imports
 from countries such as the Netherlands first entered the UK
 market on a large scale. More recently, Guernsey has
 emerged as an international finance centre and, in a matter
 of years, its financial services have superseded traditional
 industries with off shore insurance and banking now
 accounting for 45% of the Island’s total annual income
 (World History, 2004).

In 2001 the Island Government (The States of Guernsey)
 decided to establish a variety of sustainability indicators to
 track quality of life, and to form part of a monitoring and
 evaluation cycle, using the indicators to help guide the
 ‘Policy and Resource Plan’ that sets out the Islands annual
 strategic planning policies. Developing the indicators began
 in 2002 when representatives of the States of Guernsey
 spent a year engaged in public and private consultation both

897 on and off the Island to establish ‘headline’ indicators that
 898 were to reflect quality of life across social, economic and
 899 environmental dimensions. The process of engaging public
 900 participation was based on Local Agenda 21’s call for
 901 widely based consultations with community stakeholders.
 902 However, public interest and commitment to the sustain-
 903 ability indicators proved difficult to maintain, reflecting the
 904 traditional scepticism of many small communities to policy
 905 based issues that are seen to originate from outside their own
 906 locality (McAlpine and Birnie, 2003). The reluctance of the
 907 local community and business to fully engage in the
 908 development of the sustainability indicators meant that
 909 most of the initial work was driven by the States of
 910 Guernsey’s Policy and Research Unit, who eventually
 911 managed to reduce the 112 proposed headline indicators
 912 down to 17 that were themselves broken into a total of 51
 913 sub-categories or ‘strategic indicators’ (see Table 4). Data
 914 was then collected for these strategic indicators, and
 915 reported in an annual publication titled ‘Sustainable
 916 Guernsey’ and made available at <http://www.gov.gg/esu/>.

917 Given the top-down way that the initial indicators were
 918 chosen, the Policy and Research Unit decided not to set the
 919 strategic indicators ‘in stone’, but rather to allow degrees of
 920 modification as feedback was provided by Island politicians,
 921 policy users and relevant stakeholders ensuring that they
 922 adequately met the needs of these groups and reflected the
 923 Island population’s ever-changing sustainability concerns.
 924 For example, over the past year, the strategic indicator
 925 ‘changes in percentage of charitable donations,’ which was
 926 initially part of the headline indicator ‘Social Participation,’
 927 has been dropped. In its place, the numbers of people voting in
 928 local elections and the percentage of residents who are
 929 involved in local voluntary groups have been chosen as
 930 strategic indicators that better capture social participation. In
 931 allowing this flexibility, the Policy and Research Unit hopes
 932 that the monitoring process will gain acceptance amongst a
 933 wide variety of stakeholders, translating into public support
 934 for the process that will ultimately become a platform through
 935 which interested stakeholders will be able to contest data and
 936 contribute to refinements of the policy planning process.

937 Although this process is still unfolding, preliminary
 938 evidence suggests this approach is working and that a wider
 939 group of stakeholders is now more engaged than at the
 940 beginning of the process. For example, in 2002, the
 941 Research and Policy Unit was only able to collect 34
 942 (66%) out of the total 51 proposed strategic indicators due to
 943 a lack of available data. In 2003, they established 47 (86%)
 944 of the proposed indicators thanks to extra data provided by a
 945 wider group of stakeholders who had become engaged over
 946 the previous year. By 2004 the third ‘Sustainable Guernsey’
 947 report introduced 4 new strategic indicators and contained
 948 data supporting all of the 55 indicators, in other words 100%
 949 of the data required to monitor the Islands sustainability had
 950 been actively collected.

951 The evolution of the ‘land use’ indicator (Headline
 952 Indicator (HI) 15 in Table 4) illustrates this incremental data

953 collection process. Initially, the ‘land use’ indicator was
 954 broken into two separate ‘strategic indicators.’ The first was
 955 ‘building on previously developed land’ and it was
 956 anticipated that this strategic indicator would measure the
 957 percentage of building completions on previously
 958 developed sites. However, data to accurately measure this
 959 was not available, and so wider consultation led to ‘Digimap
 960 Ltd’, a GIS based mapping company on the Island to
 961 annually measure the land area used by the built
 962 environment. The second strategic ‘land use’ indicator
 963 was ‘land used for public amenity’. This strategic indicator
 964 was designed to measure the amount of land devoted to
 965 parks, recreation and other public amenity uses. This
 966 indicator has remained true to its original concept, but has
 967 been augmented by a number of key groups who through the
 968 provision of extra data dramatically increased its value to
 969 the monitoring process. These new data providers included
 970 groups such as; La Société Guernesiate (a non govern-
 971 mental natural history and conservation society), Guernsey
 972 National Trust, Guernsey Water Board and the Vale
 973 Commons Parish Council. Finally, over the past two
 974 years, a new strategic indicator has been added to the
 975 ‘land use’ indicator that is designed to measure the quality
 976 of the land on the Island. This strategic indicator maps
 977 nitrate quantities using stream catchment data provided by
 978 the Guernsey Water Board.

979 Overall, the process of developing Guernsey’s Sustain-
 980 ability Indicators was envisaged to involve local commu-
 981 nity members, in an open and transparent process designed
 982 to monitor and help steer the Islands policy planning
 983 process. Initially, a lack of enthusiasm frustrated this
 984 process and the government decided to move ahead by
 985 tasking experts, including members of its own civil service,
 986 to generate the preliminary sustainability indicators. From
 987 this preliminary iteration, this list has evolved incremen-
 988 tally, slowly involving an increasing number of stake-
 989 holders. In this way, although the process was instigated in
 990 a top-down fashion, developing and collecting these
 991 indicators has created a platform through which a wide
 992 range of people can express their concerns. This continuous
 993 re-development of sustainability indicators ensures that the
 994 indicators remain relevant to the dynamic needs of a
 995 diverse range of stakeholders, helping to realise Local
 996 Agenda 21’s call for greater grassroots participation
 997 through ‘bridging data gaps’ and ‘improving the avail-
 998 ability of information’.

999 Developing the role of Guernsey’s sustainability indi-
 1000 cators so that they meaningfully evaluate and inform policy
 1001 is a future challenge for the Island’s government. The
 1002 potential for this role is promising, as support within the
 1003 Island’s civil service and amongst its politicians is gathering
 1004 strong momentum. The difficulty however is finding ways to
 1005 actively engage policy formation around the sustainability
 1006 indicators. This challenge requires meaningful links to be
 1007 forged between the ‘Sustainable Guernsey’ report and the
 1008 Island’s ‘Policy and Resource Plan’ that do not instigate a

1009 Table 4
1010 Indicators chosen by States of Guernsey to monitor the Island’s sustainable development

1011 1012 1013 1014	Headline Indicators	Strategic Indicators					No. of SIs with data gaps		
		SI 1	SI 2	SI 3	SI 4	SI 5	2002	2003	2004
		1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051	H1 Population	Population trends	Immigration and emigration				0
	H2 Health	Life expectancy	Cost of health care	Death rate by cause	Self Perceived Health status and well-being		0	0	0
	H3 Education	Education literacy and numeracy	Education of young people	School leavers with no qualifications	Post-16 participation rates	Adult education (19yrs+)	1	0	0
	H4 Social Participation	No. of people voting in local elections	Community involvement in voluntary groups				2	0	0
	H5 Housing	Quality of housing	Use of previously developed land	Subsidised housing	Affordability of housing		1	1	0
	H6 Crime	Recorded crime levels	Public fear of crime				0	0	0
	H7 Economic Performance	National income	Island Inflation	Economic activity	Average earnings		1	0	0
	H8 Energy Consumption	Amount of energy consumed	Per capita electricity consumption	Energy from renewable sources			2	2	0
	H9 International Transport	Air transport	Sea transport				0	0	0
	H10 Workforce Development	Workforce skills	Organisation commitment				1	0	0
	H11 Biodiversity	Natural habitats and key species	Island garden birds				2	2	0
	H12 Air Quality	Emissions of Greenhouse gases	Sea level rise	General air quality and roadside air quality	Noise pollution		2	2	0
	H13 Water Quality	Water pollution incidents	Raw water storage analysis	Water treatment works compliance	Service Reservoir Water Quality	Bathing Water Quality	0	0	0
	H14 Water Resources	Raw water storage	Properties connected to the Island’s water supply	Potable water supplied	Annual water consumption	Water distribution losses	3	0	0
	H15 Land Use	Land use using GIS mapping techniques	Land used for public amenity	Land quality using nitrate mapping			2	1	0
	H16 Household and Commercial Waste	Household waste	Commercial waste	Materials recycled			0	0	0
	H17 Local Transport	Traffic volumes	Access to public transport	Mode of travel			0	0	0

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reactionary policy making process, but help nurture a corporate ‘sustainability’ framework, fed both from the ‘bottom-up’ and the ‘top-down’.

4. Discussion

A number of key issues emerge directly out of these case studies. First, the participatory methods were good in that they helped generate long and comprehensive lists of indicators. This involved a trade off, and these processes

tended to be very complicated and take a long time to complete. A second key lesson is that during the process of selecting indicators, communities became more empowered. This was probably the most significant benefit in each case. Finally, it is not clear from these cases the scale at which this kind of process works best. If this is done at too local a scale (perhaps at the community or household level) then there may be too many site-specific indicators, and it would become impossible to compare regions. It is also unclear on the best way to choose a higher level of aggregation.

1121 *4.1. Comprehensiveness versus use-ability*

1122 In general, participatory methods resulted in long and
 1123 complex lists of sustainability indicators that provided a
 1124 comprehensive assessment of local social, environmental,
 1125 and economic issues. In many ways, this is a significant
 1126 benefit. Environmental policy and management is too often
 1127 driven by simple and incomplete sets of indicators. For
 1128 example, in Canada, forest practices are traditionally
 1129 determined by measures such as net annual growth and
 1130 the price of lumber, with little regard to broader socio-
 1131 economic and ecological impacts of forest management.
 1132 The participatory processes described in all three cases
 1133 provided a more complete list of indicators that could lead
 1134 to a more accurate assessment. In British Columbia, the list
 1135 of indicators established by the communities revealed
 1136 significant data gaps where information deemed important
 1137 to assess community wellbeing were simply not available;
 1138 while these gaps were not subsequently filled, their presence
 1139 alerted planners and increased sensitivity to local issues. In
 1140 Botswana, the initial long lists of indicators was evaluated
 1141 to determine which were accurate and easy to use, and then
 1142 indicators were short-listed to develop an effective list of
 1143 ‘early warning’ indicators that community members and
 1144 experts agreed would alert rangeland managers about
 1145 pending environmental problems. In Guernsey, the initial
 1146 lists established by civil servants have been significantly
 1147 revised in light of local input, and the latest iterations are
 1148 widely viewed as containing a more accurate list of
 1149 indicators. There is at least one problem, however. The
 1150 extra accuracy and detail that participatory processes bring
 1151 to indicator selection make an apparently simple job
 1152 (choosing performance indicators) very complex. There-
 1153 fore, participatory processes may take much longer than
 1154 anticipated. The British Columbian example highlighted
 1155 this problem and the process used to harness community
 1156 input into indicator selection resulted in such a lugubrious
 1157 list of indicators that it took years to collect and input data.
 1158 During this time, the value of the activity as a tool to
 1159 influence policy diminished.

1162 *4.2. Community empowerment*

1163 Another impact of participatory processes on sustain-
 1164 ability indicator selection has been to increase community
 1165 capacity to manage the environment in all three regions. In
 1166 British Columbia, there is little doubt that this process has
 1167 defused many of the tensions that led to previous resource-
 1168 based conflicts. Disparate stakeholder groups learned to
 1169 work together, and continue to do so; there are new co-
 1170 management agreements between First Nations Commu-
 1171 nities and forestry companies in British Columbia today. In
 1172 the Guernsey case, the evidence that levels of stakeholder
 1173 participation have increased in the last year provides some
 1174 clue that this process has been a success. In Botswana, the
 1175 actual process of identifying indicators built capacity within
 1176

communities. Despite the large number of indicators elicited
 through the research process, most individuals had knowl-
 edge of only a few indicators. By sharing and evaluating the
 community’s knowledge in focus groups, and providing
 feedback from empirical testing of indicators, each individ-
 ual’s knowledge increased. There are at least two notes of
 caution, however. First, in order for participatory processes
 to result in real environmental management changes, it is
 necessary to find win-win solutions within political and
 economic constraints. If land management decisions are
 driven by political, social, or economic concerns, then
 participatory processes aimed at increasing environmental
 awareness may prove ineffective. This issue has been raised
 in both British Columbia and Botswana cases. In British
 Columbia, a Non-Governmental Organization, has argued
 that significant environmental problems still exist in how
 coastal forests are managed, and the illusion of local control
 over the resource merely masks the continued exploitation of
 a fragile ecosystem (David Suzuki Foundation, 2004). In
 Botswana, it remains unclear whether the empowerment
 generated by the process described in this paper will result in
 better land management.

On the issue of translating participatory indicator
 selection processes into good policy, it is important to note
 a significant difference in the British Columbian case. In
 British Columbia, the Scientific Panel was the body
 responsible for developing land use plans. They decided
 that they needed a large database of social, economic and
 environmental indicators to make plans and hired a
 consultant to conduct the wellbeing assessment to obtain
 these indicators. This meant that community participation,
 which was organized by the consultant were removed from
 actual land use decision-making that was still under the
 control of the Scientific Panel. The distance between the
 communities, who contributed to the wellbeing assessment,
 and land use decisions makers may have reduced the
 effectiveness of the participatory process in influencing
 environmental policy. Therefore, although it was important
 in all three cases to establish a clear framework to facilitate
 a multi-stakeholder processes to choose indicators, this in no
 way guarantees that environmental management will
 change. The experience in British Columbia suggests that
 this process must also feed quickly into formal decision-
 making forums or else risk being viewed as irrelevant by
 policy makers.

1223 *4.3. Scale*

The merits of the participatory approaches described here
 are significant. However, there still remain a number of
 significant operational issues that need to be tackled before
 communities begin defining relevant indicators in other
 regions. One of the most challenging of these is deciding the
 scale at which management and public participation should
 take place. For example, there was considerable discussion
 by stakeholders involved in developing the Wellbeing

1233 Assessment in British Columbia on how to aggregate social
 1234 data so that policy makers could adopt the best scale for
 1235 planning. Generally, it was argued that the Province was too
 1236 large a scale to be meaningful because it disguised inter-
 1237 regional variation important to developing appropriate land
 1238 management plans. However, community level data was also
 1239 inappropriate since many communities face the same
 1240 problems and a planning approach based exclusively on
 1241 community level data disguised broader trends and might
 1242 lead to inefficient duplication of services and a lack of
 1243 harmonization across the region. Ecosystem data was also
 1244 difficult to work with since migratory animals, watersheds,
 1245 and prevailing ocean and atmospheric currents mean that
 1246 environmental problems can travel independently of political
 1247 boundaries. Because of these multiple borders, finding an
 1248 appropriate scale for planning was no easy task, and was only
 1249 resolved when the Coast Information Team, responsible for
 1250 collecting and assessing data, made the choice to make all
 1251 datasets available at the finest possible resolution, and then to
 1252 provide a transparent framework for aggregation of this data
 1253 up to the planning levels. Similar issues arose in Botswana,
 1254 and the process of community involvement highlighted
 1255 regional variances. For example, significant differences
 1256 existed between South Kgalagadi and South West Kgalagadi
 1257 lists of indicators in terms of the invasive species associated
 1258 with degradation and the perceived nature of soil degradation
 1259 problems. These differences display the distinctly different
 1260 environmental conditions in two regions that are only *c.*
 1261 120 km apart. Significant differences also existed between
 1262 different stakeholders within a given region (e.g. commercial
 1263 v. communal farmers in S. Kgalagadi). This means that
 1264 policies must be flexible in how they target these
 1265 communities, and that ‘a one size-fits all’ approach cannot
 1266 work.

1267 There is still the need in all three case studies to allow
 1268 planners to observe region-wide change to understand the
 1269 larger context of policy decisions. Unless a policy maker
 1270 happens to be working in a region like Guernsey, where
 1271 bureaucratic and environmental boundaries synch up,
 1272 choosing any particular scale will be problematic. The case
 1273 studies offer two valuable lessons that can simplify this task.
 1274 The first is that data on indicators should be collected at as
 1275 fine a resolution as possible, and the process of data
 1276 aggregation should be transparent. This allows maximum
 1277 flexibility in assessing and interpreting the information that
 1278 indicators provide, and neatly side-steps the issue of scale
 1279 during the initial data collection phase. In turn, this can help
 1280 to speed up the overall process, which makes local
 1281 participation more relevant to decision-making. The second
 1282 lesson pertains to the identification of stakeholders for the
 1283 indicator selection itself. Many populations, some of whom
 1284 live far beyond the physical boundaries of local commu-
 1285 nities, can be affected by resource management decisions. To
 1286 identify these disparate stakeholders at an early stage, the
 1287 authors propose using a simplified flow diagram that shows
 1288 major environmental pathways through a landscape,

(heuristically presented in Fig. 3). In the British Columbia
 case study, forest harvesting activities high in the hills
 surrounding the Sound disrupted terrestrial biomass, and in
 turn the loss of forest cover led to significant disturbance of
 the soil systems underlying these sites. These disturbances
 also impacted the flow of water on watersheds through the
 site, which disturbed fish populations and led to mutually
 reinforcing interactions between aquatic and soil systems
 that destabilized slopes and caused landslides. Harvesting
 operations, therefore, impacted a larger population than
 those whose activities took them into the forest; and included
 people who utilized local streams and rivers, and even who
 could simply observe the slopes beneath clearcuts felt the
 impact of industrial activity. These connections spread the
 disturbance well beyond the bounds of the clearcut itself.

The approach shown in Fig. 3 is based on long-standing
 assessments that plot the fate of chemicals that have been
 emitted into the environment. In 1901, G.N. Lewis
 introduced the concept of fugacity, or the fleetingness of
 chemicals, as a convenient way to describe the various
 pathways, or transport media that exist in the environment
 (Lewis, 1901). By focusing on the pathways outlined in
 Fig. 3, we can evaluate the best scale for specific problems:
 airsheds for atmospheric problems, watersheds for flooding
 and droughts, the connectivity of agricultural land for pest
 outbreaks, and transportation corridors for the spread of
 diseases. This makes it possible to identify future
 vulnerabilities in human systems to remote threats, and

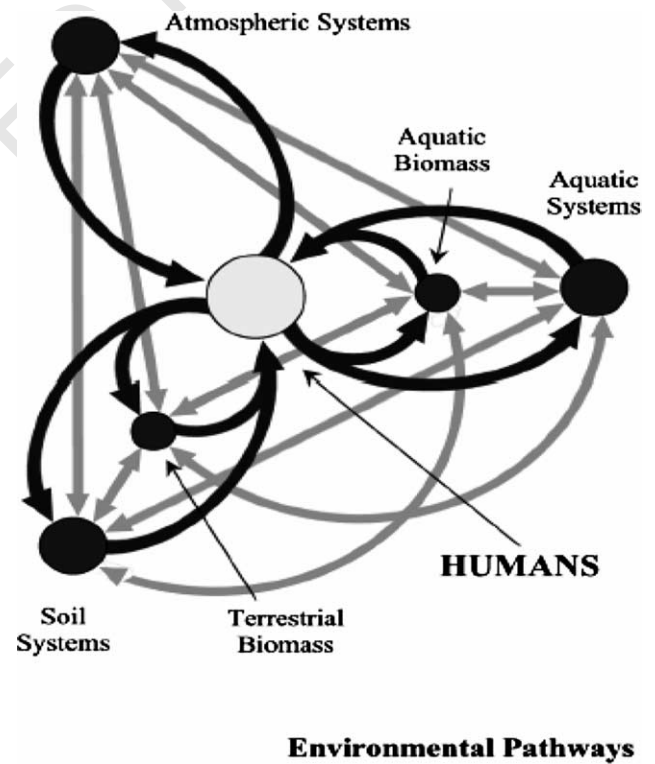


Fig. 3. Schematic representations of environmental pathways for defining understanding and defining environmental factors that affect social or political planning jurisdictions.

ultimately should allow us to prevent problems by changing practices at the source (Fraser et al., 2003, 2005).

5. Conclusions

Traditionally, developing environmental management plans has been the domain of highly trained experts who are hired for the task. It is generally perceived that this approach has led to a number of failures as these managers rarely had the benefit of detailed local knowledge and failed to generate community support for policy changes. As a result, environmental managers and policy-makers need tools to bring together local community input along side expert advice to measure the impact of policies and management plans. By reviewing three disparate case studies where this process has been tried, we can learn a number of lessons.

First, a common theme among the case studies was the need to develop a mechanism that brings together experts and community members to develop indicators that measure progress towards sustainability. This can provide databases that reflect local values, and on which specific management decisions can be made. The process of engaging people to select key indicators provides a valuable opportunity for community empowerment and education. It is not necessary that this process be initiated from the bottom-up, but it is important that local stakeholder input be allowed to drive the process. For instance, in Guernsey, the process was instigated in a top-down fashion, but indicator development and data collection has proceeded in a bottom-up manner. This has created a platform that empowers and educates the local population, and provides a forum through which a wide range of people can express their concerns to the planning process.

A second need was to connect the selection of subnational indicators with the decision-making process, so that policy can be usefully directed. The case studies showed variable success on this front. The framework used in Botswana resulted in a high degree of community engagement, and is likely to result in observable changes to policy because policy-makers and local stakeholders were included in the same process. In British Columbia, the process of indicator selection was confined to the application of a new method (the Wellbeing Assessment), which was designed to inform decision-makers. Unfortunately, the process took too long to be effective for policy makers. The presence of a gap between those involved in indicator selection and decision-making meant that top-down processes were allowed to dominate policy development. Therefore, although the framework used in British Columbia paid dividends in terms of community empowerment and capacity building, it was not altogether successful in one of its primary objectives, which was to provide timely and useful input into long-range land management.

Finally, there is the challenge of choosing the best scale for analysis. Although a huge amount of policy is generated at the national level, it is clear that is not always the best

scale for environmental management. By the same token, it is inefficient to base much environmental planning at the community level since this may result in duplication and a lack of harmonization across landscapes. To resolve this we propose two things: first, that data be collected and made available at the finest possible scale, but that it be aggregated into larger planning units using a transparent process. Second, since planning is usually based on political or bureaucratic boundaries, it is necessary to explicitly include environmental concerns that cross human-made borders, for example by basing policy on watershed boundaries or migration corridors. We have identified environmental pathways as one potential way whereby external environmental factors can be accounted for.

In conclusion, the authors believe that we can use community input to select and choose relevant indicators to monitor and guide planning towards sustainable development. However, this must directly and quickly feed back into the formal planning process. Indicators need to be collected at as local a level as possible, and then aggregated using a relatively simply and transparent aggregation process, thereby allowing information to be both summarized quickly for policy makers, and unpacked for more careful monitoring and follow-up. Matching environmental and socio-political boundaries will always prove to be a challenge. However, by recognizing major environmental pathways, it should be possible to capture at least the most significant external environmental factors and include them as part of the environmental planning process.

6. Uncited references

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