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A Participatory Assessment of Ecosystem Services and Human Wellbeing in Rural Costa Rica Using Photo-Voice

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Abstract Human well-being is intricately connected to ecosystem services. A keystone contribution to the ecosystem service literature has been the Millennium Ecosystem Assessment, MA, (Ecosystems and human well-being: a framework for assessment, Island Press, Washington, DC; 2003, 2005). Much of the work on ecosystem services to date has focused on the assessment and classification of environmental functions. The need for inclusion of community perspectives in ecosystem assessments has been widely recognized in order to better understand the distribution of impacts and benefits resulting from natural resource use. Communities can offer a direct route to understanding the complex relationships between ecosystems and human well-being and how environmental management affects their livelihoods. Photovoice has been made popular as a tool for participatory needs assessment but it has had limited use in ecosystem assessments to date. The purpose of this paper is twofold: (1) to present the results of a community-level assessment of environmental services in a watershed dominated by pineapple monoculture in Costa Rica; and (2) to evaluate the strengths and the limitations of photovoice as a tool for mapping the relationship between ecosystems and people. I argue that photovoice is an underutilized methodology that has the potential to complement biophysical ecosystem service assessments in the context of impoverished and resource-dependent communities, particularly, since assessing ecosystem services and acting upon that information requires integrating the knowledges of diverse stakeholders, recognizing power imbalances, and grappling with the complexity of social-ecological systems. Processes such as photovoice have the potential to catalyze community self-organization, which is a critical component for empowerment.

Keywords Ecosystem services · Community-based research · Photovoice · Costa Rica · Pineapple monoculture · Ecosystem benefits · Volcan River watershed

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Introduction

Human well-being is intricately connected to ecosystem services. Defined as the "conditions and processes through which natural ecosystems […] sustain and fulfill human life" (Daily 1997, p. 3), the concept of ecosystem services resonates with ecologists, environmental managers and decision-makers as witnessed by the increasing body of work devoted to their study (Fisher and others 2009). A keystone contribution to the ecosystem service literature has been the Millennium Ecosystem Assessment, MA, (2003, 2005), which introduced a conceptual framework for understanding how environmental change affects ecosystem services and human well-being (Mooney and others 2005). The MA divides ecosystem services into provisioning services associated with the supply of material goods (e.g., timber, fish); regulating services associated with the regulation of natural processes (e.g., climate regulation); cultural services associated with the nonmaterial benefits that humans might experience from their natural environment (e.g., recreational use, spiritual fulfillment); and, supporting services associated with the underlying ecological functions that sustain all others services (e.g., nutrient cycling). Similarly, the MA defined human well-being as a

multidimensional concept encompassing material wealth, health, safety and security, good social relations, and freedom of choice and actions, which emerges from obtaining the four previous components of well-being (Fig. 1).

Much of the work on ecosystem services to date has focused on the assessment and classification of environmental functions. However, despite the intuitive appeal of the concept of ecosystem services and the impressive body of work in classifying natural functions at different scales, there is still a need to better understand the actual interplay between ecosystem services and the determinants of human well-being (Carpenter and others 2009). In particular, how regulating and cultural services affect well-being remains inadequately researched and better conceptualizations and measurement tools are required (Raudsepp-Hearne and others 2010a). The need is especially pressing in the context of resource-dependent communities whose livelihoods depend on a single, or a reduced range, of ecosystem services and are therefore more vulnerable to environmental change (Duraiappah 1998; Adger 2000). Recent suggestions to further refine the MA categories are a step in that direction, for instance, some classifications now distinguish between ecosystem services and benefits: ecosystem benefits depend on services but are linked directly to a change on human welfare, hence, corn is an ecosystem service, its nutritional value once it is consumed constitutes a benefit (Boyd and Banzhaf 2007; Fisher and Turner 2008; TEEB 2010). However, by and large, precise understandings on how changes in nature affect human well-being and livelihoods are missing (Balmford and Bond 2005; Daw and others 2011a, b).

As a researcher of environmental management I had been familiar with scientific assessments of ecosystem services. However, I wanted to better understand the distribution of impacts and benefits resulting from the exploitation of ecosystem services in agricultural communities. Hence, I became interested in the potential of mixed participatory methods in general, and photovoice in particular, as a way of complementing the now ubiquitous assessments of ecosystem services. The need for inclusion of community perspectives in ecosystem assessment and management has been widely recognized (Folke and others 2005; Waltner-Toews and others 2003). Communities offer the most direct route to understand the complex relations between ecosystems and well-being (Fabricius and others 2007), often highlighting the entrenched power dynamics that affect environmental decision-making. Indeed, questions about who profits and who suffers are critically important given that benefits and burdens resulting from environmental management are unequally distributed in society, across geographical regions and through time.

In this paper, I reflect on my experience of using photovoice as an approach to better understand the relationship between ecosystem services and well-being while promoting wider community engagement. The paper is divided into four sections: (1) a review of photovoice as a method of inquiry; (2) a description of the area of study, the Volcán River watershed in southern Costa Rica; (3) a summary of how community members in an agricultural watershed relate ecosystem services to different dimensions of their well-being; and (4) a discussion of the implications of this form of analysis for participatory environmental management.

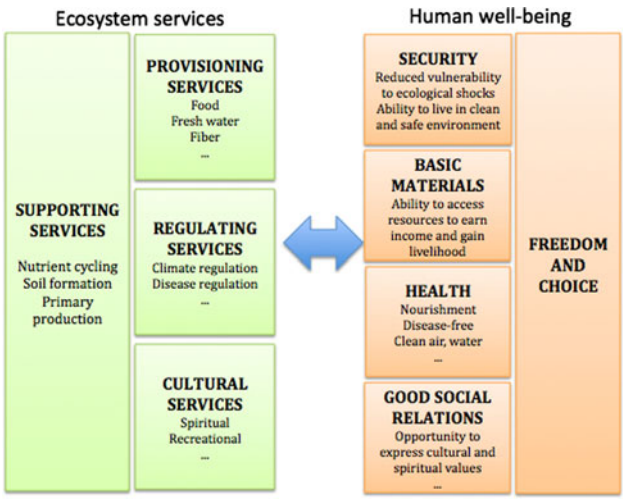

Fig. 1 Conceptualization of ecosystem services and human well-being according to the MA (2003) framework

Photovoice

Photographs and other visual tools have been integrated in social science research in a variety of ways. Early anthropologists used photographs for documenting social or cultural phenomena. John Collier (1967) coined the term "photo elicitation", which consisted of using photographs as props during interviews to stimulate and guide responses, effectively creating the field of visual anthropology (Harper 2002). Variations of photo elicitation have been adopted in psychology, education or organizational studies (Hurworth and others 2005). The underlying idea is that images are more effective in evoking experiences and insights than spoken or written words alone (Carlsson 2001; Harper 2002). In photo elicitation, the researcher usually provides the pictures upon which the participants comment, by contrast, in photo novella and photovoice, the researched take their own photographs. Photo novella and photovoice share similar origins, however, photo novella focuses on having participants tell their stories by photographing their everyday lives (Wang and Burris 1994), whereas photovoice is a process by which "people can identify, represent and enhance their community through a specific photographic technique" (Wang and Burris 1997,

p. 369). Hence, the storytelling element is relatively less central in photovoice.

Photovoice is theoretically situated within the fields of education for critical consciousness, feminist theory and documentary photography. Following Freire's approach for critical education, photovoice uses the pictures taken by the participants to create "coded situation problems", that is, abstractions that allow people to reflect upon their own realities (Wang and Burris 1994). Photovoice also emphasizes praxis—the combination of reflection and action to promote change (Freire 1970)—by entrusting the cameras to people so that they become active agents in transforming their reality. From feminist theory, photovoice considers the power dynamics and biases that exist in participatory research and it intends to become a vehicle for disempowered and hard-to-reach groups that include women but also children, peasants, the illiterate or any stigmatized population (Wang and Burris 1994). Finally, the idea behind documentary photography is to capture in pictures socially relevant phenomena (Wang and Burris 1994). In the case of photovoice, participants determine what phenomena are important, thus providing an insider perspective into an issue. These theoretical foundations underlie the three goals of photovoice, which are: to enable communities to identify their strengths and concerns; to promote critical dialogue around key issues; and to affect policy (Wang and Burris 1997; Wang and others 1998).

Photovoice has been applied to participatory needs assessments in the study of a range of issues such as health (e.g., Wang and others 1998; Short 2006), homelessness (e.g., Dixon and Hadjialexiou 2005; Rhodes and others 2008), stigmatized groups (e.g., Graziano 2004; Carlson and others 2006; Hussey 2006), disability (e.g., Jurkowski and Paul-Ward 2007; Thompson and others 2008) or experiences of immigration (e.g., Streng and others 2004). Yet, the application of photovoice techniques to questions of environmental management remains limited (some exceptions are Bosak 2008; Castleden and others 2008, 2009) and it is altogether absent from the literature in ecosystem services, even though some authors have used other participatory techniques, such as participatory rural appraisal and rapid rural appraisal, in assessing ecosystem services (e.g., Pereira and others 2005). I argue that photovoice is an underutilized methodology that has the potential to complement biophysical ecosystem service assessments in the context of impoverished and resource-dependent communities, especially since assessing ecosystem services, and acting upon that information, requires integrating the knowledges of diverse stakeholders, recognizing power imbalances, and grappling with the complexity of social-ecological systems.

Pineapple Agriculture in Costa Rica

Costa Rica is a middle-income country with an economy dependent on tourism, primary commodities and a budding technology industry. Historically the distribution of population and resources has concentrated in the Central Valley. After independence in 1821, the government focused on the expansion of the agricultural frontier through measures that promoted settlement to the north and to the south of the Central Valley, from which point the economy of Costa Rica became closely linked to the fluctuations of commodity exports, particularly coffee (Samper-Kutschbach 1993). Today the supply of export goods is more diversified, however agricultural products (bananas, pineapples, and coffee) were still among the top five exports in 2008 (Promotora del Comercio Exterior Costa Rica 2009).

The Volcán River watershed is situated in the Pacific side of the Talamanca mountain range in Southern Costa Rica (Fig. 2). Although it is small in size, approximately

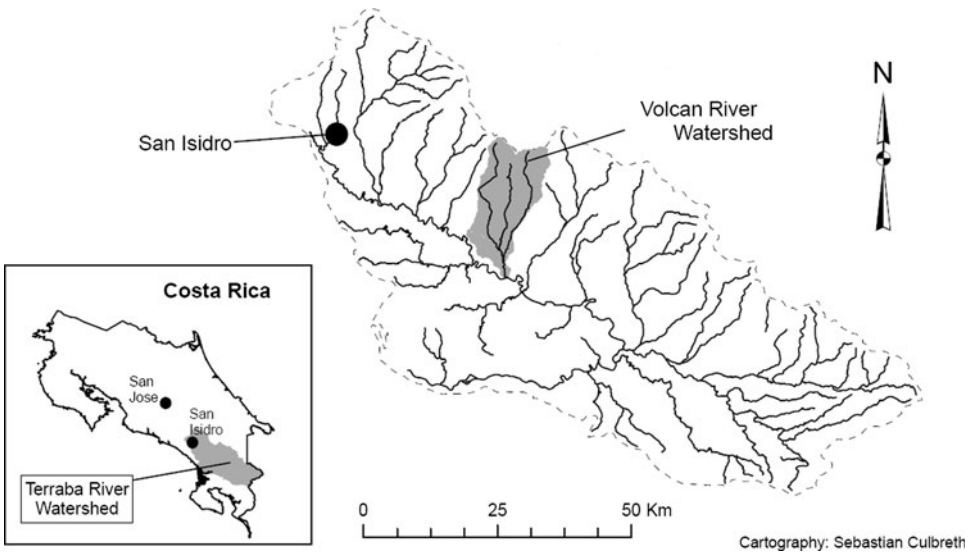

Fig. 2 Location of the Volcán River watershed within the Terraba River basin (*Source*: Wright 2010, with permission)

230 km^2, it contains five Holdridge life zones: montane rainforest, lower montane rainforest, premontane wet forest, tropical wet forest, and tropical moist forest (McConnell 2008). The Volcán River is a tributary of the Térraba River, a watershed of national importance as well as of international significance as it feeds the Térraba-Sierpe wetland, recognized by the Ramsar Convention. Finally, the headwaters of the Volcán River are within the buffer zone of La Amistad International Park, a biodiversity hotspot in Central America (McConnell 2008). The watershed averages 3,000 mm in annual precipitation that falls mostly during the rainy season (between May and November). It has steep gradients and soils that are acidic, compacted, of clayey texture and very low fertility (Calvo-Alvarado and others 2007).

The Volcán watershed has a population of 3,500 people, divided into 12 communities. Settlement in the South-Pacific region of Costa Rica occurred only in the 1900s when the construction of transportation routes and large land concessions promoted the establishment of cattle farming (Hilje-Quirós 1993). During that time, newcomers to the Volcan watershed, a handful of families of Panamanian origin, claimed sizeable tracts of forested land that they transformed to pasture for cattle. They also cultivated sugarcane, coffee and vegetables for household consumption. The land of the watershed belonged to these few families who employed others as manual laborers. Today, 30.9% of the households in the southern region are living under conditions of poverty or extreme poverty, compared to the 18.5% nation-wide average (INEC 2009). The South-Pacific region is home of several Indigenous groups including the Bribri, Brunka, Guaymi, Cabecar and Terraba (Solano-Salazar 2000).

In 1978 the Pineapple Development Company (PINDECO), a subsidiary of Del Monte Produce, started operations in the county of Buenos Aires, where the Volcán River watershed is located. PINDECO bought the lands in the alluvial plain between 400 meters above sea level (masl) and 700 masl, which are flat enough to permit the operation of the large machinery that is necessary to harvest pineapples. The upper reaches of the watershed, where the land is too steep for the machinery, continue to be used for pasture, sugar cane and some coffee. The establishment of pineapple monoculture in the region was promoted by an aggressive structural adjustment program whereby the government granted significant economic incentives to foreign firms willing to develop non-traditional crops for export (Bonatti and others 2005). This was coupled with the excellent environmental conditions for the cultivation of pineapple, including steady temperatures between 23–30°C, abundant sunlight, acidic soils, and flat terrains in the alluvial plain (MAG 1991). Pineapple production took off and by 2008 pineapples represented 14.4 % of the net agricultural product, second only to bananas (SEPSA 2009). PINDECO had a lot to do with this expansion, having developed particular fruit varieties and a technological package that allowed the company to increase the density of plantations to 60,000–70,000 plants/ha, the highest in the country (Bonatti and others 2005). In 2005, PINDECO operated 4,500 ha of pineapple in the Buenos Aires county (Bonatti and others 2005).

The social and ecological changes since the arrival of PINDECO are wide-ranging (Chapman 2005). The population in the Buenos Aires county has increased sixfold since 1950s, which has strained the capacity of institutions to deliver services and build adequate infrastructure (Bonatti and others 2005). The structure of communities has changed, there is a shrinking middle-class overshadowed by the influx of landless wageworkers looking for low-skilled labor, while local youth migrate to larger centers in search of more inspiring work prospects. Ecologically, the impacts follow changes in land use patterns resulting from the conversion of pasture to monoculture plantations. According to Bonatti and others (2005), these impacts include: decreased biodiversity, increased landscape patchiness, reduced carbon sequestration potential, reduced flows on the Volcán River as well as other tributaries of the Térraba River, loss of soil organic matter and a panoply of effects related to the use of agrochemicals.

Methods

I set out to explore how people in the Volcán River watershed understood the concept of ecosystem services, how they defined the benefits that they obtained from their natural environment and how they conceived of the relationship between their environment and their well-being using a combination of methods. Although in this article I focus primarily on the experience of photovoice, it is important to note that participant observation, transect walks, workshops and interviews helped to set the stage for the photovoice exercise. Hence, I start with a brief description of these activities.

I lived with local families in Volcán between May and September 2009. Spanish being my mother tongue, it enabled me to participate in community life by partaking in civic committees, religious, social and sports events. Through observation of everyday life and informal interviews ($n > 50$), I gained insights into underlying power relationships that shaped the community, which allowed me to discern possible stakeholders groups within it. For instance, it became clear that the community of Volcán could perhaps be better understood as three neighborhoods that had emerged as the result of disparate social and economic conditions and that maintained little

communication between them. I used these observations to divide volunteer participants for the photovoice exercise into homogenous groups according to their age, gender, occupation, and neighborhood, so that they would feel comfortable speaking in front of one another.

Given that the concept of ecosystem services comes from a particular tradition of Western science, I organized a meeting open to everyone to introduce the research project, the vocabulary of ecosystem services and the classification of services that the MA (2003) proposes. The meeting was interactive and I asked participants to voice the things that they valued doing, being or having, and then asked them to reflect on how nature provided these. The meeting also served to recruit volunteers for the photovoice exercise. In selecting volunteers, no one was turned down and no one was specifically asked to participate. This choice resulted in a sample that did not correspond to the demographic characteristics of the region (Table 1), notably males and PINDECO workers were underrepresented.

Table 1 Characteristics of the 34 residents who participated in the transect walks

Gender		
Females	21	62%
Males	13	38%
Age		
17 and under	12	35%
18–25	7	21%
26–35	4	12%
36–55	9	26%
Over 55	2	6%
Neighbourhood[a]		
Altamira	5	15%
Volcán-Centre	7	21%
Volcán-Peregrino	8	24%
Volcán-Progreso	14	41%
Occupation		
Agriculture	1	3%
Chauffer	2	6%
Housewife	7	21%
Pindeco	2	6%
Student	13	38%
Unemployed	5	15%
Volunteer	3	9%
Waterboard	1	3%

[a] Altamira is a small community higher up in the watershed. Volcán is divided into three neighbourhoods: the Centre is the richest, and it contains the houses of the first white settlers in the watershed; Peregrino was built to house PINDECO employees and other workers (e.g. the town's nurse, bus drivers); Progreso is the poorest neighbourhood built for people who used to live by the river but whom the government forced to relocate

This is partly due to the long workday in the plantations and partly due to the fear of reprisals by the company.

The actual photovoice exercise combined photovoice with a modified transect walk. Each group of 2–4 volunteer participants, e.g. young females from a given neighborhood, met with the researcher separately (Table 2). The participants agreed among themselves on a route within the geographical limits of the watershed, which usually took between 3–4 h to walk. In choosing the route, there were no specific instructions given or requests made to participants, other than the routes should allow for the exploration of ecosystem services that affected the participants' well-being positively or negatively. While the region is rural—communities are made up of neighborhoods of 20–30 households surrounded by pineapple fields—participants often chose routes some distance away from their neighborhoods and that contained natural features, such as a creek. All participants were shown how to use a digital camera and two cameras were provided for them to take pictures during the transect walk. They were asked to take pictures of ecosystem services that affected their health and well-being, in positive or negative ways. Prior to the start, the meaning of the term 'ecosystem service' was revisited and a handout with examples was given to them for reference. Depending on the group, less technical terms, such as 'environment' or 'nature', were used interchangeably with ecosystem services. During the walk, participants were encouraged to adopt the role of guides in interpreting for the researcher how the ecosystem and the changes in the landscape affected their well-being and to take as many pictures as they wished. In total, I conducted 11 transect walks in which 34 people participated.

At a later time, each group met separately with the researcher to discuss the photographs taken during the

Table 2 Transect walk groups

Characteristics of transect walk groups	Number of participants
Men PINDECO workers	2
Members of local water board	2
Men-Altamira	2
Men-Volcán El Peregrino	3
Volunteers-Volcán El Peregrino	3
Women-Altamira	3
Women-Volcán Centro	2
Women-Volcán El Progreso	2
Younger women-Volcán Centro	4
Youth-Volcán El Progreso	12

Note: the group of 12 youths did three shorter transects with four participants in each on the same day

They participated in the subsequent discussion of the photographs as one group

transect walk. Wang and others (1998) recommend to facilitate this discussion following the line of questioning suggested by the mnemonic SHOWED, which stands for "What do you See here? What is really Happening here? How does this relate to Our lives? Why does this concern or strength Exist? What can we Do about this?" (p. 80). I preferred using a semi-structured format modeled after McIntyre (2003) that emphasizes asking what the photographs mean to participants. In this way, I used open-ended questions to ask participants to reflect on what the ecosystem service represented in each image meant for their well-being. I also found that asking participants to choose among the 60–70 photographs that they usually took during the transect walk evoked more personal responses. Hence, after participants had discussed all of the pictures I asked them to prioritize the photographs that depicted the ecosystem services that were more important to their well-being (Fig. 3 displays a sample of the photographs taken by participants). If the group had two people they could choose up to five photographs, if the group had 3–4 people they could choose up to ten. This often brought insights into how the participants conceived of the relationships between the different ecosystem services and also hints of what participants considered acceptable, or unacceptable, trade-offs between ecosystem services. These conversations were recorded and transcribed with their permission. After completing this part, there were 65 pictures of ecosystem services in total that represented 76 benefits, or impacts, according to participants. Since there was repetition among the pictures selected by the different groups, I pooled them into 21 common themes as shown in Table 3.

I interpreted the results from the small group discussions according to the MA (2003) framework to classify ecosystem services and their effect on human well-being (Table 4). For instance, a group of participants said about a picture depicting a cart loaded with cut sugarcane: "This is sugarcane. We think it is good because it brings money. But it also brings chemicals and who knows what, which are bad […] We also make a lot of desserts from sugarcane like sobaos and agua dulce". Hence, I classified sugarcane as a provisioning service (after MA 2003 and TEEB 2010), and based on their explanation I gathered that participants associated sugarcane negatively with the deleterious health effects of agrochemicals, and positively with increasing their material welfare and giving them a sense of identify that comes from making traditional Costa Rican foods. Although I originally intended to uncover possible correlations between particular stakeholder groups in the watershed and the ecosystem services that affected their well-being, the small sample size prevented me from running statistical tests.

Fig. 3 Examples of photographs of ecosystem services taken by participants during transect walks. Clockwise starting *top left*: cattle was seen as a provisioning service; coffee plantations (if shade-grown) were seen as a supporting ecosystem service; soil erosion was seen as evidence of the decline of regulating ecosystem services; the Volcán river was seen as an example of a cultural ecosystem service

Table 3 Explanation of the most common themes regarding ecosystem services identified by participants

Theme	Detailed explanation
Creeks, waterways	Creeks are used for recreation (swimming) and they also provide some fish and water for irrigation during the dry season. Some creeks are contaminated by untreated grey waters and animals (cattle)
Infrastructure	Roads and bridges are essential for communication, safety and livelihoods. Residents often worry about their poor condition. However, the water filtering system in Volcan is among the region's best
Volcan River	The Volcan River was seen in positive ways. It fulfilled a variety of functions including providing freshwater, serving as a gathering place and as a spot for recreation
Coffee	Coffee is a supplemental source of income in which the whole family participates and it is consumed locally. Coffee can be part of mixed cultivation system (agro-foresty) which benefits the environment
Erosion	Soil erosion and deforestation were worries for residents who associated them with increased flooding, less predictable environment, and a reduction on the forest capacity to provide freshwater
Mountains	The Talamanca mountains have a variety of positive connotations. They give a sense of place, they provide water and regulate climate
Pineapples	Pineapples were seen as a source of income which was positive. However, residents also worried about the effect of pesticides on air quality and on the workers themselves
Sugar cane	Sugarcane was seen as a source of income, and hence as something positive. However, there were concerns about air quality (due to burning) and loss of habitat
Garbage	Garbage worries residents who see it as a health hazard and as a symptom of the lack of civic values or environmental consciousness. Some also pointed out the practice of burning garbage as negative
Flood	Flooding is a worry for residents who regularly have to cope with environmental uncertainty and risk as well as with significant material losses
Forest/trees	Forested areas and some trees are cherished by residents who enjoy going for walks and view them as part of a healthy environment
Fruit tree	Fruit trees were appreciated because they supplement food sources and some of them had cultural connotations as they are ingredients in traditional meals
Puddles/standing water	There are concerns about the presence of puddles near the houses where dengue mosquitos breed. Rotting pineapples in the fields attract flies that are a nuisance for cattle and humans
Sewage	Piping for grey waters goes above-ground, which concerns some residents. This is especially true in the poorer neighbourhoods were the water does not actually flow properly and forms puddles
Cattle	Cattle was seen as providing income in the region (it was the dominant economic activity until 1970 s) but there are concerns about the presence of cattle by the river
Fauna	Butterflies characteristic of the region are positively regarded as increasing the enjoyment that residents get from nature
Flora	Participants commented on how they appreciated some flowers and they pointed out that flowers fulfill ecosystem functions, such as pollination, but they didn't relate pollination with their well-being
Medicinal	Medicinal plants found in the wild are used by many residents to treat a variety of ailments
Outdoor recreational	Green spaces (such as the town's square or playgrounds) are used for sports and as gathering spaces
Pesticides	Pesticide use is widespread in large plantations and to kill weeds (on the side of the road). Residents were highly suspicious of their effects on their health
Reforestation	Reforestation activities along the river are viewed as beneficial as they can reduce erosion and in this way reduce the damage done by flooding

Results

Out of the list of ecosystem services identified, there are eight aspects that were mentioned more often and that can be considered priorities, these are: The state of waterways and creeks; the Volcán River; human-made infrastructures such as roads and bridges; pineapple plantations; sugarcane; coffee; erosion and the mountainous landscape. The emphasis on water, crops and mountains is not surprising since these characteristics dominate the physical landscape of the watershed. In terms of ecosystem services, participants identified a variety of functions from their environment but provisioning, cultural and regulating services were more prominent than supporting services. Table 5 below summarizes the links between ecosystem functions and human well-being.

Provisioning Services

The provisioning services of importance related mostly to food sources from which people derive their livelihoods

Table 4 Links between ecosystem services and aspects of human well-being identified by participants

Number of pictures depicting an ecosystem service		Ecosystem function type					Impact on human well-being identified by participants			
		Provision	Cultural	Regulating	Supporting	N/A	Material for good life	Health	Social relations	Security
Creeks, waterways	8	***	**	***			++	++−−	+	+
Infrastructure	6					na	+		−	++−−
Volcan River	6	*	*****				+	+	++++	
Coffee	5	***			**		+++	++		
Erosion	5			*****			−			−−−
Mountains	5		***	*	*		+	++	+	+
Pineapples	5	**		***			++	−−−		
Sugarcane	5	**	*	*	*		+++	−−		
Garbage	4		***	*				−−−	−	
Flood	3			***						−−−
Forest/trees	3		***					+	+	
Fruit tree	3	**	*				++		+	
Puddles/standing water	3			***				−−−		
Sewage	3			***				−−−		
Cattle	2	**					+	−		
Fauna	2		**					++		
Flora	2		*	*				+		
Medicinal	2	**						++		
Outdoor recreational	2		**					+	+	
Pesticides	1			*				−		
Reforestation	1			*						+

The first column on the left indicates the number of times that an ecosystem service was photographed (e.g., there were eight pictures of creeks). In the next column, the ecosystem function is classified using the categories of the MA (2003). The number of stars (*) that appear indicate how often participants identified a particular picture with a particular kind of ecosystem function. The next section indicates the impacts that the ecosystem function had on the participant's well-being. If the participant spoke positively of the ecosystem service it is indicated with a "+", if s/he spoke about it negatively it is indicated with a "−"

Table 5 Number of times that participants identified particular types of ecosystem services with aspects of their well-being

	Material and good life	Health and healthy environment	Social relations	Security
Provisioning	14	3	–	1
Cultural	-	9	9	–
Regulating	1	15	–	8
Supporting	1	3	–	–
Infrastructure	1	–	2	4

Categories are based on the MA (2003) framework

(cattle, coffee, pineapple, sugarcane), but also to the availability of fresh water and some medicinal plants. When participants talked about a photograph that depicted a provisioning service, they associated it with material aspects of well-being (77% of the time), and to a lesser extent with having access to a healthy environment (17% of the time) and security (6% of the time). It was interesting to note how participants spoke of fruit trees compared to monocultures: while the first group was referred as "natural" or "given by nature" and their relation to well-being was portrayed as sustenance, the latter was not perceived strictly as food but rather as a source of income. Indeed, pineapples and sugarcane are not primarily destined for local consumption. This hints at how the introduction of monoculture agriculture brought the beginning of the disassociation of labor and sustenance, something relatively new to this region (Bonatti and others 2005). Further to this point, one participant observed: "before the father would bring home the fruit of his labors, corn or beans… Nowadays he goes to work 12 h and only the money comes back". Overall, participants seemed caught in between mourning for the loss of values connected to working the land and welcoming cash-earning opportunities, however younger participants agreed that "if one is to improve, s/he has to leave the town".

Pineapples, sugarcane and coffee were among the provisioning services more frequently mentioned and there were differences in how participants viewed the impacts of these crops on their well-being. Pineapples and sugarcane were often depicted as a necessary evil, that is, participants agreed that these crops provided them with an income that was needed, but they also pointed out negative health effects for themselves and for the environment, e.g., the use of agrochemicals or air pollution from burning the sugarcane before harvesting it. Coffee on the other hand was seen in a much more positive light. For instance, participants indicated that coffee plants can be combined with trees and that this "protects the land [against erosion], produces oxygen that we humans need and captures carbon dioxide". As well, participants emphasized that coffee picking can be a family activity, usually employing women and teenage children during harvest. This contrasts with pineapple agriculture that has a much more gendered workforce, where fieldworkers are invariably males and women are hired in the pineapple packing factories (along with some males).

Regulating Services

Residents associated regulating functions with aspects of their well-being that related to their health and the health of the physical environment (63% of the time), as well as with security (33%), in the sense of being safe from natural disasters and having predictable surroundings, and the provision of materials for a good life (4%). Nearly three quarters of all the regulating services were perceived as worries, these included erosion due to land-use change; contamination of waterways due to inadequate sewage treatment; side-effects related to monoculture cultivation (e.g., air pollution from pesticide use or from burning sugarcane during harvest); and flooding.

In terms of security, the periodic flooding of the river is worrisome to residents in the centre of Volcán, which sits on the river's floodplain. In an informal interview with an elder woman she mentioned how she worries during the rainy season when she hears the river rushing loudly behind her house. Despite revelations of this kind, and despite having had an unusually high flood in 2007 that broke bridges and caused substantial material damage, many Volcán residents oppose the county government's efforts for risk zoning and relocation. This is because residents feel that they have not been properly compensated during past relocations

Along the same lines, residents were concerned about erosion. The watershed has naturally very steep terrain, as the river descends from an altitude of 3,000 masl at the headwaters to 450 masl in the alluvial plain, in less than 30 km of horizontal distance. However land use change has played a critical role in altering the physical characteristics of the soils in the region (Krishnaswamy and Ritcher 2002). Indeed, the photographs that participants took to illustrate erosion depicted agricultural landscapes. They also photographed the banks of the river, which under Costa Rican Forestry Law (article 33) must have a vegetated buffer of at least 15 m if the terrain is flat and at least 50 m if the terrain is steep, to show that non-compliance is widespread. Participants expressed their frustration at landowners for not doing their part for conservation and indeed, some of the more active grassroots efforts in the watershed are directed at reforesting the riversides.

In terms of human and environmental health, the main worries of participants revolved around pollution, inadequate waste treatment and disease. Participants associated

contamination with the spray of agrochemicals on the pineapple plantations, which are separated from human dwellings only by a natural barrier of tall grasses that is missing in places. A mother commented that sometimes when she "leaves [her] kid in the kindergarten [she] can smell the pesticide", someone else mentioned that "those who spread the poison in the fields have a hard time having babies" or that "the pesticides affect their head". To date, an epidemiological study on the health effects of pesticides used on pineapple plantations in Costa Rica is still needed. However, residents have reason to worry based on past experience from other monocultures (e.g., banana plantations are notorious) and the poor track record in occupational safety of many of the transnational companies that operate in the country (see for instance Thrupp 1991; Sass 2000; Wesseling and others 1993, 2001).

Participants identified a variety of environmental conditions that could have an adverse effect on their health. This was often in relation to some form of contamination, where the regulating capacity of the ecosystem to absorb pollutants had been exceeded. For instance, participants mentioned the risk of getting a skin condition "from fungus in contaminated creeks" that receive untreated grey waters from the houses. Other times, in drawing the connection between health and the environment participants alluded to deficiencies on the built infrastructure. An example was the presence of "mosquitoes with white spots that live in puddles" that transmit hemorrhagic dengue. In this case, the puddles that residents photographed formed on the unpaved streets in their neighborhoods, which they consider problematic by themselves.

Cultural Services

When participants identified cultural functions of ecosystems these revolved around recreational uses, especially around waterways that helped to build social relations; the aesthetic beauty of the mountainous landscape and local flora and fauna species. On the other hand, participants were critical about the presence of garbage in their environment as they associated it with the lack of education or civic values. In terms of livelihood impacts, cultural services affected participants' health (50% of the time) and their social relations (50% of the time).

Almost every transect group chose to include the Volcán River during their walk, which speaks to its centrality. One of the main cultural benefits that the river has served historically is as a gathering place for families. A participant recalls "going to the river on Sundays and finding all the neighbors cooking and sharing food". From the transect walks and other interviews, the consensus that emerges is that residents appreciate what the river provides even though they indicate that its integrity is declining. For instance, participants talked about physical changes of the river that have altered their experience of the place, e.g. "there used to be shade where you could cool down", or "it used to have a lot more water". In some cases, participants showed me old pictures of the river that demonstrated the physical transformation.

Participants identified and boasted about their natural surroundings, and there was a range of benefits that participants derived from their natural settings. Some pointed to how they enjoyed seeing particular fauna, e.g. butterflies. Others observed how "tourists come to see here what they don't have over there". Indeed, eco-tourism is often mentioned as an alternative livelihood option in the watershed, although there is little in terms of concrete action. Still others highlighted the value of landscape features. One group of women showed me a small lake that they do not visit very often, but that "just knowing that it was there" made them happy.

Supporting Services

Participants identified few supporting ecosystem services. In fact, participants did not photograph supporting ecosystem services as such, rather they brought up supporting functions—like soil formation or nutrient cycling—while talking about the pictures of other ecosystem services. This is to be expected because ecosystem services occur as bundles of interacting variables across space and time (Rodriguez and others 2006; Brauman and others 2007; Raudsepp-Hearne and others 2010b). For example, while discussing the photograph of a shade-grown coffee plantation, a participant mentioned that it was "almost like a forest because you can plant poró trees which protect the soil and give us oxygen and sequesters carbon dioxide" and went on to contrasting it with sugarcane, which is grown as monoculture plantations and does not provide any of these benefits. When participants mentioned supporting services they linked these with securing their basic materials for a good life (25%) and maintaining a healthy environment (75%).

Photovoice in the Assessment of Ecosystem Services

As mentioned earlier, the goals of photovoice are threefold: (1) to enable communities to identify their strengths and concerns; (2) to promote critical dialogue around key issues; and (3) to affect policy (Wang and Burris 1997; Wang and others 1998). With respect to these specific goals, the use of photovoice in the Volcán River watershed was effective in the following ways: first, in terms of identifying strengths and concerns, photovoice encouraged

residents to make visible what matters most to them (Turner and others 2008). In doing so, it is the people in the community, and not the researcher who determine what is relevant to the study, choosing the elements and the relations in the system to which they wish to bring attention (Waltner-Toews and others 2003; Hurworth and others 2005). Depending on the context, photovoice can be a tool for openly exploring all issues that a community faces, or it can be more focused on a particular aspect. Since I was interested in the relationship between ecosystem services and well-being in order to inform a future plan for participatory environmental management in the watershed, I used ecosystem services as the entry point while being open to include broader concerns about the environment. Hurworth and others (2005) observe that photovoice tends to produce unpredictable information and, in reviewing the assessment, it was surprising to note the number of pictures of human-made infrastructure that were important for residents but that would have not been included in a typical assessment of ecosystem services.

Photovoice also provided an arena for people to highlight positive aspects of their ecosystem. In fact, when participants discussed possible routes for the transect walks, it was evident that showing me something that they liked was a consideration, even though I just asked them to show me ecosystem services that affected their well-being in positive or negative ways. In turn, this uncovered places that would have gone unnoticed, or whose meaning could have been misconstrued. For example, a group of youth took me to a water hole, most certainly contaminated, but that serves as a fun hangout for them. Likewise, coffee was characterized in mostly positive terms, even though coffee plantations are by no means free of agrochemicals. Hence, in this manner photovoice was a way to correct the researcher's assumptions while facilitating the creation of community perspectives.

Second, with respect to critical dialogue, photovoice helps to create informal conversation forums (Wang and Burris 1997). Since pictures and cameras are rare in the community, it is likely that participants would talk with non-participants about their experience, thus fostering informal dialogue around watershed issues. At the same time, it was interesting that because pictures are fairly self-explanatory and there was a sense of anonymity during the exercise, participants felt freer to photograph issues that were difficult to address openly otherwise. For example, the number of pictures of pineapple plantations from the photovoice exercise contrasted with the experience during an unrelated workshop where people were asked to identify drivers of change in their community and pineapple agriculture was not mentioned once. Indeed, the relationship between PINDECO and the communities has experienced ups and downs. Tensions ran high in the 1990s, when a grassroots movement formed in Volcán to bring attention to the company's environmental impact and PINDECO responded with harsh pressure tactics eventually leading to the demise of the movement (Chapman 2005).

Third, with respect to affecting policy, it is still too early to tell. While a few town leaders were involved in the photovoice exercise, there is a need to include decision-makers at other levels of governance, which will be the objective of follow-up activities. However, this initial assessment can be utilized as a rough baseline to monitor and document change in an inexpensive, yet convincing manner. Particularly for those manifestations of the ecosystem that are visible to the naked eye, e.g., the amount of vegetative cover by waterways, the physical appearance of streams, the presence of garbage, the absence of grass fences surrounding the plantations, the existence of areas with poor drainage around the houses, and so on.

In terms of the larger picture, this assessment aspires to be an initial step in influencing current ecosystem management practices in the watershed towards broader participation from community stakeholders. Currently, the agribusiness model that has been operating in the region for the past 30 years bypasses local community actors in the decision-making process, thus leaving them powerless and vulnerable to environmental change. By contrast, photovoice is compatible with the goals of community-based participatory research, which aim to reduce power differences, build trust and create a sense of ownership (Castleden and others 2008; Catalani and Minkler 2010). Although far from achieving the desired goals in this short time, processes such as photovoice that create critical dialogue around issues important to residents have the potential to catalyze community self-organization, a critical component for empowerment.

Challenges

While photovoice has tremendous potential as a participatory tool in the assessment of ecosystem services, there are also important limitations. For one, taking pictures of ecosystem services is a difficult thing. The main drawback is that, at times, important aspects of ecological integrity are hard to capture in film given the scale at which they occur (e.g., landscape patchiness, soil nutrient loss) and so the photographic equipment available will limit to some extent the scope of the issues that are discussed. Similarly, photographs produce snapshots but cannot capture dynamic flows as one could do with a video-recorder. Hence the dynamic relationships of ecological functions cannot be depicted effectively using photos only. Some have observed that it is important to consider not just what is photographed but also what is left out of the pictures

(Bosak 2008). This issue is common to participant-driven methodologies and it can be explored by asking participants specifically what factors influenced their choice of subjects (Bosak 2008). Finally, the rich, complex data that photovoice produces can be hard to convey in a straightforward manner to policy-makers and it is therefore best to complement it with evidence of a different kind. In many photovoice studies some form of triangulation is used, e.g., participant observation, reflexive journals, etc. In the case of an assessment of ecosystem services, it would be important to include these as well as a biophysical assessment to get a more complete picture.

Likewise, there are limitations with the use of the MA (2003) framework in this context. While the MA offers a good start for thinking about the relationship between ecosystem services and well-being, it would be best to let participants define their own categories for these terms and the scales at which they are relevant. In turn, this would allow classifying the photographs into ecosystem services collaboratively. Instead, I felt that the technical language of the MA would have precluded some participants (although not all) from engaging with it.

One important insight that comes from attempting to interpret what participants felt about the pictures in relation to the MA (2003) framework is that it would be best to distinguish between ecosystem services and ecosystem benefits (Boyd and Banzhaf 2007; Fisher and Turner 2008; TEEB 2010; Daw and others 2011a, b). Along these lines, I propose to consider the path from the biophysical reality to the realization of human benefit as mediated by social processes as shown in Fig. 4. First, through ecosystem management humans manipulate ecosystem functions to produce a flow of ecosystem services, which can be roughly subdivided into provisioning, regulating, supporting and cultural services. Food crops are considered provisioning ecosystem services (MA 2003, 2005; TEEB 2010). Ecosystem services become benefits once they increase human welfare. Environmental governance structures influence the access and distribution of ecosystem services into ecosystem benefits. As an example, warm temperatures, abundant sunlight and acidic soils are physical characteristics of southern Costa Rica. An environmental management regime that relies heavily on mechanization, chemical inputs and irrigation has been established in this region to produce pineapples (an ecosystem service) in monoculture plantations. Through a series of global trade agreements the pineapples are sent outside of the country where they become a benefit for north American and European consumers, or they provide a material benefit to workers in the form of a salary. The process that I have outlined is artificially neat, however, two important insights that emerge from this characterization are: One, that there can be a gap between where ecosystem services are produced and where the ecosystem benefits are realized and two, that this relationship is mediated by environmental management and governance structures.

Conclusion

Understandings of ecosystem services from a community perspective provide valuable insights into the relationship between ecosystem services and human well-being. In the case of the Volcán River watershed, the assessment revealed that participants associated provisioning ecosystem functions predominantly with material aspects of well-being; regulating services with their health and safety; cultural services with developing social cohesion, a sense of place and creating civic values; and supporting services with having a healthy ecosystem. Photovoice can provide a conduit for residents to define the strengths and concerns of their community, thus correcting the perspective of outsiders while fostering wider discussion. Although photovoice has the potential to affect policy, it is difficult to assess its impact in the case of Volcán River watershed.

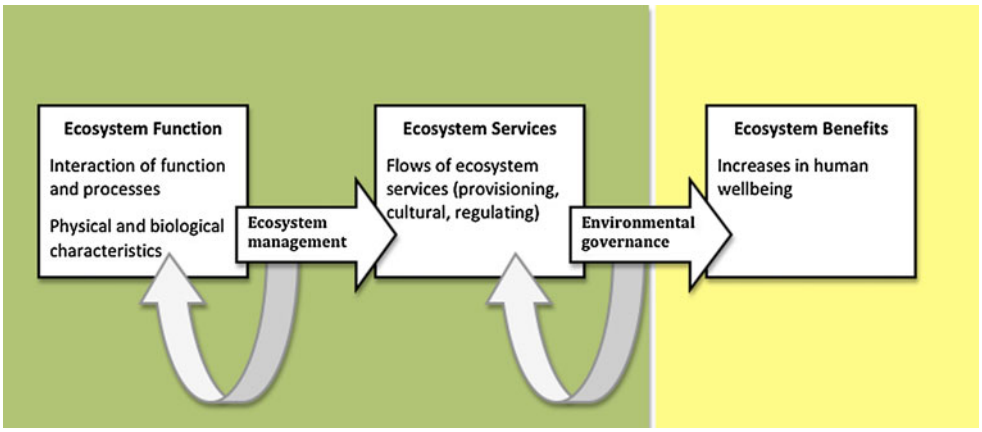

Fig. 4 Pathway from ecosystem function to ecosystem benefit (after TEEB 2010)

The idea advanced by the MA (2003) that human well-being depends on ecosystem services has served well as a departing point and for illustrative purposes, however, its simplicity is deceiving. It would be more illuminating to consider ecosystem services as distinct from ecosystem benefits. This difference is important in the type of analysis that I conducted because while most people generally agreed on what were the main ecosystem services, there might have been more divergent opinions were different stakeholders to consider the benefits that they each derived from the same ecosystem function. This is because the production of ecosystem services does not result, in a straightforward manner, in the increase of human well-being. Instead questions of access (Ribot and Peluso 2003), distribution and personal circumstance mediate the transformation of ecosystem services into ecosystem benefits (Daw and others 2011a, b). Understanding these differences will be an important consideration for future work that should delve deeper into the underlying power relations between stakeholders that regulate access to ecosystem benefits. Likewise, a more targeted approach to choosing participants might have been more revealing of the different perspectives.

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