

International Journal of Biodiversity Science, Ecosystem Services & Management

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/tbsm21>

Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies

Joachim H. Spangenberg^{ab}, Christoph Görg^c, Dao Thanh Truong^d, Vera Tekken^e, Jesus Victor Bustamante^f & Josef Settele^g

^a Department of Community Ecology, Helmholtz Centre for Environment Research UFZ, Theodor Lieser Str. 4, 06120 Halle/Saale, Germany

^b Sustainable Europe Research Institute SERI Germany eV, Vorsterstr. 97-99, 51103 Cologne, Germany

^c Department of Environmental Politics, Helmholtz Centre for Environment Research UFZ, Permoser Str. 15, 04318 Leipzig, Germany

^d The University of Social Sciences and Humanities, No. 336, Nguyen Trai Street, Thanh Xuan District, Hanoi, Vietnam

^e Department of Sustainability Science and Applied Geography, Ernst-Moritz-Arndt-University, Friedrich-Ludwig-Jahn-Straße 16, 17487 Greifswald, Germany

^f Department of Community Ecology, Helmholtz Centre for Environment Research, Barangay Tam-an, Banaue, Ifugao, The Philippines

^g Department of Community Ecology, Helmholtz Centre for Environment Research UFZ, Theodor Lieser Str. 4, 06120 Halle/Saale, Germany

Published online: 06 Feb 2014.



[Click for updates](#)

To cite this article: Joachim H. Spangenberg, Christoph Görg, Dao Thanh Truong, Vera Tekken, Jesus Victor Bustamante & Josef Settele (2014) Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies, *International Journal of Biodiversity Science, Ecosystem Services & Management*, 10:1, 40-53, DOI: [10.1080/21513732.2014.884166](https://doi.org/10.1080/21513732.2014.884166)

To link to this article: <http://dx.doi.org/10.1080/21513732.2014.884166>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies

Joachim H. Spangenberg^{a,b,*}, Christoph Görg^c, Dao Thanh Truong^d, Vera Tekken^e, Jesus Victor Bustamante^f and Josef Settele^g

^aDepartment of Community Ecology, Helmholtz Centre for Environment Research UFZ, Theodor Lieser Str. 4, 06120 Halle/Saale, Germany; ^bSustainable Europe Research Institute SERI Germany eV, Vorsterstr. 97–99, 51103 Cologne, Germany; ^cDepartment of Environmental Politics, Helmholtz Centre for Environment Research UFZ, Permoser Str. 15, 04318 Leipzig, Germany; ^dThe University of Social Sciences and Humanities, No. 336, Nguyen Trai Street, Thanh Xuan District, Hanoi, Vietnam; ^eDepartment of Sustainability Science and Applied Geography, Ernst-Moritz-Arndt-University, Friedrich-Ludwig-Jahn-Straße 16, 17487 Greifswald, Germany; ^fDepartment of Community Ecology, Helmholtz Centre for Environment Research, Barangay Tam-an, Banaue, Ifugao, The Philippines; ^gDepartment of Community Ecology, Helmholtz Centre for Environment Research UFZ, Theodor Lieser Str. 4, 06120 Halle/Saale, Germany

Ecosystem services (ESS) are frequently described as nature's free gift to humankind. However, the first step of ESS and benefit generation is recognising the usability of structures, processes and outputs of ecosystems. This use-value attribution transforms the ecosystem functions (ESF) into ecosystem service potentials (ESP). By investing physical resources, energy and labour, and frequently money as a means to provide them, agents mobilise (part of) the potentials. Cultural, economic and legal constraints limit the mobilisation. The resulting ESS are appropriated to be directly consumed, exploited to provide other goods and services, or marketed, resulting in monetary income. Changing use-value attribution leads to change service potentials, to different mobilisation and appropriation patterns, and different benefits. Human agency, not ESF determine the services provided. This is illustrated by comparing traditional and current services generated from the same ecosystem in four countries undergoing socio-economic transitions: Kenya, Mongolia, the Philippines and Vietnam. All four cases show that changing habits, preferences and modes of regulation lead to specific services provided. Institutions such as tradition, belief systems, markets or state planning are the key to understand which ESS are generated from any ESF. Value attribution, mobilisation and appropriation are key processes.

Keywords: ecosystem services; ecosystem service potentials; use-value attribution; use-value mobilisation; benefits; mode of regulation; institutions

1. Introduction: from ecosystem functions to ecosystem services

This article discusses the relation of ecosystem functions (ESF), ecosystem services (ESS; in parts of the literature they are labelled ES) and the resulting benefits. The systematique used is based on the ESS cascade as suggested by Haines-Young and Potschin (2011; Haines-Young et al. 2012). They describe ESS as nature's free gift to humankind, generated as a rather linear flow from ecosystems to humans. Biophysical structures and processes generate ESF which provide ESS to humans benefitting from them: that is the core structure of their cascade model. For reasons of simplicity, we merge the ecosystem structures and processes, and the functions they bring about as emergent properties of the ecosystem, into one category of ecosystem properties, representing the biophysical basis of service provision (see the first box in Figure 1, named 'ESF and ecosystem elements', the latter comprising ecosystem structures and processes). This provides the space to introduce ecosystem service potentials (ESP, the second box in Figure 1) as an additional stage between the functions ESF and the services ESS, a stage familiar in landscape planning and management, but so far not in ESS

analysis. We show that neither are the potentials determined by the functions, nor can they be assessed by analysing the services: ESP are generated in complex social processes, and they determine the kind of services ultimately realised.¹

Describing the process in a stepwise manner, first an ESF must be recognised. After that a variety of uses and thus of services the system could potentially provide can be identified. We call this step use-value attribution; it results in the societal determination of a set of ESP (as social definitions, they vary with agency and change over time). The ESP are then mobilised, at least in part, to generate actually available ESS. These are appropriated to be either directly consumed, or exploited to produce new goods, or marketed as commodities. All three options provide benefits, direct non-monetary benefits the first, direct monetary ones the last and indirect benefits the middle one.

Each step from ESF via ESP to ESS is narrowing down the scope of potentially available benefits. In pluralistic societies any given function will be attributed to different use potentials by different stakeholders, restrained by a lack of knowledge or imagination. In

*Corresponding author. Email: Joachim.Spangenberg@ufz.de

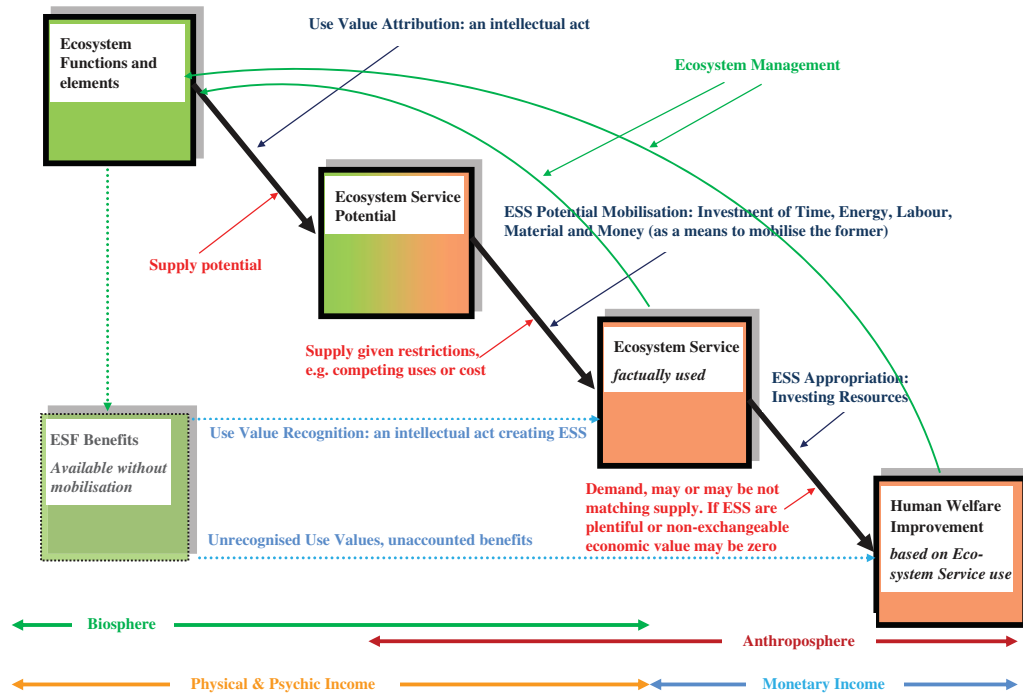


Figure 1. The ESF–ESP–ESS cascade. By attributing use values to functions, use potentials are generated. They require mobilisation investments in order to produce services. Only in the exploitation phase it becomes obvious if there is really a market potential. Then commodification is possible if the owners choose to, but even if not, contributions to human welfare materialise, providing resources (physical income) and enhancing well-being (psychic income, Fisher 1906).

participatory societies, ESP mobilisation faces limitations from external restrictions such as competing uses, legal limitations or cost levels; their institutional system will lead to compromising. The remainder, available for generating ESS, has been called the ESS capacity by Nedkov and Burkhard (2012).

Other authors have made similar distinctions (e.g., Boyd and Banzhaf 2007), while others take ESS as a starting point, defining two meanings of ESF, the *functioning* of an ecosystem and the *function* of a system for human society, that is, as service potentials (Braat & de Groot 2012). We use the term exclusively in the former meaning, for three reasons: (i) this is the meaning commonplace in natural science (although in ecology the term ‘function’ can mean a number of different things (Jax 2010), as ‘potentials’ has been used in different meanings by economists, ecologists and planners); sticking with this basic definition helps avoiding miscommunication between social and natural science. (ii) Using terms with an ambiguous meaning is not helpful for unambiguous analysis; in particular when using the same term for a result of scientific analysis and for a subjective attribution. (iii) The definition as function for human society is not operational without determinism and blurring the distinction between ESF, ESP and ESS. Equating functions and service potentials implies a one-to-one relation of ESP and ESF, creating a veil of ignorance hiding socio-economic processes from the analysts’ eye. Trying to determine ESP based on observed ESS implicitly assumes a relation of $ESS = \lambda \times ESP$, with $0 < \lambda \leq 1$, the load factor

distinguishing functions/potentials and services delivered. However, as λ cannot be derived from accounting for services, the implicit assumption is $\lambda = 1$, allowing to use all three terms as equivalents. Unfortunately, doing so obfuscates the socio-economic processes of use-value attribution and mobilisation: functions seem to determine the services provided, as the ‘free gifts’ of nature to humankind.

Thus, clearly defining ESF as biophysical traits and ESP as socioculturally defined helps avoiding terminological confusion. ESS are then services recognised by humans to be useful (an economics-based definition by Harrington et al. 2010). Once appropriated, individually or collectively, they or the products derived from them can be either directly consumed/enjoyed (e.g., in subsistence economies) or sold. In the latter case, a market supply is established, and provided a corresponding demand exists, the commodification was successful, exchange takes place and market prices can be calculated. However, after all these steps, they cover only a fraction of the services generated, let alone of the service potentials initially available. Figure 1 illustrates this version of the ESS cascade.

The intention of this article is to suggest a plausible description of the steps constituting the benefit generation process by distinguishing stocks (ESF, ESP and ESS) from the flows they generate, or by which they are generated. Doing so requires differentiation between the kinds of services provided, as different kinds of ESS exhibit different ESF–ESP–ESS relations. Provisioning services are either market goods or consumed by the producer and

produced by investing time, labour, resources and knowledge, and often money to mobilise them. Regulating services benefits humans only indirectly, often through the provisioning services they make possible, like biocontrol leading to higher harvest, or coastal protection allowing housing nearer to the water line at constant risk. Investments vary over space and time – the mismatch of beneficiaries and investors may be one reason for the underinvestment in protecting them. For cultural services, the investment made is also time, and societal discourses generating and shaping cultural identity (here a complex feedback loop kicks in, as the perception of usefulness, the use-value attribution, is in turn shaped by culture, identity and societal discourses; Chan et al. 2012). The case studies presented in this article illustrate the approach, focussing on the interaction of cultural and provisioning services (regulating services are only indirectly addressed) in four mixed economies including subsistence as well as market elements. Section 2 formulates the research question against this background and describes briefly the empirical work. Section 3 presents the case studies and Section 4 concludes.

2. Methods: theoretical approach and empirical testing

2.1. *The theoretical basis: ESF, ESP and ESS – deriving the research question*

The four traditional societies described in this article are characterised by a mixed regime of modern and traditional institutions. Whereas the location-specific traditional institutions have co-evolved with the respective ecosystems and the challenges they pose, the modern ones are mainly market-driven mechanisms, and similar all over the world.

Our first research question addresses the use-value attribution: we ask if – and if so, how – the flow between the stocks of ESF and ESP influences their relation in reality, and whether respectively how the second flow, mobilisation, corresponds to changes observed in the ESP–ESS relationship. For this behalf, we describe how the definition of ESP was under the traditional regime and confront this with the changes in ESP definition enforced by the market mechanisms. With changing use-value attributions, the ESP of mostly unchanged ESF change, leading to different mobilisation patterns and thus different ESS. We conclude (in Section 4) that it is highly recommendable for future ESS analyses to take the steps of use value attribution, ESP definition and mobilisation into account when trying to understand which set of ESS is produced from a given set of ESF.

Closely linked to this is the second research question: are the ESS provided free gifts of nature, or are they produced by humans, using nature as an input besides other resources including labour, time and money as a means to mobilise such resources? We pursue these questions by analysing the changes in what are the benefits expected from an ecosystem in all four cases, how this

definition has changed over time under the influence of monetary systems, and which changes in management patterns (ESP mobilisation and ESS generation) have been brought about by this development.

2.2. *Field work: data gathering in the four case study sites*

In order to answer the research questions, data were gathered in all four case studies following a similar approach. As the research question refers to qualitative elements in the interaction of sociocultural, economic and biophysical processes, the method of choice was qualitative, questionnaire supported interviews.

The interview team usually consisted of at least two researchers (in Mongolia and Vietnam plus interpreters), one serving as interviewer and at least one as note-taker; tape recording was possible only twice in Vietnam as in other cases interviewees preferred not to be taped. The team jointly interviewed experts and decision-makers, and separately male and female farmers, and jointly produced a consolidated record of the interviews afterwards. In Mongolia, the 15 interview partners came from the central and the provincial government (departments of agriculture, of industry and of tourism) and from politics (two government and one opposition representatives). In the Philippines, political and administrative representatives from the national, provincial, city and barangay (settlement) level were interviewed (senator, governor, mayors and barangay captains). In Vietnam, representatives from the Lao Cai provincial administration (departments of agriculture and of tourism, in total nine) and the Sapa municipal level (three, tourism administration) were our source of information. In these cases, the selection of interview partners was based on their functions; potential biases are due to the functions interviewees represented but not considered decisive for the issues under analysis. In Vietnam, the Philippines and Kenya, local business stakeholders were included, both from the agricultural and the tourism sector, not a necessarily representative selection. In all four cases, we interviewed peasant farmers, conducting only individual interviews in Mongolia (eight herders), while in Kenya, Vietnam and the Philippines, additional group interviews were held (15–20 people each, one group in Kenya, five groups in the Philippines and seven groups in Vietnam). The data were gathered between 2008 and 2012; their interpretation is backed by additional interview series undertaken in South Africa and Kyrgyzstan within the EO-Miners project; Vietnam and the Philippines were analysed within the LEGATO project.

In each case, the interview team started with an audience analysis, asking the farmers about their social (including family) and economic situation followed by a baseline survey of their land management practices (input, output and processes). In the next step, we tried to identify the respective attitudes towards nature and their cultural background. Experts and administrative professionals

were the main source for the identification of ESF that might yield services (the choice of agricultural and tourism departments may cause a bias, but they represent by far the dominating economic activities in the areas analysed). The service potentials ESP and the services received turned out to be a bone of contention, as different groups (farmers vs. administrators; different departments) held different definitions. Less dissimilar but often not openly discussed were the perceptions regarding who are the main beneficiaries, and who decides what potential services are and which ones are to be exploited. While only few experts and professionals were familiar with the details of changing social practices (this information came mainly from the farmers), they often had valuable information regarding the change of services over time, in particular on the development trends on the macro level, and the structural change associated to it.

As the interviews were held in different contexts, those results relevant to the research questions of this article were selected and transformed into the matrix showing the transitions observed (see Table 1).

3. Results: conflicting institutional modes of regulation – four case studies

In any sociocultural context, the prevailing definitions of ESF, ESP and ESS are regulated by a variety of institutions (Ostrom et al. 2007; Potschin & Haines-Young 2011; Chan et al. 2012). Thus the institutional system of a society, that is, its system of rules for decision-making, is decisive for determining which ESP are defined and later on mobilised, and for the transformation of the resulting ESS into contributions to human well-being. For our research questions, the interplay of different types or systems of institutions plays a key role, some of them part of the economic system and its processes and (global or local) markets (like property rights systems), while others are guided by different rules or laws such as traditional belief systems or cultural and ethical perceptions (such as sacred places or aesthetical values). Figure 2 illustrates that ecological processes are located outside the anthroposphere, while the institutional system of a society, its decision-making mechanisms and orientations are outside the biosphere. Both spheres overlap when human action, shaped and directed by the institutional system, deliberately acts on natural systems, causing pressures to modify their functioning following human interests (unintended side effects and feedback loops are omitted for the sake of simplicity).

Focusing on the choice of ESS actually mobilised from the range of ESP, what is needed is an analysis of the interplay of and potential conflicts between these different institutions and their impact on ESF, ESP and ESS. Thus, institutions within different modes of regulation (Lipietz 1998; Brand & Görg 2001), affecting value attribution, resource mobilisation and realisation of ESS, are at the heart of our investigation. The following cases of traditional regulation processes and their interference with

market regimes illustrate how different modes of regulation differ in their value attribution and thus ESF constitution, and in the subsequent ESS mobilisation, although the landscape and its ESF have hardly changed (yet).

3.1. Case 1: managing the Masai Mara, Kenya

The Masai Mara is a nature reserve of about 1500 km², located in the Southwest of Kenya as the northern extension of the 30,000 km² Tanzanian Serengeti savannah. Located 1500–1650 m above sea level, and with precipitation of 800–1200 mm/year, it is mainly a grass savannah with bush and tree savannah elements, plus gallery forests along the Mara river. It is well known for its hoofed species (eland, wildebeest, zebras and Thomson gazelles, but also warthogs, giraffes, elephants, ostriches, crocodiles, hippos, etc.), their large-scale migration and their predators (lions, hyenas, wild dogs, etc.). The wildlife roams freely across both the reserve and the surrounding conservation areas which are a continuous wildlife ecosystem. The Mara is the end point of a large-scale annual animal migration from the Serengeti, crossing the Mara river to reach a rich grazing area during the dry season in the South. Sustaining these populations is one of the most obvious ESF of the Mara.

Unlike most other National Parks in Kenya, the Masai Mara National Reserve is not administered by the Kenya Wildlife Service, but by the Narok County and the Trans-Mara County Councils; the latter contracts management to the Mara Conservancy, a local non-profit organisation formed by the local Masai. They earned this privilege in the past as experienced warriors in defence of their traditional habits and their home territory, and they practice it as rangers and in the anti-poaching units associated with the Mara Conservancy.

The Masai are traditional herders, with cows as core of their livestock, and herding, gathering and some hunting constituting their subsistence economy (the famous national drink is a mixture of cow blood and milk). They live in small villages consisting of a ring of often less than 10 hamlets, surrounded by a fence consisting of thorny bush to keep out lions and protect the cows which are sheltered in the night in the space between the hamlets. The houses are built around a centre with the cooking place and the beds, where a strong column (a tree with some remains of branches) supports the roof; the walls consist of wattle covered with cow dung. The Masai society is structured by age classes and a gender hierarchy. This kind of lifestyle is dependent on biodiversity and husbandry health; a cow pest in the nineteenth century caused the decline of the Masai empire (Rutten 1992). It is also susceptible to climate change, in particular drought and overuse (population and tourism have been growing rapidly). The traditionally enjoyed ESS include grazing, plant collection and construction material harvested from the Mara.

As a significant part of the former Masai area is no longer accessible to grazing, but either has been turned

Table 1. Changing use-value attribution (UVA) leading to different ESS derived from the same ecosystem function, comparing the former and current situation for the four cases.

Case	Ecosystem function	UVA	Ecosystem service potential	Mobilisation	Ecosystem service	Exploitation	Welfare gain
1 Kenya former	Diverse savannah landscape, high biodiversity	→	Grazable grass, edible fruits and game, stems for construction	Herdling, gathering and hunting, logging	Cattle feed, fruit and meat, construction material	Herd management, cooking, construction	Milk, blood, other food, housing
1 Kenya current	Landscape increasingly grassland character	→	Grazable grass, game tourists pay to see	Burning the savannah	Increased number of grazing animals and their predators	Tourism marketing	Cash income from tourism
2 Mongolia former	Vulnerable grassland. Temporary water scarcity	→	Nurturing herds, in particular horses representing wealth	Herdling mainly horses	Herds of many horses	Milking, sociocultural valuation	Food for the family, prestige and social status
2 Mongolia current	Vulnerable grassland, eroding. Temporary and local water scarcity	→	Nurturing goats for Kashmir production	Stocking up on goats in herds	Grazing many goats	Shearing the goats	Selling Kashmir wool for cash
3 Philippines former	Rice terraces, sweet potato fields, woodlots and forests	→	Suitable for producing rice and sweet potatoes. Water regulation and supply for rice fields	Sustaining terraces for rice planting, protecting forest against overuse	Rice and sweet potato production, mostly sufficient water supply	Drying rice, storing it in the houses, threshing by hand before use	Basis of subsistence existence. Preparing aromatic rice dishes
3 Philippines current	Rice terraces, rich cultural heritage. Increasing erosion problems	→	Attracting tourists ready to spend money. Source of wood	Logging and carving souvenirs	Tourists demanding souvenirs, willing to pay	Selling craft work	Cash income
4 Vietnam former	Rice terraces, forest	→	Extendable; suitable for rice production, vegetables and spices. Forest product collection, water regulation	Sustaining and extending terraces, exploiting forest products, collection, hunting, logging	Planting and harvesting rice, vegetables and spices such as cardamom collecting forest products and firewood.	Drying and storing rice, limited local trade. Producing household goods, e.g., from bamboo, selling them locally	Basis of subsistence agriculture
4 Vietnam current	Rice terraces, rich cultural heritage, eroding	→	Rice production, intensified, ecotourism, ethno-tourism	Mechanisation where possible, pesticide and fertiliser use. Hiking, home stays	Increased yields of non-aromatic rice, often self-sufficiency reached. Tourists paying for stays, buying souvenirs	Producing souvenir textiles and carvings, offering homestays, providing information (museums) and infrastructure	Cash income topping up agricultural incomes, opportunities for entrepreneurs

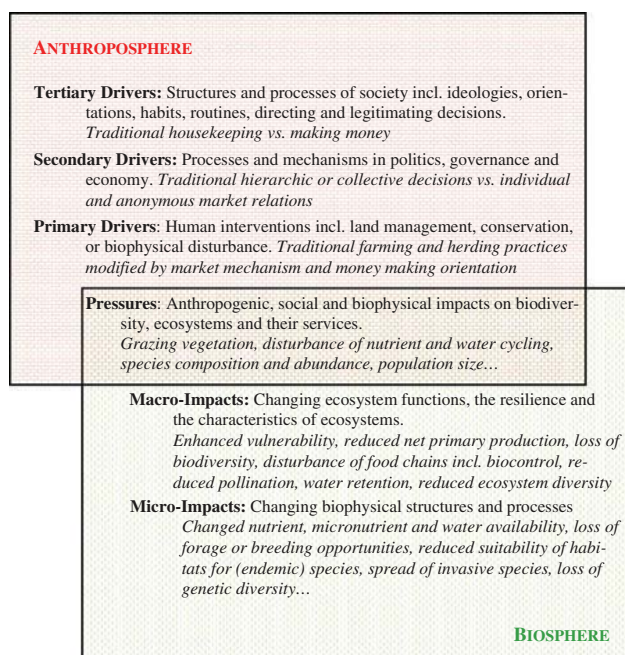


Figure 2. The interface of the anthropogenic and the natural system, and the role of institutions in shaping it. Human interventions (such as harvesting and ploughing) are intended to maximise the provision of certain services (collateral effects not included in the graph).

into settlement and farming area, or belongs to the national park, the growing population cannot be fed in the traditional way. The legal act of establishing the park changed the ESP significantly: gathering is limited, and grazing no longer (legally) possible. Several adjustments of the park size to accommodate communities' needs illustrate the competition of use potential attributions of the traditional and the modern, cash-based economy.

The revenues cashed in from tourists provide a new source of income; today the Masai are dependent on it to stock up the subsistence income from (increasingly productive, Rutten 1992) herding. According to our interviews, besides the remittances from Masai migrated to cities, tourist payments to the Councils are crucial for the economic survival of the communities. They consist of entrance fees to the park, remuneration as tourist guides and the sale of souvenirs. ESS appropriation is no Masai monopoly but the government and entrepreneurs get their share; the Masai play no dominant role in the management of camps around the park. As the number of tourists is decisive for the monetary ESS benefit, the Masai try to maximise this ESS benefit by managing the park accordingly. Consequently, the definition of the Mara's service potential has changed from grazing ground to tourist attraction, and the Masai manage the park to mobilise this potential.

The main management measures are establishing driveways (i.e., setting the course of mud roads connecting sightseeing hot spots) and a regular burning of the savannah resulting in strong grassland growth and less bushes and trees, that is, higher visibility and tourist attractiveness. One indirect effect is also welcome: more grassland attracts and feeds more grazing animals (temporary

population losses were caused by intrusions and poaching, not by the management) which in turn attract and feed more lions, which in turn attract more tourists which 'feed' the Masai. Whereas for herders, a low number of predators and a limited number of competing herbivores were desirable, tourism has turned the tables: more wildlife now means a higher service potential. High lion or cheetah densities are now a major attraction of the park and thus a source of income (commercial ESS benefits). This changed ESP definition – not traditional rules and habits, or biodiversity concerns – determines the management patterns.

However, there are more effects of burning the savannah: the number of trees is declining, as while old ones survive the grassland fires, young ones often do not: the natural rejuvenation of the tree stock is interrupted; intensive grazing contributes to this. Due to the same mechanisms, bush and shrub areas are shrinking or at best stagnate in number and size. Amphibians and reptiles such as lizards, formerly relevant food sources, are lost, as are snakes, birds and insects. The management changes ecosystem composition, processes and functions, and thus unintentionally the ESP. Comparing the Masai Mara to other reserves in Kenya where management does not include burning the savannah, the shift in fauna and flora is obvious.

Among the Masai, the loss of trees is not perceived as depriving the supply of firewood since traditionally cow dung is used as fuel, but the absence of strong stems is felt in house building: due to the difficulty to find sufficiently strong stems for construction, the lifespan of a traditional Masai house has been declining from 30–40 years down to 10–15 years, according to local sources. However, this

disservice resulting from the way of mobilising the newly defined ESP is not recognised as a result of the management approach: that the land management practice may contribute to putting the traditional lifestyle at risk, by gradually eroding its biological basis, was not recognised by our local interview partners.

In the literature, the degradation phenomenon is known, as well as its coincidence with increasing tourism, attributing the decline in biodiversity to 'excessive development of infrastructure to support tourism' (Tallis et al. 2008, p. 9463). As opposed to that, in a meta-study Ogotu et al. (2009) gave a different explanation. They found that the marked and persistent decline in the abundance of six hoofed species throughout the reserve from 1989 to 2003 was associated with progressive habitat deterioration in particular due to changing land use in pastoral ranches bordering the reserve, accentuated by illicit harvest, competition with livestock and elevated predation. The declines were significantly correlated with increasing number of settlements and people in the pastoral ranches for five species (Ogotu et al. 2009).

We hypothesise that it is not the relatively small area of tourism infrastructure, nor exclusively the influence of surrounding herders' settlements (representing the old and the new definitions of ESP, and their inherent conflict), but also the overall system management approach which drives the dynamics of losses. With the change of the ESS appropriated, the traditional strategies of optimising the ESP had become obsolete, and the new ones cause these side effects. The self-regulatory capability of the communities is limited in this respect, as the institutional system is not (yet) capable to deal with the challenges emerging from the new situation. The positive feedback loop (a key institution) of increasing tourism income is not balanced by a negative one: the components affected by biodiversity loss are not those which are valued by tourists, leaving the positive loop unaffected – an institutional mismatch emerges.

The local population does not perceive the degradation phenomenon; the loss of traditional ESS (provisioning of construction material) is not associated with the change in management practice, that is, the mobilisation of the redefined ESP. The resulting scarcity of certain food components and construction material is not an immediate and direct result but unfolds gradually, in the long term. Consequently, the management is not seen as problematic, and the resulting negative feedback loop – if at all existing – remains too weak to limit or modify the prevailing practice. The traditional management system causes conflicts with the new one; traditional institutional mechanisms erode, and with them skills and knowledge. In this way, global market incentives interact with rural livelihoods by redefining the ESP, thus undermining their sustained existence and the ESS, the biodiversity they depend on.

3.2. Case 2: herding in Mongolia

Mongolia is a country of dry grasslands and shallow soils, with an extreme continental climate of long, cold winters and short summers. Mongols have traditionally been migratory herders in a subsistence economy, and they are proud of this tradition and the lifestyle it is associated with. Indeed herding seems to be the most environmentally sensitive ESP to be mobilised in this fragile grass ecosystem. The herders have adapted to the vicarious climate changes by using well-isolated mobile homes called yurts or gers and by using everything from wood to animal droppings as resources for survival. They keep mixed herds of sheep, yaks, horses, goats and sometimes camels, grazing across the landscape. The nomadic culture is related to Shamanism in a country dedicated to Tibetan Buddhism, including rituals for worshipping the sky, water, land and mountains (Christian 2012).

Even in the twentieth century, when peoples with similar lifestyles were forced to settle down in the neighbouring Soviet Union and later in China, this lifestyle remained a part of the cultural heritage and a marginal but existing practice – two competing ESP definitions coexisted. Despite its preference for settled farmers in collective farms, the past time state socialist government even distributed solar cells to the herders to connect their yurts to the radio – nowadays frequently combined with a satellite receiver for TV or even Internet access. By appropriating and commercialising provisioning ESS of their herds, migratory herders now contribute about one-third to the GDP of Mongolia (Chuluun et al. 2011).

Unlike what we observed in countries such as neighbouring Kyrgyzstan in Mongolia significant parts of the tradition and the management knowledge survived. Our interviews revealed that after the collapse of state socialism, old traditions were revitalised (including Buddhist religion), and migratory herding along traditional lines became common, even fashionable. Herders live with their herds, following a seasonal migration pattern over long distances, often based on water availability which as a side effect limits grazing impacts at each location (suppressing such migration contributed to overgrazing in large parts of Northern China, Tong et al. 2004). Nonetheless, they are no longer isolated: TV and mobile phones are omnipresent, and having cars, the next settlements are not as far away as in earlier times.

Traditionally herd size was the only measure of real wealth, but institutionally limited by mutually agreed rules set by the elders and enforced by the different Mongolian tribes in their respective ways. Currently, while the tradition of cattle as wealth still has significant impact on citizens' behaviour (wealth is measured in numbers of animals, not in their market value, complementing monetary income), changing lifestyles and the loss of traditional authorities have weakened the regulation (Akiyama et al. 2012). City dwellers own herds as a status symbol managed by relatives and used as a leisure destination – they are

most obviously outside the traditional system of regulation by informal institutions.

Our interview partners confirmed that today even city dwellers in Ulaanbaatar spend their holidays with their relatives in the country sides and their herds. Children are put on horses before they learn walking – at the age of 3 years they may have their own horse, and at 5 years they ride to school. Even if it is hard to imagine young fashionable disco kids on horses, their relatives insist that they can and do change roles, behaving as ‘real Mongols’: the cultural heritage is an important part of their identity. However, their lifestyle is at risk through a number of intrinsic and external factors. Intrinsic factors include education and population development. In Soviet times, life expectancy rose from about 30 to almost 70 years. Offspring numbers are sinking more slowly, in particular in the herding population where kids are an important source of labour. In the state socialist period, illiteracy declined from about 90% to less than 5% (most of the early literates were Buddhist monks; the majority of them was killed by the early Soviet regime).

Important external factors, representing competing and often dominant ESP attributions and ESS mobilisation and appropriation, are as follows:

- Mining: In spring 2012, The Economist featured a story about Mongolia, titled ‘Mine, all mine’: mining the rich mineral resources was described as turning Mongolia into the fastest growing economy in the world, outpacing China (which would be a very special satisfaction for the Mongols) (Booming Mongolia 2012). However, that is probably not only unrealistic, given the existing infrastructure, the distance to market and institutional weakness but also institutionally it is only the priority of the national government. Locally most projects are facing stiff resistance, from demonstrations to outright attacks and sabotage in defence of more traditional ESP use value attribution and ESS mobilisation and appropriation. Mining destroys the land, and that causes outrage. However, one of the most dangerous aspects of mining is only about to emerge: the contamination of soil and grasslands with radioactive particles caused by wind transport of mining residues from uranium mines. Such a contamination would change the ESP dramatically and irreversibly.
- Land privatisation: While not implemented on a country-wide basis, the demarcation of private land, wherever enforced, is a massive institutional change with severe sociocultural and environmental impacts (Nomadism 2012). The privatisation of grassland use rights is a change of the ESS appropriation, befitting a few who reap the ESS benefits, and inflicting harm on others. It weakens the pastoralists’ ability to benefit from rangelands by weakening or dismantling the rights-, structure- and relations-based abilities that enabled them to

cope with non-equilibrium conditions. This leads to a community failure that engenders feedbacks of increased impoverishment and environmental deterioration (Li & Huntsinger 2011).

- Climate change modifying the ESF and thus changing the ESP: water availability in some regions of Mongolia seems to be declining (according to local observers), in particular in regions that have always been drought prone. Increasing herd sizes due to institutional failures are leading to bottlenecks at the water places during the dry season. Overstocking does not only put pressure on limited water availability, but high stock densities are also ruining neighbouring grazing grounds due to overgrazing and soil compaction, resulting in top soil loss and productivity decline in some of the most fertile grazing areas.
- Finally, the least discussed and monitored phenomenon may be the changing composition of herds as a result of a market-driven redefinition of the ESP, and the environmental impacts resulting from it. This is the aspect we will briefly discuss here.

Traditionally the herds consisted of roughly 80% horses, 5% cows, 10% sheep and 5% goats. According to our interviews, this average composition has been changing dramatically in the last few years. While cows remain just a few and sheep have stayed constant or declined, the number of goats has been stocked up, making up for 40% or more of the herds in some places. The effect is not only additional grazing intensity, but the risk of also completely losing fragile grazing areas: goats (called ‘marauding livestock’ in Western Africa) rip out the grass and its roots instead of just cutting it off, leaving the soil open to wind erosion – a serious problem in the Mongolian climate, and a serious disservice caused by a changed ESS mobilisation and a new ecosystem benefit commercialisation pattern. The tradition of limiting their numbers had good – albeit forgotten – reasons.

The driving force behind this overstocking with goats is a change of the ESP definition from the provision of goods for the subsistence economy to the generation of monetary income, driven by the demand for market goods (cars), and the need to pay for fees (like schooling) in cash. Goats produce Kashmir wool, which offers a market price several times higher (8–10 times, but varying) than sheep wool. Mongolia has become the world’s second largest producer of Kashmir wool, and rumours have it that a significant share of the Chinese production also comes from Mongolia. Anyway most of the Mongolian Kashmir is processed and spun into high price textiles in China. The domestic capacities are limited, and thus the lions’ share of the ESS benefits is not appropriated in the country of origin.

In this way, the partial revitalisation of traditional practices regarding the administration of a common pool good is severely weakened, testifying for the effectiveness of market incentives as well as for their unforeseen

environmental impacts. Biodiversity and bio-productivity are suffering from the intrusion of market mechanisms into traditional management habits.

3.3. Case 3: rice terrace agriculture in Ifugao, Philippines

In the central Luzon mountain area, the Ifugao people have maintained their specific (agri) culture for centuries. They are excellent engineers and architects, building and sustaining terraces as the basis for rice agriculture in a mountain region from 700 to 1400 m above sea level since more than 1000 years. In doing so, they created a human-made landscape designed to provide space for settlements and fields suitable for food production: the desired ESS was the basis for creating a landscape with particular ESF. Organised in tribal structures with informal institutions, the elders played a decisive role in preservation of traditions, decision-making and enforcement. Families tended to live in small traditional (and movable) houses in the midst of their respective rice fields.

The production system was dominated by rice, complemented by *camote* (sweet potato) which was mainly grown in so-called *swidden* areas (Conklin 1980), that is, steep, dry areas, for instance on the dykes or at steep mountain slopes not suited for terraces. Directly around houses and villages small forested areas (woodlots in the sense of Conklin 1980) were maintained, where fruit trees were cultivated and firewood was harvested. Vegetables were partly grown in the rice fields during the fallow season, fish caught in the river or raised in the rice fields, snails collected from the rice fields. Furthermore, free running chicken and few pigs providing provisioning services are typical for Ifugao. Hardly any buffaloes occur; they tend to be too heavy for use in the rice terraces.

The community life was completely oriented at the rice cycle, demanding peaks of labour for seeding, transplanting and harvesting, while less labour intensive times were used for wood provision, forest maintenance, cultivation of *camote* and vegetables, and social life. Figure 3 illustrates the dominance of the rice cycle (inner circle), and how non-rice time was dedicated to other activities. This pattern emerged historically, in particular as under the mountain climate only one harvest per year was possible – based on traditional aromatic varieties (e.g., Tinawon or Ipugo). Traditional aromatic varieties still dominate in the terrace cultures as new high yielding varieties did not perform better; often they were not even able to produce tillers under the given climatic conditions.

Pest control was traditionally organised by the community, with rituals playing an important role. They were performed by the local animist priest, the *mumbaki*, following old traditions and inherited knowledge (Conklin 1980). The *mumbaki* (always male) held ceremonies at each stage of the rice cycle, involving songs and dances, slaughtering sacrificial animals, but also spreading plant-based substance mixtures over the field which may potentially have been effective repellents for many pests. A key element of

minimising pest damage may relate to the synchronisation of rice growth combined with a rather rice-free fallow period all over Ifugao (see Loevinsohn et al. 1988). On the other hand, as the efficiency of natural enemies might even increase in the case of larger asynchrony of the system (Heong et al. 1992; Way and Heong 1994; Heong 1996), local synchrony was combined with regional asynchrony as in other traditional rice producing systems (Lansing 2012). The rich landscape structure may have additional beneficial effects on the dynamics of pests and their natural enemies; the application of pesticides was and will most probably never be necessary in Ifugao rice agriculture.

Traditionally, the most successful farmer of the previous years had the privilege to start the transplanting of rice seedlings, and – mobilised by the *mumbaki* – all farmers of the village would follow just on the same day (neighbouring villages tended to start on different dates, allowing for mutual support in the harvest season, paid with a standard number of rice bundles). The steep mountain area, the terrace agriculture and the social institutions of time management and collaboration are part of the cultural identity of the Ifugaos – a set of cultural ESS, unintentionally co-produced with the provisioning services.

Today *camote* planting has been pretty much given up (in particular around Banaue), while remittances and tourism provide new sources of income (Ifugao, and in particular the municipality of Banaue, is now the third ranking tourist destination in the Philippines). Whereas remittances

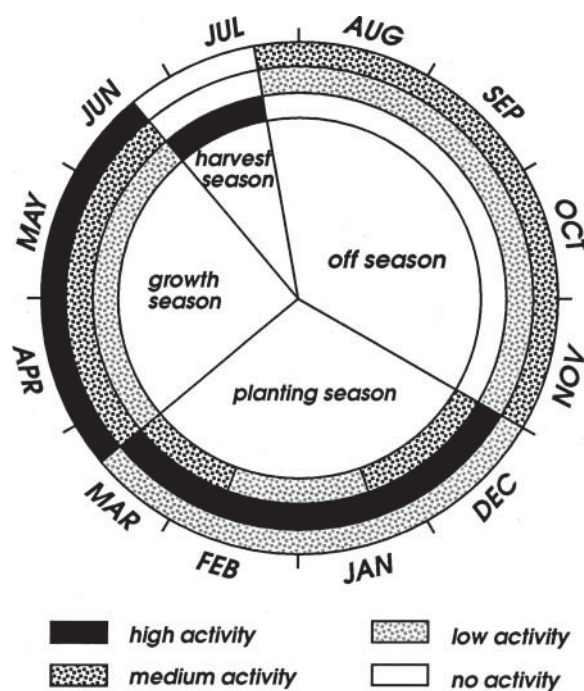


Figure 3. Ifugao land-use cycle of the Banaue area, Philippines, in the 1960s (taken from Settele and Martin (1998); based on Conklin (1980)). Note: Inner circle: activities in rice/pond fields; middle circle: swidden fields (=sweet potato); outer circle: activities in woodlots = small patches of (mostly fruit) trees.

are benefits not provided by the local ecosystem, tourism is dependent on the rice terraces as the main attraction of the region, as a cultural ESS. For long time tourism activities were bound to feed into the scheme set by the rice cycle (although the synchronisation based on traditional rituals has long been eroding), but the situation seems to be changing at the moment. An increasing number of farming families have recognised the additional ESP the anthropomorphic landscape provides, sustained by the work necessary to mobilise the provisioning services (i.e., by sustaining and farming the terraces), and try to appropriate a share of the benefits from tourism. However, while being aware of the need to sustain the terraces, the changed value attribution nonetheless changes the routines: an increasing number of local inhabitants are prioritising the cash income from carving wooden souvenirs and selling them to tourists over an optimal income from rice farming. This is visible from the fact that they continue carving and selling carved items right into the rice transplanting period, thus risking a bad harvest, or even a complete loss, in order to exploit the opportunities from tourism.

The suspended or shifted rice planting period bears the risk of damages caused by an overlapping of the flowering rice crop stage with the annual monsoon period. Further, while ecologically the application of pesticides does not make sense, the temptation to use pesticides may increase, for example, through industry-based extension activities praising the 'time saving potential'. In that case, not only cultural heritage/ESS would be lost, but also the opportunity to market local products as traditionally organic (another new potential provisioning ESS, competing with and complementary to tourism), together with an important element of the reputation attracting tourists (the cultural ESS).

A further key element for rice production currently at risk is the private and community forest above the terraces, the *myung* which due to its large proportion of endemic species represents a globally important natural heritage, while the high species diversity also contributes to natural pest control (a regulating ESS). The water retention ESF of the *myung* is not only essential for preventing severe erosion and mudslides (an ESS), but also for safeguarding the water supply for the vertical irrigation system, a precondition for terraced rice cultivation (an ESP mobilised by building and maintaining technical irrigation systems and their sociocultural control mechanisms). However, the demand for carving wood has already substantially contributed to the loss of larger trees in the *myungs*, rendering wood suitable for carving a scarce resource in many places. Consequently, either wood is imported from the lowlands, or less suitable trees (fast growing soft wood species like alder) are used for carving, further undermining the ESF of the *myung*. Thus, while tourism creates additional incomes (ESS), its secondary effect (the redefinition of the ESP) does not only contribute to the disservice of rice terrace degradation and abandonment, but they even undermine tourism's own resource base: a typical case of competing ESP providing different yet mutually dependent ESS.

As agriculture is the *raison d'être* for sustaining the terraces, the prime ESP, a neglect of agriculture threatens to undermine the maintenance of the very object that attracts tourists in the first place, and thus the secondary ESP, the generation of income from tourism. Damaged terraces and irrigation systems as a result of insufficient investments in prime ESP mobilisation need substantial manpower and financial means to be reconstructed or renovated. As this might easily be overstraining regional capacities (in particular if not subsidised from the benefits generated from the secondary ESS, tourism) the risk of a permanent loss is not negligible. The opportunity for generating a cash income in a local economy characterised by a mixture of market and subsistence income begins to erode the very basis of the subsistence economy: if the non-monetary income in form of the rice harvest is not complemented by monetary transfers honouring the maintenance of the rice terraces, the market may absorb former farmers. However, once the prime ESP is no longer mobilised, it will be almost impossible to maintain the terraces: The shift to a new ESP could be undermining its own basis, the human-made landscape and its ESF, in a vicious cycle.

3.4. Case 4: terrace agriculture and tourism in Lào Cai, Vietnam

The Lào Cai province is located in the northern mountain area of Vietnam, bordering the province Yunnan in China. It is currently one of the two poorest provinces in the country, with more than 70% of the population living under the poverty line. Traditional economic activities such as agriculture and forestry and their ESS remain important, constituting nearly 80% of the economic activity; cross-border trade with China is a growing source of income, as is tourism centred on trekking, with ecotourism gaining ground. National parks and the locally unspoilt landscape provide the ESF for this new ESP.

The temperature in the lowland varies between 10°C and 35°C, while in the mountain region of Sapa (1600 m above sea level), close to the 3243 m Fansipan mountain (called 'the roof of Indochina'), it is between 25°C in July and even below 0°C in January. With rainfall between 1500 and 2500 mm/year it is a very humid region. Lao Cai agricultural ESS includes the production of not only rice but also other agricultural crops such as maize and – in particular in the lowland valleys – specialties such as plums or cardamom. In the lower parts, and in the valleys of the mountain region, two rice harvests per year are possible, while the climate conditions restrict the agricultural ESP year in the mountain rice terraces, the short growth period allowing for only one crop year, between March and August.

Those terraces have been built for the last 300–600 years by different ethnic groups living in the area, among them the H'mong, Dao, Giay and Tay, mobilising the ESP. Their terraces have been and are still built in differing forms and at different elevations. Throughout the year,

rice growing is complemented by mobilising other ESP, planting maize (often on steep slopes above the rice paddies), vegetable growing/gardening and animal husbandry, while other crops such as cardamom, or forestry product collection and housekeeping have time patterns of their own, well fitted into the local rice cycles (see Figure 4). A complex mix of ESS is generated, varying in its composition throughout the year as labour availability restrictions by the rice cycle determine the possible mobilisation efforts for other ESS.

The past subsistence agriculture is facing problems, not least due to the traditional inheritance scheme dividing the land a family cultivates (the state is the official owner) between the sons. Within average six children which – unlike in earlier times – due to the improved healthcare system tend to survive, the ongoing extension of terraces cannot keep up with the increasing number of families to feed. The demand for the traditional ESS, rice provision, is out-competing the ESP and its growth potentials. As a result, indigenous farmers are dependent on rice supply from lowland regions organised by the government.

While in the province a limited degree of industrialisation is taking place, in particular in the mining sector, and the cross-border trade with China provides some not ESS-based income opportunities, this is hardly the case in Sapa. Here tourism is the dominant source of complementary income, and for many families the economic basis of their existence. Tourism has been recognised as a valuable ESS and source of income by the provincial authorities, as our interviews have confirmed. Its development follows a pattern set by state authorities, but on the local level private hotel owners, tourism agencies, restaurants and souvenir traders play a crucial role in mobilising this cultural ESP. Many of them belong to the Kinh ethic

group, as Vietnam's vast population majority, but the provision of goods is in the hand of local peoples, providing food (mostly rice) and souvenirs (textiles, wood carvings, etc.). While the administration considers the quality of textiles on offer as poor and opts for training courses to enhance it, local women explain that they take a year to produce a high-quality outfit for their own use, less so for their husbands and of course do not invest the same effort in tourist products. The main form of tourism is low budget cultural tourism, including hiking in the Fansipan mountain area and natural reserve, visits to ethnic minority villages selected (and partly built for that purpose) by the government and homestays with local farmers (a programme supported by the provincial administration) selected for that by the local branch of the government tourism agency. The limited investment in mobilising the ESS/income opportunities from tourism is based on a clear cost-benefit analysis regarding the potential income from budget tourism, and reflecting the primacy of agriculture. Despite the large area of sourcing for tourism products (up to 60 km from the tourism hot spots, according to our interviews), erosion of the primacy of the agricultural ESS mobilisation and appropriation is not observed. Only a limited number of farmers' families members, usually too old or too young for working in the fields, spends most of their time on souvenir provision and trade.

Traditional animist religious regulation and time structuring are only visible in the holiday and festival calendar of the different groups; in interviews male farmers deny their relevance, while females seem to uphold at least part of the tradition. Nonetheless, both emphasise the importance of the mountain landscape for their cultural identity. This cultural ESS, with or without transcendental elements, is mobilised by collective action (e.g., rituals) and

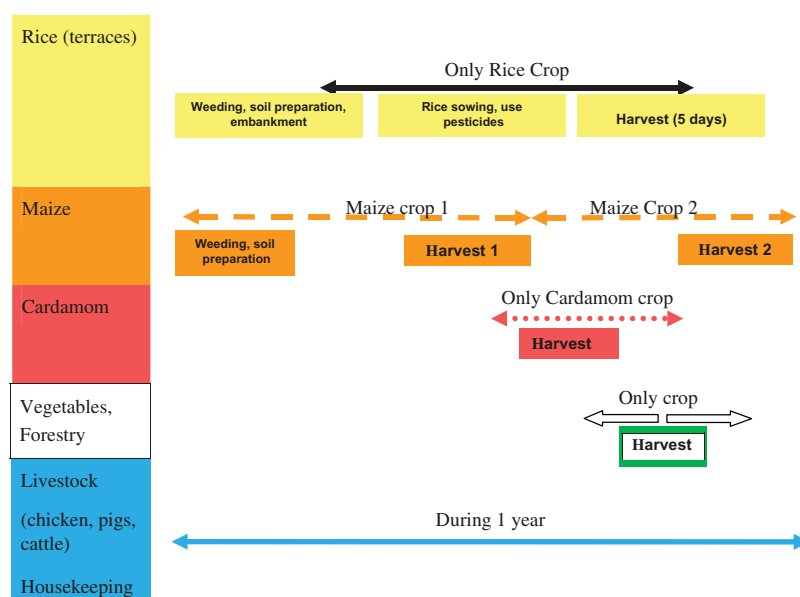


Figure 4. Land use in the Sapa region of Vietnam. Distribution of activities in different compartments of the agricultural system throughout the year. The rice cycle dominates; labour intensive work periods of other crops are neatly fitted into the gaps of work in the rice fields.

everyday communication, and still expressed by wearing traditional clothes, from early age on.

The traditional agricultural system is thus modified by two overlapping external influences: government planning and market mechanisms. The intention of the Vietnamese government is to reduce food aid dependency by enhancing rice yields through agricultural modernisation, thus modifying the ESP and changing the mobilisation efforts by introducing provincial government regulations and recommendations regarding rice varieties to be used and complementary crops to be planted. Extension workers promote the substitution of traditional subsistence varieties for high yielding ones for the market, with seeds originating from the International Rice Research Institute IRRI in the Philippines and from China. In the meantime even hybrid varieties are promoted, plus the corresponding use of chemical fertilisers, herbicides and insecticides; the product provision happens through private traders and in the local market. In the valleys, where mechanisation is possible, this has led to an increase of yields from 1–2 t/ha to 5 t/ha and more per harvest, but in the terraces where human labour and occasionally buffaloes are performing the mechanical work of ESP mobilisation, the increase of yield and thus the effect on ESS is limited. Nonetheless, traditional agricultural practices are fading and the environmental impacts of pesticide use (most often without taking dosing and safety provisions into account) begin to be felt: the disservices of intensification are unfolding, while the knowledge about how to mobilise the ESP without such effect is becoming scarce.

Both government and businesses are promoting diversification of income sources, and an increasing role for ecotourism as a means to exploit the landscape's aesthetic ESP, although their communication and coordination leaves significant room for improvement. Regarding agricultural ESS, however, both sectors send diverging signals (although the possible conflict between the ESP of ecotourism and intensification including pesticide use is not in issue of debate yet). Local farmers use most of their rice production for their daily life (appropriating without commercialising the ESS: selling rice is not popular – a traditional habit). Nonetheless, they are attracted by the fact that due to its more aromatic taste (a higher quality ESS) traditional rice, sticky and non-sticky, carries a higher price than high yielding varieties, offered mainly by hotels, restaurants and visitors. This demand has to be fulfilled with rice produced in the region as supply from other regions is limited due to high transport cost. Thus tourism and the market encourage the preservation of traditional habits and products (rice, clothing, artwork for the market), an influence partly competing with the government's agricultural modernisation strategy. Again competing ESP are defined on the basis of the same ESF, and lead to a mix of ESS mobilisation strategies.

4. Discussion

The article draws on four case studies to illustrate a well-known phenomenon, the fading of traditional regulatory

mechanisms in the presence of commercial markets. They are presented here to illustrate how the approach of ESS provided by mobilising ESP defined by stakeholders can be used to describe such developments. The empirical basis is a number of qualitative stakeholder interviews – identifying relevant mechanisms, not deriving statistically significant data was the objective. Thus, selection bias poses a lesser risk than in quantitative studies; additional mechanisms not revealed in the interviews due to bias would complement rather than undermine our findings.

In the first case described, the Masai Mara management for tourism, the landscape and thus the ESF are modified to better exploit the opportunities offered by the market. To generate income from services by mobilising the service potentials identified, farmers introduced non-traditional landscape management methods (large-scale burning the savannah) and objectives (cash income). This is different in the second and the third case. In Mongolia, the ESF may be overexploited due to the pull effects from markets in the country and beyond. Offering more cash for cashmere than for wool constitutes a pull effect on each herder triggering a collective, ecologically unsustainable change in herd composition and thus in ESS generation, overruling the traditional experience-based herd composition rules. Unlike in the Masai Mara case, changing ecosystem processes and functions is not an intended effect, but an unintended and not (yet) realised side effect, a collateral damage of generating market income from cashmere production as the new ESP attributed to the fragile grazing land. In Ifugao (Philippines), the new value attribution and ESP, and the resulting behavioural change are not collective. Traditional farming, largely regulated by subsistence economy traditions, continues alongside market-driven tourism activities. The coexistence of the traditional perception of ESP and the new perception are represented by different subgroups of the local society – a potential for conflicts over ESP definition and ESS appropriation exists as tourism depends on unremunerated terrace sustenance work. The two spheres are regulated by different institutions, some of them strongly local or regional (the traditional rice cycle), some more national (the governmental subsidies for foreign rice) or even international (such as tourism and the global markets for rice and ecotourism). As the market-based activities attract an increasing share of the work force due to lighter work, better salaries, higher reputation and public support, traditional farming depends on a shrinking number of mostly elderly farmers. Some traditional knowledge has already been lost, and much more is at risk. In Vietnam (see also the ESF–ESP–ESS classifications in the table) again external pro-market signals by government and businesses modify the ESP through new value attributions. This leads to changes in the local institutional system and creates additional challenges for traditional ESS provision, a sustainable agriculture based on inherited regulatory systems. Whereas tourism and local consumption patterns encourage the preservation of traditional products and production processes, and thus of local

cultural identities, this conflicts with the government's agricultural modernisation strategy, aimed at producing surplus for the world market: incommensurable ESP definitions provoke conflicts.

A clear distinction between ESF, ESP and ESS and the socio-economic processes linking them makes it possible to analyse the complex relationships between ecological and socio-economic processes in more detail and to address conflicts between different modes of regulation. These conflicts include but go beyond potential trade-offs in the use of ESS; they are policy relevant as they involve real-world management strategies and institutional regulations that govern the value attribution, usability definition, appropriation and exploitation of nature. Such conflicts may create huge positive or negative impacts on social issues, affecting, for example, the income distribution and social welfare across different social groups, both local and non-local, and on ecosystem processes and functions (e.g., through overexploitation, but also by undermining traditional management practices). Analysing the conflicts between different modes of regulation by identifying conflicting ESF, ESP and ESS offers the opportunity to *ex ante* assess probable or at least possible real-world outcomes of strategies of ecosystem utilisation and exploitation.

4.1. Conclusion

Traditional habits and institutions coexist with market incentives and changing preferences, leading to specific kinds of service potentials being recognised and services being provided. In particular sociocultural ESS may change already with alterations in the use-value attributions, as the perception of the landscape is a part of the cultural identity. Societal processes, with their typical mix of traditional norms, changing preferences and interfering or emerging power relations decide on the ESP attributed to any ESF, and thus on services delivered and their beneficiaries.

The different relations of ESF to ESP (and downstream, to ESS and contributions to human welfare) in the four cases illustrate that ESF, ESP and ESS should be distinguished whenever more than incremental changes of user groups and/or use objectives are dealt with. In the case of marginal changes of functions and service potentials, outside the vicinity of tipping points and far off other discontinuities, they are still distinct entities, but it can be a legitimate and useful simplification to take the changes in one as proxies for the changes in the others.

However, where these conditions are not given, the differentiation is needed to adequately describe their complex relationships. Simultaneously, the different, culture and context-dependent social processes of use-value attribution, mobilisation and appropriation need to be analysed to understand how potentials, services and benefits are generated. This is particularly important if the ecosystem cascade concept is used for the management of ecosystems and wider landscapes, turning the cascade into stairways,

from desired benefits up to management measures modifying ESF. Thus, it is important to be aware that ecosystem services are man-made, conceptualised in the step of use-value attribution and realised through anthropogenic activities (ESP mobilisation and ESS appropriation). For provisioning services, this is usually realised by the investment of time, energy, materials and labour which can be bought by money or be contributed based on non-market social relations. This requires rethinking a concept of ESS which in the recent past has seen ESS as free gifts of nature, disembedding their provisioning and enjoyment from its sociocultural and political context.

Psychology, cultural anthropology and sociology still have to contribute a lot to improve our understanding of the processes of use-value attribution, and together with political and ecological economics to explain the processes of ESS mobilisation and exploitation. Particular efforts are needed to address not only potential trade-offs of different value attribution and valuation methods, but also to analyse the outcome of real strategies of ESS mobilisation and appropriation, and their impacts in social, economic and ecological terms. In particular the links of such strategies to environmental justice conflicts offer a rich and so far rather untapped field for future research. Analysing the socio-economic system as a system governed by a system of economic, social and cultural institutions (which includes the perception and definition of ESP and ESS, but also the property rights and market structures) offers the opportunity to address non-intended side effects of institutional reforms and large-scale planning, both in ecological and socio-economic terms. We are confident that performing such analyses *ex ante* can help taking potential unintended side effects into account early in the planning phase in order to minimise them.

Acknowledgements

This article has benefitted from discussions with colleagues. We are particularly grateful to Vera Tekken, Monina Escalada, Beatriz Rodriguez Labajos, KL Heong, Benjamin Burkhard and Christoph Görg. Special thanks go to our colleagues in the Ecosystem Services Partnership Cascade Task Force, Marion Potschin, Roy Haines-Young and Ralf Seppelt, for inspiring discussions about the ESS cascade. We were able to improve earlier versions of the manuscript due to helpful feedback from two anonymous reviewers.

Funding

This work was supported by the German Federal Ministry for Education and Research under research grant no. FKZ01LL0917A-01LL0917O, for the LEGATO project.

Note

1. The article does not refer to what has been called 'final ESS', that is, services enjoyed directly without any processing, such as breathing oxygen.

References

- Akiyama T, Nomure R, Li J. 2012. An integral approach to sustainability assessment of pastoral livelihood system in the Inner Mongolia, Dryland China. Paper presented at: People, Progress and Environmental Protection. 18th Annual International Sustainable Development Research Conference; Hull, UK.
- Booming Mongolia: Mine, all mine. 2012 Jan 21. *The Economist*; p. 47–48.
- Boyd J, Banzhaf S. 2007. What are ecosystem services? The need for standardized environmental accounting units. *Ecol Econ.* 63(2–3):616–626.
- Braat LC, de Groot R. 2012. The ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy. *Ecosyst Serv.* 1(1):4–15.
- Brand U, Görg C. 2001. The regulation of the market and the transformation of the societal relationship with nature. *Capitalism, Nature, Socialism.* 12(4):67–94.
- Chan KMA, Guerry AD, Balvanera P, Klain S, Satterfield T, Basurto X, Bostrom A, Chuenpagdee R, Gould R, Halpern BS, et al. 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience.* 62(8):744–756.
- Christian D. 2012. An anthology of Mongolian history. *J Econ Soc Hist Orient.* 55(4–5):4–5.
- Chuluun T, Ojima D, Kasperson R, Berberian M. 2011. Land in transition: coping with market forces in managing rangelands in Mongolia. In: Kasperson RE, Berberian M. editors. *Integrating science and policy: vulnerability and resilience in global environmental change.* London: Earthscan; p. 363–380.
- Conklin HC. 1980. *Ethnographic Atlas of Ifugao: a study of environment, culture, and society in Northern Luzon.* London: Yale University Press.
- Fisher I. 1906. *The nature of capital and income.* New York: Kelly Publ.
- Haines-Young R, Potschin M, Kienast F. 2012. Indicators of ecosystem service potential at European scales: mapping marginal changes and trade-offs. *Ecol Ind.* 21:39–53.
- Harrington R, Anton C, Dawson T, De Bello F, Feld C, Haslett J, Kluvánková-Oravská T, Kontogianni A, Lavorel S, Luck G, et al. 2010. Ecosystem services and biodiversity conservation: concepts and a glossary. *Biodiv Conserv.* 19:2773–2790.
- Heong KL. 1996. Pest management in tropical rice ecosystems: new paradigms for research. In: Hokyo N, Norton G, editors. *Proceedings of the International Workshop on Pest Management Strategies in Asian Monsoon Agroecosystems.* Tokyo: Kyushu National Agricultural Experimental Station, Ministry of Agriculture, Forestry and Fisheries; p. 139–154.
- Heong KL, Aquino GB, Barrion AT. 1992. Population dynamics of plant- and leafhoppers and their natural enemies in rice ecosystems in the Philippines. *Crop Prot.* 11:371–379.
- Jax K. 2010. *Ecosystem functioning.* Cambridge: Cambridge University Press.
- Lansing S. 2012. *Perfect order: recognizing complexity in Bali.* 4th ed. Princeton (NJ): Princeton University Press.
- Li W, Huntsinger L. 2011. China's grassland contract policy and its impacts on herder ability to benefit in Inner Mongolia: tragic feedbacks. *Ecol Soc.* 16(2):1–14.
- Lipietz A. 1998. *GRÜN – Die Zukunft der politischen Ökologie [Green – the future of political ecology].* Vienna: Promedia Verlag.
- Loevinsohn MA, Litsinger JA, Heinrichs EA. 1988. Rice insect pests and agricultural change. In: Harris MK, Rogers CE, editors. *The entomology of indigenous and naturalized systems in agriculture.* Boulder (CO): Westview Publ; p. 161–182.
- Nedkov S, Burkhard B. 2012. Flood regulating ecosystem services – mapping supply and demand, in the Etropole municipality, Bulgaria. *Ecol Ind.* 21:67–79.
- Nomadism in Mongolia: The – best place – last. 2012 Dec 19. *The Economist*; p. 27–28.
- Ogutu JO, Piepho HP, Dublin HT, Bhola N, Reid RS. 2009. Dynamics of Mara – Serengeti ungulates in relation to land use changes. *J Zool.* 278(1):1–14.
- Ostrom E, Janssen MA, Anderies M. 2007. Going beyond panaceas. *PNAS.* 104(39):15176–15178.
- Potschin MB, Haines-Young RH. 2011. Ecosystem services. *Prog Phys Geogr.* 35(5):575–594.
- Rutten MMEM. 1992. Selling wealth to buy poverty: the process of the individualization of landownership among the Maasai pastoralists of Kajiado district, Kenya, 1890–1990. Fort Lauderdale: Breitenbach.
- Settele J, Martin K. 1998. Rice terraces of Ifugao (N-Luzon, Philippines)-ecological history and developments. In: Settele J, Plachter H, Sauerborn J, Vetterlein D, editors. *Rice Terraces of Ifugao (Northern-Luzon, Philippines). Conflicts of Landuse and Environmental Conservation.* UFZ-Bericht 5/1998. Leipzig: UFZ; p. 13–28.
- Tallis H, Kareiva P, Marvier M, Chang A. 2008. An ecosystem services framework to support both practical conservation and economic development. *Proc Natl Acad Sci USA.* 105(28):9457–9464.
- Tong C, Wu J, Yong S, Yang J, Yong W. 2004. A landscape-scale assessment of steppe degradation in the Xilin River Basin, Inner Mongolia, China. *J Arid Env.* 59(1):133–149.
- Way MJ, Heong KL. 1994. The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice – a review. *Bull Entomol Res.* 84(4):567–587.