Biofuel as Social Fuel:
Introducing Socio-Environmental Services as a Means to Reduce Global Inequity?

Abstract

The increasing cultivation of energy crops for biofuel production has significantly altered the focus of the traditional agricultural sector. But the impact of biofuel production and use is not merely an agricultural one. Even more importantly, it is an issue, which – by demanding a trade-off provocatively labeled as 'food vs. fuel' – likely promotes inequitable conditions and the social conflict of different (basic) needs in north and south. Within this context, the dominant argument criticizes the growing demand for biofuels in the north to compromise food security and sovereignty in the south. It thus remains questionable, whether the production of biofuels can meet its promise of *sustainable progress*, if the western standard of mobility so offensively confronts the demand for sufficient food in parts of the developing world.

In order to address these trade-offs and conflicts, objective of this paper is the introduction of a conceptual framework of *socio*-environmental services. By expanding the construct of environmental services to explicitly include the social dimension, it shall accommodate for the fact that the provision of environmental services is often embedded in a complex system of global (economic, ecological as well as social) interdependencies. Recently, the concept of payments for environmental services (PES) has received much attention with respect to its potential contribution to both environmental sustainability and the economic alleviation of poverty. By linking the idea of payments for *socio*-environmental services (PSES) to the three functions of justice (i.e., procedural, distributive, and compensative), its beneficial impact may be more fully tapped.

Consequently, the paper shall help to answer the question, how global resources (natural as well as financial) can most efficiently and equitably be allocated, given the constraints imposed by the meta-objective of sustainability – including, e.g., the protection of ecosystems, climate change mitigation, energy security, social justice, or poverty alleviation.

Introduction

Agriculture can provide a better mix of ecosystem services to meet society's changing needs. Farmers depend on, and generate, a wide range of ecosystem services. Their actions can enhance and degrade ecosystems. Through changes in land-use and production systems, agricultural producers can provide a better mix of ecosystem services, expanding the share of those characterized by positive externalities, to meet society's changing needs.
-- FAO 2007, p. 10

Agricultural landscapes have long been discussed in the literature with respect to their role in providing ecosystem services. Björklund et al. (1999), for example, discuss the impact of production intensity on the ability of agricultural landscapes to provide ecosystem services, while Swift et al. (2004) focused on the valuation of ecosystem services (specifically biodiversity) and its protection under intensified agricultural land use conditions. The Food and Agriculture Organization of the United Nations (FAO*)* instead stresses the fact that 'agriculture' constitutes both a notable source of the three major greenhouse gases (carbon dioxide, methane and nitrous oxide), while also playing a significant role as a carbon sink – due to its capacity of carbon sequestration and GHG storage (2007, pp. 14f.). Although meeting food demands remains – and will continue to remain – the primary objective of agriculture (Björklund et al. 1999, p. 270), the use of energy crops for biofuel production has added a significant further perspective to the traditional agricultural sector. Two of the main driving forces behind the strong political promotion of biofuels are increasing concerns with respect to energy security as well as the objective to reduce greenhouse gas emissions (Brännlund et al. 2008; Fargione et al. 2008; FAO 2008, p. 15; OECD & FAO 2007; Peters & Thielmann 2008; WBGU 2008).

With the recent rise of crop-based liquid biofuels as transport fuels, the direct linkage between energy and agricultural output markets has been reaffirmed (WBGU 2008, p. 5). Although expected to remain a relatively small share of the total energy market (e.g., IEA 2007, p. 92; FAO 2008, pp. 3f.),[1] their increasing popularity exerts significant new ecological and economic pressures on agricultural landscapes and markets. Intensively and very controversially discussed, past research in this context has focused on separate aspects such as, e.g., energy efficiency, the potential of significant CO_2 reductions as compared to fossil fuels and the effects of extensive monocultures (e.g., FAO 2008, p. 5; Ansel 2009, pp. 245ff.; Henke & Klepper 2006, pp. 9ff.; Scharlemann & Laurance 2008; Schmer et al. 2008; Weltbank 2008).

[1] According to several recent studies, for the year 2030 a share of 3.0-3.5 percent of global transport energy consumption is expected for biofuels (see e.g., FAO 2008, p. 5).

In the context of conventional agricultural activity, the concept of ecosystem (or environmental) services[2] has often been resumed in order to provide a comprehensive analytical framework that integrates the emerging conflict between (primarily economic) production objectives and their resulting impact on natural resource depletion and ecosystem sustainability (see e.g., Björklund et al. 1999; Swift et al. 2004; Wunder 2005). While the classical understanding of agricultural ecosystem services, such as e.g., soil fertility, water household (quality and quantity), nutrient supply, biodiversity, biotic regulation, etc. has long been expanded to include ecological aspects of sustainability (e.g., contribution to climatic regulation and emission of greenhouse gases (GHG)), biofuel production with its requirements as an ecologic fueling alternative moves a further dimension of sustainability into the focus: the social.

With the production and use of biofuels, the conflict between different necessities in north and south is further aggravated, as is most strikingly reflected in the discussion often labeled “food vs. fuel”. This discussion focuses on the criticism that the growing demand for biofuels in the north, compromises food security and sovereignty in southern countries while increasing famine in certain regions. The social argument, however, cannot be limited to rising world market prices for foods and the increasing relocation of biofuel production in developing and emerging countries. Further reasons include the low production costs in developing countries, which can be maintained in the absence of strict environmental standards or under low legal protection of ecological and social resources.[3] With the continuous expansion of energy crop cultivation, alternative agricultural production practices, specifically subsistence and food production, are continuously displaced, so that the local population is often forced to rely on purchasing expensive, imported foods produced elsewhere.

If, however, – because limited agricultural land prohibits the even satisfaction of needs – the demand for sufficient food confronts the western standard of mobility in such an offensive way, then the production and use of biofuels can hardly meet its promise of *sustainable* progress. Instead, it generates or aggravates unjust and inequitable conditions.

Consequently, the consideration of *socio*-environmental services as an addition to the conventional concept of environmental services becomes inevitably necessary. Objective of this paper is thus the conceptual introduction of a theoretic framework of *socio*-environmental services, which is based on the classical theory of ecosystem

[2] For a semantic differentiation of these terms, see the following pages.

[3] In order to meet its demand, the USA uses roughly one sixth of its entire maize harvest. However, even if the country’s entire cereal crop was used for the production of bioethanol, only roughly 16 % of the northamerican fuel demand could be replaced. This explains the high demand for biofuel imports from developing countries (Wiersbinski et al. 2007, p. 10).

services, but accommodates for the fact that many environmental services today are strongly embedded in a complex system of global (economic, ecological as well as social) interdependencies; its importance is further signified by the inequity of cost-benefit distribution between North and South. The global effects of biofuel production and use – as one example of an agricultural activity with a significant impact on environmental service provision – can thus hardly be reasonably analyzed without the clear and – above all – systematic consideration of social effects within their complex context, as shall be further discussed below.

The concept introduced and discussed here – i.e., *socio*-environmental services – follows a broader perspective than the common ecosystem service approach. It contributes to the field of socio-ecological research by suggesting a framework, which formalizes the direct interdependence of social and ecological sustainability, thus allowing an integrative analysis of the key factors, which currently impact the efficient and equitable allocation of global (natural as well as financial) resources. Aspects of consideration include, e.g., the protection of ecosystems, climate change mitigation, energy security, social justice, and poverty alleviation.

Background and Literature Review

Ecosystem and Environmental Services

> *The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation of poverty for some groups of people.*
> -- Millennium Ecosystem Assessment, 2005, p. 1

The provision and preservation of ecosystem services has long been a topic of extensive scientific research (e.g., King 1966; Helliwell 1969; Odum & Odum 1972; Pearce 1993; Turner 1993; Bingham et al. 1995; Daily et al. 1997; de Groot et al. 2002; Swift et al. 2004). Its social relevance becomes inherently clear when reading the following statement: “Humans have evolved as part of the world’s ecosystems, depending on them for food and other products and for a range of functions that support our existence” (Swift et al. 2004, p. 114). Defined as “the benefits people obtain from ecosystems” (Milllennium Ecosystem Assessment 2005 p. vii; Rapport et al. 1998, p. 397) or the “biological underpinnings essential to economic prosperity and other aspects of our well-being“ (Daily et al. 1997, p. 2), ecosystem services are generally classified into the four broad categories – (a) provisioning services, (b) regulating services, (c) cultural services

and (d) supporting services (see e.g., Millennium Ecosystem Assessment 2005, pp. 28ff.; FAO 2007, p. 43). In order to frame a general scientific understanding, Daily et al. (1997, p. 2) subsumed the general consensus at the time as follows:

- Ecosystem services are essential to civilization.
- Ecosystem services operate on such a grand scale and in such intricate and little-explored ways that most could not be replaced by technology.
- Human activities are already impairing the flow of ecosystem services on a large scale.
- If current trends continue, humanity will dramatically alter virtually all of Earth's remaining natural ecosystems within a few decades.

Furthermore, the FAO (2007, p. 3) goes so far as to argue that "today, the provision of ecosystem services generally, and agriculture-based services in particular, is being challenged as never before by the combined effects of expanding populations, rapid economic growth and greater global integration". This is not least due to the fact that the world's population is expected to increase by 50% by the mid of this century, further increasing both energy as well as food demand (ibid.).

Based on this perspective, the understanding of ecosystem services has recently been challenged and expanded to the more general concept of 'environmental services'. Although in the literature the terms ecosystem and environmental service have often been used interchangeably (e.g., Wunder 2005, p. 4), the delineation as assumed here considers environmental services as those services, which refer "specifically to the subset of ecosystem services characterized by externalities", i.e. 'off-site' effects (Swallow et al. 2007; acc. to FAO 2007, p. 6). According to Wunder (2005, p. 1), the four types of environmental services most commonly discussed include (a) *carbon sequestration and storage*, (b) *biodiversity protection*, (c) *watershed protection*, and (d) *landscape beauty*.

As alluded to above, the widened understanding of 'environmental services' has opened the concept for the consideration of a much broader set of additional effects related to what was classically limited to bio-ecological properties. The past focus of ecosystem service[4] research on changes caused by human intervention has thus been expanded to include the entire array of indirect (environmental *as well as* socio-economic) effects – from the potential of poverty reduction to climate mitigation, global justice and equity (as shall be further discussed below, which can and should be considered when evaluating changes in land-use and ecosystem functioning.

[4] In the literature, the terms 'ecosystem service' and 'ecosystem function' have often been used interchangeably or inconsistently (see e.g., Rapport et al. 1998; Hein & de Groot 2007; OECD 2008). In this paper, however, both of the above terms shall refer to those ecosystem 'goods, services, or functions' that provide a benefit to humans as individuals, groups of individuals or society as a whole (de Groot et al. 2002).

Agricultural Landscape as an Ecosystem

With a total land area of roughly 13 billion hectares, agricultural ecosystems are considered the world's largest managed ecosystems (FAO 2007, p. 3; IUCN 2008, pp. 4ff.). At the same time, by converting large regions into agricultural lands, the long tradition of human intervention has significantly imperiled the amounts of 'ecosystem services' provided by these areas (Björklund et al. 1999, p. 270; Daily 1997). As a result, depletion effects of agricultural landscapes with respect to the maintenance of soil fertility, biotic regulation, nutrient recycling, assimilation of wastes, sequestration of carbon dioxide, and maintenance of genetic information have become common challenges (ibid.). It can thus be argued that "farmers constitute the largest group of natural resource managers on earth. They both depend on and generate a wide array of ecosystem services. Their actions can enhance and degrade ecosystems" (FAO 2007, p. 5). Consequently, decisions with respect to agricultural intensification are made in consideration of food need, market opportunity, as well as expected improvements in management efficiency associated with specialization (Swift et al. 2004, p. 128). It is also this aspect that provides the reason for the past emphasis on provisioning services[5] over other types of ecosystem service. Provisioning services generally constitute 'private goods', whereas regulating, supporting and cultural ecosystem (or environmental) services are often 'public goods' (characterized by non-rivalry in consumption and non-excludability), whose benefit cannot be confined to particular consumer groups (see e.g., FAO 2007, p. 13; European Communities 2008, p. 27; Swallow et al. 2009, p. 1). A key question, therefore, concerns how society can motivate farmers to reduce negative side-effects while continuing to meet the increasing demand for agricultural produce (ibid., p. 6).

Biofuels

As discussed in the introduction, the increasing cultivation of energy crops for biofuel production has significantly altered and shifted agricultural production decisions. 'Biofuels' in this context refer to any *biogenic* form of liquid or gaseous fuel used predominantly in the transport sector, but may include fuels used for the production of

[5] Provisioning services generally include ecosystem products (goods and services), which are of direct, tangible use to humans. Common examples include food, crops, water, energy (biomass fuels), biochemicals or pharmaceuticals (see e.g., Millennium Ecosystem Assessment 2005, pp. 155ff.).

electricity or heat, e.g., in combined heat and power plants (CHP) (WBGU 2008, p. 160). Although several further differentiations of biofuels exist, such as e.g., the differentiation of first- and second-generation biofuels,[6] for the purpose of this paper a very brief introduction of the two most common biofuel types – bioethanol and biodiesel – shall suffice.

Bioethanol can be produced from any feedstock that contains a significant amount of sugar or starch. Consequently, sugarcane and sugarbeet constitute the dominant sugar-based crops, while maize, wheat and cassava are the most common starchy feedstocks for bioethanol production (FAO 2008, p. 11). In tropical countries such as Brazil sugarcane is the most widely used feedstock. With respect to its use, bioethanol can be blended with petrol or burned purely in slightly modified combustion (spark-ignition) engines (Westerholm et al. 2005, p. 4).

In contrast to bioethanol, the production process of biodiesel is based on oil, which can be produced from any oilseed crop. The most common sources here include rapeseed in Europe and soybean in Brazil and the USA (WBGU 2008, p. 37). As its name suggests, biodiesel can be blended with traditional diesel fuel or burnt purely in compression ignition engines (Hofman 2003, p. 1).

In the recent past, much research has focused on the specific opportunities and risks related to the production and use of biofuels – especially those of the first generation. The main results and propositions of these studies can be summarized as follows (see table 1):

Environmental	Social	Economic
Opportunities		
Climate Change Mitigation • ‚green' climate-benign form of energy provision • GHG reduction in world energy system **Reduction of Air Pollution** • reduced emission of air pollutants (exhaust) in urban areas	**Rural Development** • new source of demand of agricultural products • access to energy in rural areas / reduction of energy poverty	**Energy Security** • mitigation of resource-scarcity and increasing energy prices • reduced dependence on imports of fossil fuels **Poverty Reduction** • increasing demand and (in the long term) higher prices for agricultural

[6] Biofuels are further differentiated into first and second generation biofuels. While this differentiation is anything but consistent, first generation biofuels typically refer to vegetable oils, biodiesel and bioethanol, produced by established physical-chemical (pressing, extraction, esterification) or biochemical (alcohol fermentation) processes; second generation biofuels, in contrast, subsume predominantly synthetic biofuels such as BtL (biomass-to-liquid, fischer-tropsch-diesel), biomethane, or bio-SNG (synthetic natural gas), as well as bio-hydrogen, produced by thermo-chemical processes (gasification, pyrolysis) (WBGU 2008, p. 160).

Restoration of Degraded Land • restoration of degraded vegetation, carbon sequestration and local environmental services		

Risks		
Land Use Change • direct land use change • indirect land use change *Impacts on Climate Change* • increased emission of GHG (esp. if converting forests & wetlands) *Environmental Impacts* • negative impacts on water and soil resources as well as biodiversity	**Food Security** • threat to the food security of poor net food buyers in both urban and rural areas (in the short-term) • negative implications on poverty levels **Equity Concerns** • increased competition for resources may impact labor conditions, access to land and may constrain smallholders	**Adverse Economic Impacts** • competition with the cultivation of energy crops raises food prices • higher food import prices may negatively impact food import bills

Table 1: Commonly stated sustainability opportunities and risks related to biofuel production and use[7]

Several of these opportunities and risks have already been addressed in the introduction. Because a discussion of their specific causes and impact mechanisms would go well beyond the scope of this paper, a further and in-depth discussion shall be omitted here. It shall, however, be recapitulated that the challenges involved in the discussion on biofuels – as presented in the table above – center around conflicts in meeting (basic) human needs: food security in the developing world, on the one hand, and maintaining the western standard of mobility without significantly imperiling individual freedom, on the other. Resolving this challenge will require a global framework of justice as one important step towards achieving sustainable development.

Justice as a Key Precondition of Global Sustainability

As alluded to, the objective of sustainable development in the context of biofuels is closely related to the question of achieving *justice*[8], especially with respect to the function it is to fulfill. Currently, the following three functions of justice are differentiated:

[7] This table constitutes an overview of prevailing opinions; major sources include FAO 2008; Fargione et al. 2008; Searchinger 2009; WBGU 2008.

[8] Justice is considered a cardinal virtue of human action. It fulfills an unconditional function of legitimacy, both with respect to power as well as the distribution of goods (Rieger 2001, p. 176). The discourse around justice is characterized by partially very heterogeneous definitions as well as theoretic approaches. However, inspite of these differences all approaches assume that principles of justice must be universally applicable to all humans (O'Neill 2001, p. 188).

(a) procedural, (b) distributive, and (c) compensative – all of which are (or should be) equally relevant in the context of biofuels. So far, its *distributive function* has been most extensively considered, when discussing the even allocation of scarce resources, or the rights and responsibilities as well as opportunities and risks concerning biofuels. Distributive justice is based on the question, whether the (re-)distribution of something is just with respect to its outcome or result (Rawls 1975, pp. 81ff.; Ladwig 2004, p. 121).

The *compensative function* addresses primarily the question of reimbursement or compensation for any loss or damage that occurs (or has occurred) due to the production and use of biofuels. Individual actors may cause damage, which affect a variety of people (Schultz 2008, p. 2). Therefore, it must be determined, whether – and if so how – compensation or reimbursement is possible and acceptable. Increasing importance has been attributed to justice and its compensating function, especially since the development of certification systems for biofuels.

In the same context, the *procedural function* comes to the fore, which sets the focus on the preconditions, requirements and procedures of social allocation processes. As justice of equal opportunity and participation, it refers to the necessity of sufficient opportunities for individuals to adequately participate in social life and relevant political decision processes (see e.g., Ladwig 2004, p. 124).

The term *sustainability* itself defines a reference to time and place of justice. It inheres an *intertemporal* as well as *intergenerational justice*, understood as currently relevant "future rights of future people" (author's translation acc. to. Ekardt 2005, p. 91), whereby 'rights' refer to complete freedom with respect to (even only potential) impairments of life, health and a minimum level of subsistence. Current generations thus implicitly agree to a non-reciprocal commitment to near as well as far future generations. In the context of biofuels, natural capital must therefore constitute a relevant factor to be provided (or maintained) for future generations in intact condition and sufficient amount. Consequently, the question must be asked, under which political framing conditions the production and use of biofuels (with respect to natural resources) can generate a fair heritage, and where – instead – alternative compensation in the form of capital appears justifiable.[9]

[9] While representatives of a weak conception of sustainability assume the substitution of natural and social capital as generally possible, representatives of a strong conception of sustainability limit this to certain goods, in order to achieve an intact natural capital with respect to future justice (Schultz 2008, p. 10; see also Ott & Döring 2004, pp. 51f.).

Because sustainability addresses the future potential of a globally even satisfaction of (basic) needs (e.g., food, resources), the global dimension of justice is immediately and directly involved. *Global justice* thereby functions as a central vision of sociality within a universal political community in a complex, irreversibly globalized world (Höffe 2001, p. 96). Geographically distant people are thus entitled with rights (e.g., protection, opportunities for development), which obligate 'us' (Ekardt 2005, p. 160). In view of the geographically uneven distribution of wealth on earth, achieving 'fairness' in the fulfillment of (basic) needs in north and south thus deserves special focus.

The Political Realization of Global Justice

Global justice can only be achieved by political governance that can be and is equally applied to all citizens, intergovernmentally as well as in the form of global principles and standards (ibid., p. 239). It is therefore no longer limited to 'just' relationships among countries and citizens, - and thus primarily the question, what aspects are subsumed under the term 'justice' (e.g., rights, institutions, distribution of resources) and how the contents should be aligned – but also includes just relationships among citizens of different countries.

Reiner Forst (2002) in this context differentiates between internal and external justice, which must continuously be 'thought together'. This differentiation implies, on the one hand, that internal justice must not be achieved at the cost of external injustice. In the case of land use conflicts, enabling mobility based on non-fossil fuels for the population in one country can never be just, if it impedes food security of populations in other countries. The approach of Forst, on the other hand, implies that the target of global sustainability requires the achievement of internal as well as external justice. Consequently, just structures with respect to the production, distribution and consumption of biofuels can only be achieved in a country, when external structures – such as e.g., certification systems, trade-regimes, etc. – are designed in a fair way.

Since a sufficiently effective, global policy, which can guarantee sustainability – and therefore also justice – currently does not exist (Ekardt 2005, p. 161), an increase in

global (often trisectoral)[10] political networks as a response to specific transnational problems can be noticed (see e.g., Brühl et al. 2001; Dahl 1999; Nye 2001; Pogge 2002; Risse 2006). Similarly, initiatives for the introduction of (voluntary) sustainability standards[11] and their certification were initiated by non-governmental actors. Given the insufficiently used governmental regulation competences, various corporations along the value chain thus decided to cooperate – either based on their voluntary engagement in sustainability ("corporate social responsibility") and/or economically motivated (see e.g., Fichter et al. 2005) – with globally operating NGOs, which represent the interests of stakeholders within the value chain as well as environmental protection (v. Geibler 2007, pp. 17f.). Under specific circumstances,[12] such non-governmental standard setting by global networks has been considered as a necessary, although not sufficient, supplement to global governance with respect to the realization of sustainability (ibid., p. 18).

For the latter, the reference framework of justice must be re-discussed, as well as the questions, whether principles of justices should be of transnational scope, who can and should assert which claims with respect to justice, and who – in return – is responsible for meeting and monitoring these claims (Kreide 2006, p. 134; Fraser 2005). The realization of common objectives with respect to global justice rephrases the question of rights and responsibilities and thus constitutes the focus of theory building as currently controversially debated in the scientific discourse (Pogge 2002, p. 2).[13] Points of discussion in this context include content and range, as well as bearers and addressees of responsibility.

While the majority of theories on justice still attributes the role of the agent of justice to governments, O'Neill instead (2001, p. 201) assumes that justices in an interlinked world

[10] Ideally, global political networks are defined as trisectoral, i.e. governmental, economic and civil actors are equally involved. Nonetheless, the term remains ambiguous insofar as also the punctual cooperation of economic and civil actors is frequently subsumed under it (Dingwerth 2004, p. 76).

[11] Burger and Mayer (2003) understand standards as unambiguously determinable quality attributes, whereby the bearer of the attributes (processes, products) must be equally defined as the timeframe, within which the attributes must be provided, the quality (measurement prescription) of attributes (criteria), as well as the required characteristics of the attributes (indicators) (Geibler 2007, p. 18).

[12] The literature (e.g., ibid., p. 24; Dingwerth 2004; Partzsch 2007) classifies these preconditions into *legitimacy requirements* – acc. to which, for example, the conformity with legal regulations shall be ensured and the approach of harmonizing standards shall be a participative and transparent process, which strives to integrate and balance all interest groups – and *efficiency requirements*. The latter include, e.g., the participation of actors within the value chain, the commitment of the implementing actors, and the definition of ambitious targets. Under the stated requirements, those standard-setting global networks also have the potential, to increase the effectiveness and democratic legitimation of governance beyond the national state (Dingwerth 2004: 75).

[13] See also Beitz 1983, 1999; Forst 1994; Höffe 1999; Gosepath 2004; Kersting 1996; Rawls 1999 and Walzer 2000.

must be provided by a variety of agents with different competences. This rather universalistic array of obligations related to justice primarily calls attention to the fact that responsibility competences of national governments toward its members must be reduced or questioned, while the increasing frequency of trans-national interdependence endangers the functional integrity of the interactions it regulates. O'Neill's approach of multiple responsibilities further focuses on the (yet to be defined) obligations among a variety of 'bearers of responsibility' (yet to be defined) for addressees (yet to be defined), and thus poses the central question of "*who must do what for whom?".*

Similar to O'Neill, Young (2006, pp. 102ff./2007) in her conception of participative joint responsibility assumes that global drawbacks generally result from political injustice; in view of non-reconstructable causal chains, this inevitably implies a political, shared responsibility of all involved actors – directly linked to the implied obligations of justice. For the identification of specific actors and the differentiation of different degrees of obligation, she compiled a catalog of responsibility criteria (ibid. 2006, pp. 128ff.), which has been reviewed and extended by different authors (see e.g., Hahn 2009). In her opinion, obligations depend on the position[14] a person or institution holds within a structural process. Furthermore, obligations of justice are to be resumed, where participation in injustice-generating practices is realized, although – however – it remains questionable, whether causal damage is induced (ibid., p. 10).

Finally, the profiteers of an unjust political order should be made responsible as well, albeit the attribution of unjustified benefits in this case has often proven difficult.[15] In the case of attribution problems, Young (2006, p. 14) refers to an indirect 'consequence responsibility' for action-coordinating rules, which obligate every person – within their bounds of possibility – to commit to a justice-securing system of rules or regulations.

Different authors (e.g., Forst 2002; Kreide 2009, pp. 41ff.; Sen 1997, 1999, 2009) view global institutions as especially justice-relevant contexts, since they bear the primary responsibility for justice within the areas under their coordination. Along these lines, John Rawls referred to justice as the "first virtue of social institutions" (acc. to Acker-Widmaier 1999, p. 68), whereas Armartya Sen (2009) stressed the purpose of

[14] The position depends on (1) its power to exert collective influence on a social practice, (2) its privileges within current structures, (3) its interest in changing these structures, and (4) its collective ability, i.e., its ability to engage in publically effective groups or parties (Hahn 2009, p. 2).

[15] Young (2006, p. 128) justifies this responsibility as follows: "Persons who benefit relatively from structural injustices have special moral responsibilities to contribute to organized efforts to correct them, not because they are to blame, but because they are able to adapt to changed circumstances without suffering serious deprivation". Such a resumption of responsibility would be necessary in order to prevent future injustice.

institutions to promote justice. To him, institutions *per se* are not to be treated as an inherent manifestation of justice. Regina Kreide (2009, pp. 41f) mentions different preconditions for the definition of a (global) social system of rules – e.g., constitutions, legal and financial systems, rules of political participation, etc. –, which in combination compose institutional justice.

Consequently, global institutions can be considered as just, when they neither harm nor humiliate humans, and when they establish procedures of participation and consideration of all involved. These procedures shall enable a change of current circumstances as well as the identification of causes for, e.g., exclusion, insufficient freedom of choice, non-access to important resources, etc.. Public institutions shall thus become transparent places of participation and access to decisive public goods (Siller 2009, p. 48). Finally, Kreide's understanding of institutional justice also includes criteria for the assessment of institutions or (cross-)social institutional systems, as well as their impact on human lives and livelihoods (Kreide 2009, p. 41).

Conceptual Model

Global Sustainable Production and Use of Biofuels: "Who Must Do What for Whom?"

The question of global and social justice as raised above, must be resumed and considered when trying to evaluate ways that would allow a truly sustainable production and use of biofuels under equal consideration of all three dimensions – the economic, the environmental and the *social* – as well as their interplays.

With the objective to combine at least the former two dimensions, de Groot et al. (2002) introduced the following model of comparative ecological economic analysis based on their recognized need for "a standardized framework for the comprehensive assessment of ecosystem functions, goods and services" (p. 393):

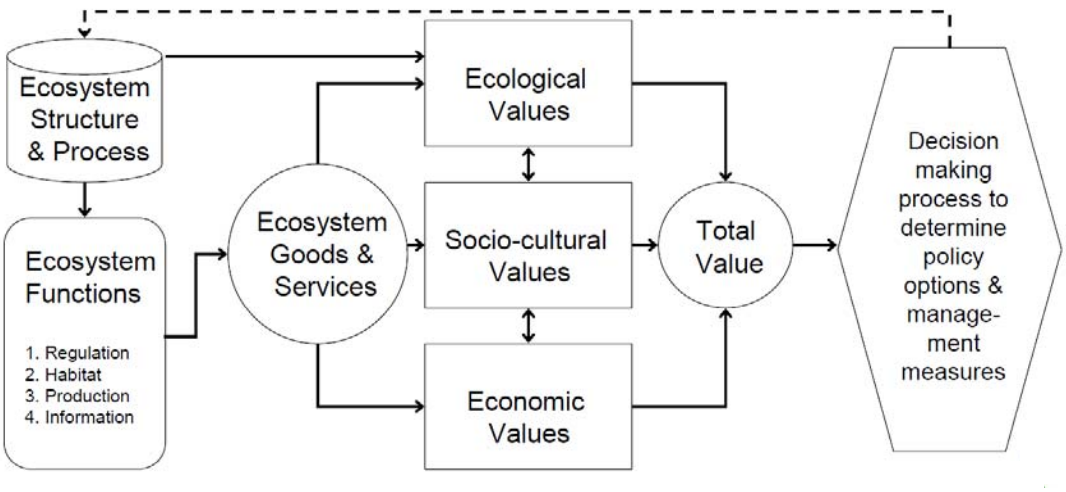

Figure 1: Framework for integrated assessment & valuation of ecosystem functions, goods & services
Source: de Groot et al. 2002, p. 394

While the differentiation of four diverse ecosystem functions corresponds to classical ecosystems research, it is the attribution of specific (ecological, socio-cultural, or economic) 'values'[16] in their interdependence to the different ecosystem functions, which makes the concept a valuable toehold in the given context.

Within this framework, de Groot et al. (2002, p. 403) recognize – what they call – the 'socio-cultural' perspective (characterized as 'social values' (such as equity) and perceptions) to play an "important role in determining the importance of natural ecosystems, and their functions, to human society". Although the recognition of the socio-cultural dimension's importance is a significant first step, its narrow conceptual understanding proves insufficient. As has been discussed above, the term 'social' in the context of sustainability and environmental systems embraces much more than the mere 'recreation-cultural' (emphasizing physical and mental health, education, cultural diversity and identity (heritage value), freedom and spiritual) (ibid.) value as assumed here. Instead, as will be extensively discussed below, it is exactly this dimension referred to as the 'socio-environmental' perspective, which consolidates sustainability (in its three-dimensionality) into a powerful, though idealistic, epitome of global responsibility.

[16] For a discussion of the three concepts of ecological, socio-cultural, and economic value categories, see also Limburg et al. 2002; Howarth and Farber 2002; Wilson and Howarth 2002.

PES as an Economic Tool of Direct Market-Transactions

Based on the idea as introduced by de Groot et al. (2002) – namely that monetary values should be attributed to the classical 'non-value' (public) goods produced by ecosystems within each of the three value categories involved in the concept of environmental services (ecological, socio-cultural, and economic) –, much recent research has focused on Payments for Environmental Services (PES) as a means by which "external ES beneficiaries make direct, contractual and conditional payments to local landholders and users in return for adopting practices that secure ecosystem conservation and restoration" (Wunder 2005, p. 1). Foundation of this concept is the fact that land users are generally not financially compensated for the environmental services they provide (see e.g., Pagiola et al. 2005, p. 238; FAO 2007, p. 7; Lee et al. 2007, p. 6). A key question that has been asked is thus, how societal demand can be translated into a direct motivator for farmers to adapt their practices in order to reduce negative side-effects without neglecting their primary objective of meeting increasing agricultural demands (FAO 2007, p. 6). Under mounting land use pressures, the provision of an incentive in the form of PES may contribute to the reconciliation of these conflicting interests by reflecting the 'real' social, environmental and economic benefits that environmental services deliver (ibid., p. 7), thus aligning land users' interests with those of society as a whole (see e.g., Landell-Mills & Porras 2002; Pagiola et al. 2005). In view of a missing, formal definition of PES, Wunder (2005, p. 3) delineates PES as:

- a *voluntary* transaction where
- a *well-defined* ES (or a land-use likely to secure that service)
- is being 'bought' by a (minimum one) ES *buyer*
- from a (minimum one) ES *provider*
- if and only if the ES provider secures ES provision (*conditionality*).

As a market-transaction-oriented concept, the following basic aspects of PES can be summarized:

The Concept of PES – basic parameters
• voluntary market transactions (rather than conventional 'command-and-control' measures)
Preconditions: • real land-use choices (rather than insecure land tenure and titles or illegal resource use) • effective legal framework (often not given in developing countries, esp. in agricultural frontier areas with weak governance)
Operational Implementation: • Implementation of a legal and enforcement apparatus for PES • measuring the actual amount of environmental services provided, so that appropriate payments can be made • monitoring the desired change in land use

• avoiding perverse incentives[17]

Table 2: The concept of PES – basic parameters

Source: based on Wunder 2005, p. 3[18]

Especially in the context of the here suggested explicit consideration of social effects, PES has been analyzed with respect to its potential contribution to poverty reduction – mainly by providing an additional source of income for often poor land users in developing countries (Pagiola et al. 2005, p. 238). In comparison to different currently available approaches that target at the economic compensation or remuneration of conservation activities, Wunder (2005, p. 6) points out the strength of PES based on their high degree of economic incentive setting combined with a very direct effect on conservation activity (see also figure 2).

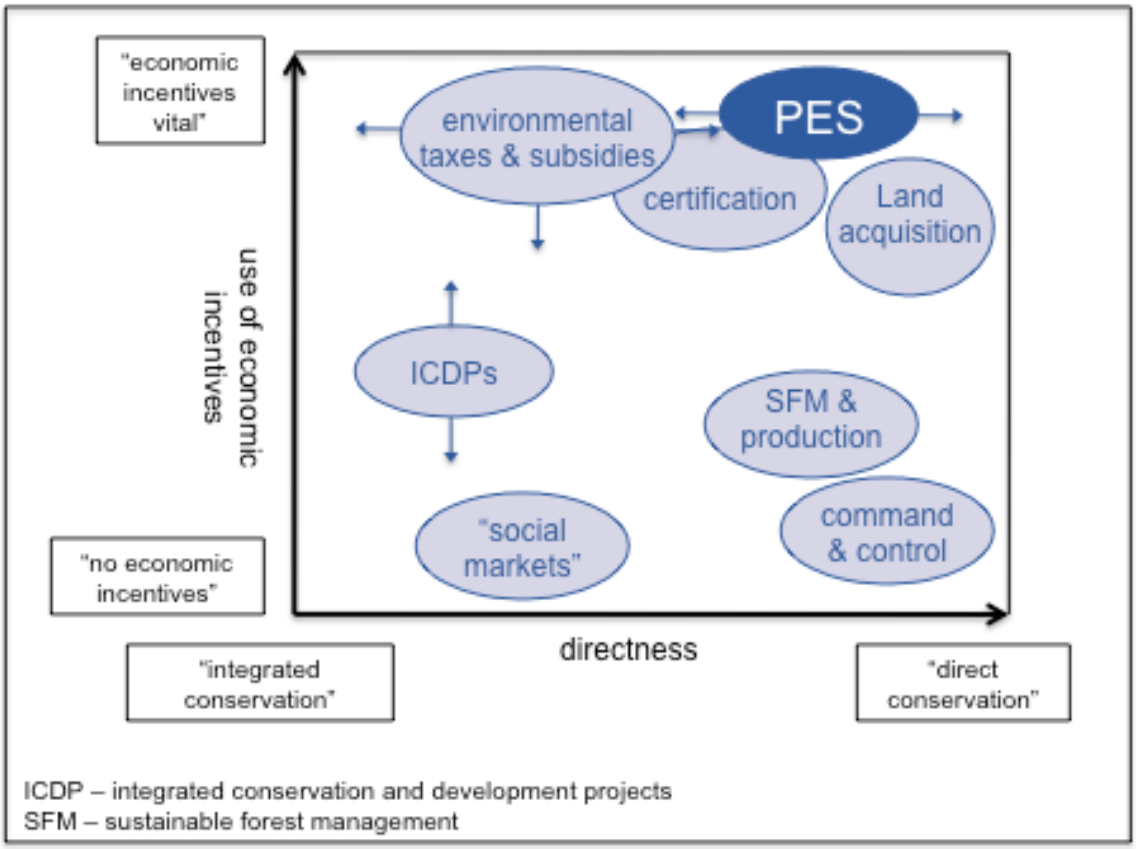

Figure 2: Comparing PES to other conservation approaches[19]

Source: based on Wunder 2005, p. 6

[17] One common example is the possibility for land users to cut down existing trees so as to qualify for additional payments for tree planting (see e.g., Pagiola et al. 2005, p. 238).
[18] Further sources include: Sokolow & Zurbrugg 2003; Bayon 2004; Pagiola et al. 2005.
[19] For a more detailed comparison of different conservation approaches, see also Jordan et al. 2005 and Swallow et al. 2009.

One of Wunder's (2005) main objectives is the identification of those specific conditions under which PES operate most effectively. In this context, it is especially the expected trade-off between 'efficiency' and 'fairness', expressed – among others – in the determination of those agricultural activities, which actually pose a threat to ES provision. To clarify this challenge, he discusses the following three cases in Brazil (Wunder 2005, p. 12):

> *Case 1: "negligible additionality"*
>
> The remote federal states of Amazonas and Amapá have recently declared large areas to be protected, and federal government representatives have also expressed hope that their pro-conservation policies will be rewarded with international PES resources. Yet, deforestation rates in most of these remote areas remain very low, indicating that the development frontier has still not reached them – i.e., the forest is not currently threatened.
> *Question: If land-use pressures are distant, how far-sighted should a PES initiative be?*
>
> *Case 2: "aggressive pressures"*
> The state of Mato Grosso is aggressively promoting the expansion of ranching and soy. High deforestation rates reflect land-use threats and high conservation opportunity costs, especially in terms of soy beans' high profitability, so that deforestation is constrained only by capital shortages, road infrastructure, time, and possibly legal constraints.
> *Question: Can even large-scale PES be sufficient to change such a 'pre-geared' process, or are – in this case – conservational command-and-control measures (i.e., enforcing the Brazilian legal restrictions mandating a minimum percentage of forest retained on farms) a more suitable approach?*
>
> *Case 3: "intermediate, foreseeable threats"*
> The state of Acre (remote and forest-rich) constitutes an intermediate example. Its self-declared *Governo da Floresta* (Forest Government) has been innovative in socio-environmental legislation and implementation. At the same time, emerging economic factors like road projects linking Acre to neighboring Bolivia and Peru and expanding timber and beef demand, pose increasing pressures on forests and slowly accelerate clearance rates.
> *Question: Is this intermediate setting, with foreseeable major threats and rising opportunity costs, the most favorable scenario for PES application?*

While PES certainly constitute an appealing approach to combine positive effects both with respect to sustainability and social development, it is exactly these questions as contemplated above that require much more in-depth research on their effectiveness as well as potentially unintentional or even counterproductive impact mechanisms. To summarize his findings, Wunder (2005, p. 12) writes:

> PES schemes need to strive the balance between short-run efficiency and fairness, the latter influencing long-run viability. However, what seems certain is that neither the 'ecologically noble savage' who fully safeguards his or her environment, nor the impoverished farmer too poor to do significant ecological damage, will emerge on the scene as major ES sellers. They simply do not constitute a credible threat, so paying them creates zero additionality – it makes no difference. Is that unfair?

What Wunder alludes to here essentially can be subsumed under the central philosophical debate around the concept of 'institutional justice' as introduced above – leading straight to the question "*Who must do what for whom?*" –, which shall constitute one of the key concerns discussed below and is not only a question of 'fair' allocation, but also refers to aspects of "negotiation, political feasibility (which includes perception of fairness), legality (particularly vis-à-vis land tenure) – and possibly also of ethics, since some actors may lose illegal revenues, corrupt payoffs, and iniquitous profits" (Wunder 2005, p. 14). For the concept of PES to be just, a logical consequence would be the compensation of anyone affected. This, however, is often prohibitively expensive, especially when assuming the necessary consideration of opportunity costs (as the fundament of PES) (ibid., p. 14). Because PES are often discussed with respect to their potential contribution to poverty alleviation, the main mechanisms in this context shall briefly be introduced.

Poverty Alleviation

> *If poverty – which may be defined as lack of income or assets, vulnerability or powerlessness – is a major cause of environmental degradation, then paying poor producers to adopt more environmentally friendly systems of production would appear likely to generate a "win–win" outcome resulting in both poverty reduction and environmental benefits.*
> -- FAO 2007, p. 97

In the Literature, PES have often been discussed with respect to their potential as a 'just source of reward' for often poor rural dwellers who – in the past – have consciously produced environmental services in care of the environment without any (financial) compensation (see e.g., Shilling & Osha 2003; Rosa et al. 2003; van Noordwijk et al. 2004). Although PES are generally discussed as a promising potential option to reduce poverty in agricultural, rural settings via direct payments, while concurrently improving environmental management (see e.g., FAO 2007, p. 97; Swallow et al. 2009, p. 3), questions of unintentional adverse side effects have increasingly been raised. One of the main concerns is the fact that PES may increase the value of 'marginal' lands (Landell-Mills & Porras 2002), and could thus "increase the incentive for powerful groups to take control of it. Thus PES might exacerbate problems in situations where tenure is insecure" (Pagiola et al. 2005, p. 239).

When discussing poverty alleviation, the following three aspects of consideration must thus be raised: (a) *participation* (i.e., how can 'poor' ES providers compete), (b) *effects*

on ES sellers (i.e., how does PES participation affect their livelihood), and (c) *effects on non-sellers* (i.e., how are those 'poor' affected that do not directly participate in PES (e.g., non-participating farmers, poor ES users, product consumers, landless laborers, etc.) (Grieg-Gran et al. 2005; Wunder 2005, p. 16), as summarized in the following table 3:

(Access to) PES participation
Explicit PES Access Rules:
• Poor farmers seeking to become service sellers face both explicit PES access rules and underlying structural constraints. Explicit PES access rules can favor or disfavor smallholders.
Underlying Structural Constraints:
• *Effective Land Use Control:* The 'poorest of the poor' often do not own land or have secure formal land tenure or own land and may be ruled out by 'area-based' PES scheme. PES is thus more relevant to 'moderately poor' smallholders. Pro-poor PES schemes must acknowledge and account for tenure informality and effective land-use control by external intervention. • *High Transaction Costs* of dealing with many smallholders (or land owned collectively by internally conflictive communities), compared to only a few big landowners (Smith & Scherr 2002).
Effects on ES sellers
Adverse Effects:
• Individual service providers can only be made outright worse off if they are cheated, *de facto* forced, into participation, or surprised by the *ex post* livelihood impacts (e.g. due to under-estimated opportunity costs) and local economy derived effects (e.g. changing land or labor markets).
Magnitude of Effects:
• Even if poor PES providers are likely to be better off, questions remain as to 'how much' and 'in what way' they will gain from participation. As in any commercial transaction, there is an inherent conflict over price between ES buyers maximizing consumer surplus ('biggest conservation bang for the buck') and ES providers boosting their producer surplus (PES payments net of opportunity costs). ES buyers will often, though not always, be in a better negotiating position on account of being fewer in number, better informed and initiative seeking than ES providers.
Non-Monetary Effects:
• Participation in PES contracts may help to ***increase land-tenure security*** by mapping and demarcating the land and by demonstrating an income-generating activity from it. • PES may help to develop ***social-capital effects*** through 'learning-by-doing' and/or prior 'formal trainings'. This social-capital effect is generally to the advantage of local people in their other business dealings with the outside world. • PES programs serve as a strategic ***'site propaganda'***, increasing the visibility of the village or community vis-à-vis both donors and public entities. • ***Negative social effects*** may include, e.g., tensions between PES participants and non-participants.
Effects on non-ES sellers
Side Impacts:

- Determining ***effects on non-participating thirds*** is difficult to determine, since this group is very heterogeneous and impacts are dominated by complex secondary effects that occur in factor markets (land, labor) and in commodity markets (agricultural crops, forest products, etc.). It seems, however, necessary to look at three impoverished groups: service users, on-site landless people, and offsite actors in the value-added chain.
- In many cases the landless 'poorest of the poor' self-engage (or are being employed) in some of the most ES threatening activities. To the extent that the PES scheme is use restricting, i.e. it caps planned forest-product extraction or agricultural conversion, groups involved in these activities may result in ***loss of employment or informal-sector income***.
- If PES is locally lucrative, it could increase competition for PES-eligible land, possibly to the ***detriment of the weakest actors' access to that land*** (Rosa et al. 2003).
- ***Long established practices may be hard to overcome***. Building trust, and setting up the rules, monitoring and rewards, may be cumbersome, take time and require an 'honest broker' like an NGO as intermediary — yet success is still not guaranteed.

Table 3: Preconditions for effective poverty alleviation using PES

Source: based on Wunder 2005, pp. 7ff.

Summary: Structural Overview of Sustainability Requirements related to Biofuel Production and Use

Main focus of the following section is the introduction of a theoretic framework (see figure 3), which formally integrates the different perspectives as outlined above. As has been argued, a comprehensive analytical framework of biofuel production and use must account for the complex dynamics and interdependencies implied in the concept of sustainability – namely meeting both the *ecological* as well as *economic* standards of sustainability, while simultaneously strengthening the objective of restoring and maintaining global *social* justice. Risks and disbursements related to biofuels are concentrated primarily in biofuel-producing developing and emerging countries and, within those, indirectly affect small farmers and field workers often excluded from large-scale commercial cultivation of bioenergy and other agricultural crops. Furthermore, employees in the production of biofuels as well as local populations are affected, as they are often forced to work under precarious working conditions or must burden the higher costs of foods that can no longer be locally produced. These actors can thus be considered as potential addressees of so-called 'obligations of justice'. Primary 'obligators' in this case are the consumers of biofuels geographically centered in developed countries who intend to meet their demand for mobility based on non-fossil fuels likely motivated by the objective to 'respect the environment', reduce GHG emissions, and/or increase energy security.

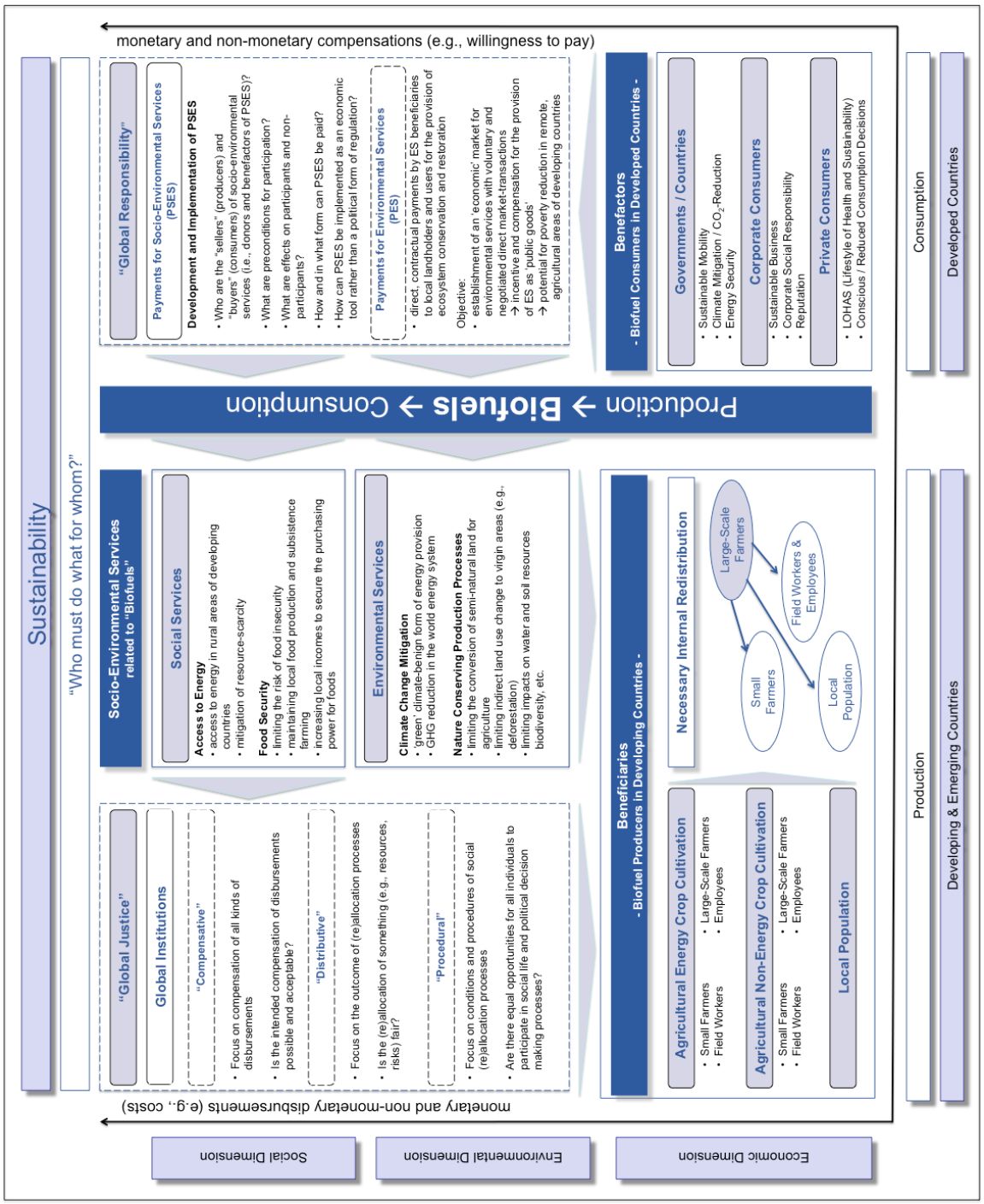

Figure 3: Structural overview of sustainability requirements related to biofuel production and use

The economic dimension in the framework reflects the classical market mechanism of demand (consumption) and supply (production). As extensively discussed, in the context of biofuel production and use the uneven distribution of risks and benefits creates unjust

conditions, which directly contradict the common understanding of *sustainability* and *justice*. In order to provide monetary as well as non-monetary forms of compensation, private end-users and corporations must and can be held just as responsible as governments. On a voluntary and non-regulated basis, significant and powerful trends have long developed in response to the increasing acknowledgement of 'global responsibilities'. Most notably these include the social 'lifestyle of health and sustainability' (LOHAS) movement to support sustainability and counteract or prevent unjust (social) conditions via conscious (non-)consumption decisions, or 'corporate social responsibility' (CSR) as a corporate means of obligation to sustainable corporate practices (both internally and/or through the support of external projects).

Focusing on the former, the LOHAS consumer behavior constitutes one potential example of (in this case 'indirect') payments for socio-environmental services as a conscious form of compensation; a CO_2-benign lifestyle and ethical consumption decisions which acknowledge aspects of justice may contribute to a notable reduction in the demand for fuel (fossil as well as biogenic), and thus reduce the danger of ecological as well as socio-economically negative consequences. LOHAS thereby serve as pioneers of a positively connoted socio-ecological change process especially in the north, where the often prevailing values of 'performance' or 'fun' are increasingly replaced by 'engagement' or 'authenticity'. Their payments for socio-environmental services are monetary (if, e.g., fair trade or locally/regionally produced products are purchased), but predominantly non-monetary (if, e.g., the choice is made to renounce from unethical or unsustainable activities or products entirely). Based on this aspect, they extend the so-called payments for environmental services (PES), which – as a form of mere monetary compensation – have been discussed in more detail above.

The interpretation of the LOHAS movement as one example within the conceptual framework of socio-environmental services further strengthens the proposition that a significant potential exists to utilize the corporate and social strive for sustainability for the targeted mitigation of unsustainable conditions, and that a general willingness to pay for such socio-environmental services exists. As the elaboration further reveals, however, significant institutional efforts are required to provide a regulative, political framework of global justice, which allows the targeted allocation of such payments to the specific causes of relevance - i.e., the threats to social, ecological or economic sustainability. Similar to the concept of PES, payments for *socio*-environmental services (PSES) remain an economic, transaction-oriented instrument, which – although likely

institutionally mediated - can maintain the high degree of efficiency often attributed to PES (see also figure 2), based on their high degree of economic incentive setting combined with direct effects on sustainable practices.

While the discussed mechanisms certainly constitute powerful tools and reflect the strong interest in sustainability, challenges yet remain as to how this general willingness to contribute can be efficiently used to mitigate global inequity and injustice, and which specific tools appear viable in order to supplement current regulatory or 'command-and-control' instruments such as, e.g., certification, compulsory blending quotas or taxation mechanisms for biofuels. Future research shall thus target the question if and in which form global institutions may resume the role of 'regulative authorities' capable of coordinating and monitoring the fulfillment of 'obligations of justice', their range, content, addressees as well as those in responsibility.

Conclusions

Environmental services are embedded in a complex global system of not only ecological and economic, but also social interdependencies. It is therefore important to relocate and expand the perspective from environmental services to the concept of *socio*-environmental services, which explicitly integrate the social dimension of sustainability.

Even if the conventional understanding of agricultural ecosystem services has long been expanded by certain factors of sustainability, the new market for biofuels has moved a number of (indirect) ecological and socio-economic effects into the focus, which concurrently raise significant questions of global justice. Land use conflicts, for example, point to conflicts in meeting (basic) needs (mobility vs. food security and sovereignty) especially between north and south.

Given their characteristics as a market-near, transaction-based approach, payments for environmental services (PES) constitute a promising implementation alternative to mitigate the challenges as addressed above. The specific context of biofuels, however, requires their expansion to the explicit consideration of payments for *socio*-environmental services (PSES) as introduced in figure 3.

Given the main objective of global sustainability, e.g., in the case of biofuels, the realization of just conditions and circumstances constitutes a basic precondition. In a complex and globalized world it must therefore be determined, who – as a profiteer –

must commit to ‘obligations of justice’ vis-à-vis whom, how and to what extent. Even if justice-relevant contexts exist beyond global institutions, the latter remain those who can and should democratically characterize and attribute rights and obligations of justice. In the future, the politically central question for the achievement of global sustainability via the establishment of justice will thus be: *“Who must do what for whom?”.*

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