contracts2.0

Co-Design of innovative contract models for agri-environment and climate measures and the valorisation of environmental public goods

Key concepts in Contracts2.0

Extract from Deliverable 1 / 1.1

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Work Package:	WP 1
Date of delivery:	30/04/2020

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant Agreement No. 818190.

Concept Note 1: Environmental Public Goods & Ecosystem Services

Environmental public goods

In the standard economics literature, goods are classified by the rivalry of consumption and excludability, resulting in four types of goods: public goods, club goods, common pool resources, and private goods (see Table 2). These classifications are meant as broad and abstract categorisations, and similar goods can move between categories depending on context (property rights, transaction costs, costs of exclusion etc.). For instance, a road could be a common pool resource if it is open and congested, a public good if it is open and non-congested, a private or club good if access is restricted.

Table 1: Classification of goods

	Non-excludable	**Excludable**
No rivalry of consumption	*Public goods*, e.g., street light, clean air	*Club goods*, e.g., non-congested toll road, restricted access to a website (Spotify)
Rivalry of consumption	*Common pool resources*, e.g., open pastures, ocean fish stock	*Private goods*, e.g., chocolate bars

Historically, it has been argued in economics that public goods are underprovided (Olson, 1965) and that common pool resources are generally overused (Hardin, 1968). As a consequence, government regulation or privatisation have been promoted. This view has been challenged by political scientist Elinor Ostrom (1990) who identified “design principles” that mediate successful common pool resource management (at least at a small scale). As a consequence, optimal management options of natural resources that entail common pool resources or public goods must be identified on a case-by-case basis.

Carefully designed case studies and multi-method approaches culminated in the social-ecological systems framework that identified a wider set of conditions and variables affecting sustainable natural resource governance (Ostrom, 2009; Poteete et al., 2010). Criticism of this model often mentions the implicit ontology (methodological individualism and localism which would lead to a frequent neglect of structural and global market forces).

Ecosystem services

An increasingly applied concept related to public goods is ecosystem services. Ecosystem services have been defined as the benefits that people directly or indirectly obtain from the environment (Millennium Ecosystem Assessment, 2005). This definition includes ecosystem goods (such as food) and services (such as climate regulation) (Costanza et al., 1997). In contrast to the concept of public goods which was developed within neoclassical economics, the concept ecosystem services has a theoretical background in environmental science. In the 1970’s and 1980’s, researchers started to work with the concept of ecosystem function, to analyse the benefits that ecosystems provide to society (Bouma and Van der Ploeg, 1975; Heuting, 1980). De Groot (1992) defined ecosystem function as ‘the capacity of the ecosystem to provide goods and services that satisfy human needs, directly or indirectly’. The state and the functioning of the ecosystem influence ecosystem functions.

An ecosystem function may result in the supply of ecosystem services, if there is a demand for the concerned good or service. For instance, the function 'production of firewood' follows from a range of ecological processes like photosynthesis and water uptake from the soil. And the amount of firewood demanded by a local community defines the amount of firewood extracted from the ecosystem (Hein, 2010).

Several classification systems exist to categorise ecosystem services. For example, TEEB (2010) distinguish provisioning, regulating, habitat, and cultural services (See Table 3 for definitions and examples).

Table 2: Classification of ecosystem services

Ecosystem service classes	Examples
Provisioning services are ecosystem services that describe the material or energy outputs from ecosystems.	Cultivated plants for nutritional purposes, raw materials like wood, and fresh water
Regulating services are the services that ecosystems provide by acting as regulators e.g. regulating the quality of air and soil or by providing flood and disease control.	Air and water quality regulation, moderation of extreme events like flooding, pollination and natural pest control
Habitat services highlight the importance of ecosystems to provide habitat for migratory species and to maintain the viability of gene-pools.	Habitats that provide everything for individual plants or animals needs to survive
Cultural services the non-material benefits people obtain from ecosystems.	Recreation possibilities, tourism, and aesthetic appreciation of the natural environment

Ecosystem services can be classified as rival (e.g. wood harvested from a forest) or non-rival (recreation possibilities like enjoying beautiful views over a landscape). An example of an excludable ecosystem service is the hiking possibilities on a private property (i.e., a *club good* in the economics definition above). In contrast, hiking possibilities in a public nature area are an example of a non-excludable ecosystem service (i.e., a *public good* in the economics definition above).

Agricultural landscapes provide and receive several ecosystem services (Figure 2, TEEB). On the one hand, farmers utilise the capacity from the ecosystem to provide crops and materials for the production of food, feed or fuel (private goods). Ecosystem services provided for this purpose by the natural environment are for example pollination, nutrient cycling and natural pest control. The use of such ecosystem services for agricultural products presumes the modification, improvement or impairment of an ecosystem's capacity (Huang et al. 2015, von Haaren et al. 2014) by means of significant inputs from human systems such as fertiliser or technology (see the 'inputs' in Figure 2). On the other hand, agricultural landscapes can also provide regulating, cultural and habitat services like carbon sequestration, possibilities for recreation and habitat services (i.e., public goods). Depending on the management of the agricultural system, the provision of these ecosystem services can be impacted negatively through for example loss of wildlife habitats, nutrient runoff, sedimentation and pollution of waterways, as well as greenhouse gas emissions (Power 2010; Swinton et al., 2007).

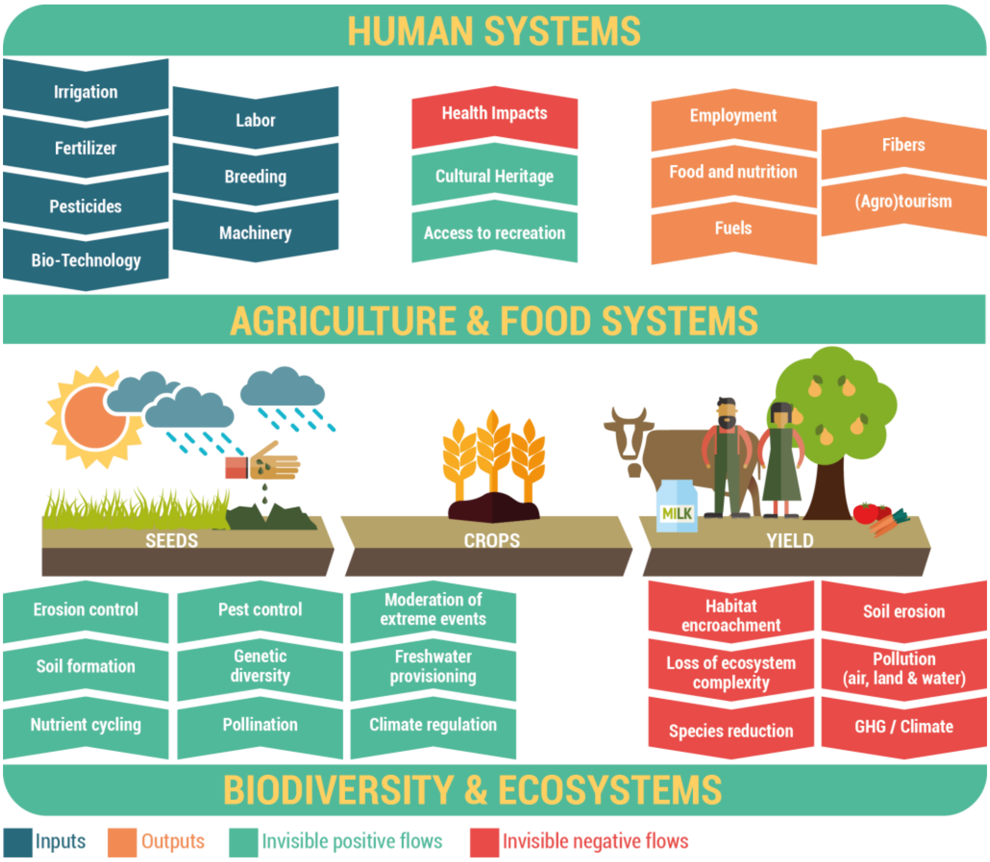

Figure 1: Illustration of inputs, outputs, positive and negative flows between natural and human systems (TEEB, http://img.teebweb.org/wp-content/uploads/2016/02/02.png

Challenges of managing environmental public goods and ecosystem services

In the context of natural and agricultural environments, there is a large debate and literature on public goods and common pool resources. For common pool resources, there is the risk of overuse – the so-called 'tragedy of the commons' (Hardin 1968). For public goods, there is a risk of under-provision. In principle, if perfect markets (perfect information, zero transaction costs, perfectly defined property rights) would exist for these goods, this would ensure an equilibrium where the value of the good would be high enough to provide an incentive to manage them sustainably (a situation famously described in Ronald Coase's seminal article "The problem of social cost", 1960). Unfortunately, markets for public goods and ecosystem services are not perfect (asymmetric or missing information; transaction costs are substantial; property rights are often ill-defined; future generations' preferences are not known). At the same time, economic benefits of public goods and ecosystem services such as conservation of biodiversity and carbon sequestration can be large. As these economic benefits often do not accrue to the local ecosystem manager, unless appropriate Payment for Ecosystem Services schemes are in place (Hein, 2010) there is a role for public policy (improved policy instruments in Contracts2.0) or the development of markets (value chain approach in Contracts2.0).

How the concept has been applied

A wide range of factors has been shown to affect public good provision at the individual level (much of the evidence stems from laboratory experiments, but has been tested in the field). These include but are not limited to rewards and sanctions; communication and trust; altruism, reciprocity and self-interest; attitude to the environment; social norms and culture (e.g. Bremer et al. 2014, Calvet et al. 2019, Chen et al. 2009, Defrancesco et al. 2018).

Examples of application with a focus on governance aspects include:

- Strengthening nature conservation policy in the frame of the Convention of Biological Diversity and the EU Biodiversity strategy 2020
- Implementation of legislation for management of water resources (e.g. Water Framework Directive); mapping and assessment of ecosystem services (MAES) produces comprehensive information on water quality and quantity and, thus, facilitates more efficient protection and management
- Visualisation of trade-offs resulting from different land use alternatives.

Significance to Contracts2.0

The "private-public good dynamic of ecosystem services" (Fisher et al. 2007) and the benefits they provide set the framework for the Contracts2.0 project and guide the activities of all work packages. The concept allows the potential of the provision of public goods to be assessed along with private goods, and for economic and ecological aspects to be considered simultaneously. It is therefore an important concept for the ex-post evaluation of existing contractual approaches in WP2 and also for the development of 'dream contracts' in WP3 and the upscaling of contracts in WP4.

For a sustainable and more targeted (re)design of contractual approaches and policy instruments, the ecosystem services concept can provide guidance on identifying critical environmental goods and services, and developing management options and production conditions to promote these environmental goods and services. The ecosystem services concept can improve deliberative and coordination processes among administrative, political and land use actors. It also offers the possibility to standardise assessment and evaluation methods in order to generate meaningful results when comparing different types of contracts and their impacts. This information can be used for economic valorisation of environmental public goods, e.g. in the sense of payments for ecosystem services (see Concept Payment for Ecosystem Services), via agri-environmental measures, which support land-use or agronomic practices that improve the state and functioning of (agro-) ecosystems.

Strength and weaknesses

A major strength of the **public good concept** in economics is its simplicity and the ease with which it can be operationalised for empirical studies such as laboratory experiments. That being said, a lot of context and complexity is typically ignored in standard economic applications. These challenges can be addressed by a deliberate attempt to complement methods (cf. Poteete et al., 2010). Conceptually, working with nested games or ecologies of games may help in capturing and making explicit some of the complexities and interactions among different action situations (cf. Kimmich, 2013). In Contracts2.0, we address this challenge by working with co-designed public goods game experiments that also carefully document the qualitative aspects of the co-design process (WP5).

In contrast, the **ecosystem services concept** is very concrete and closely linked to ecological functions of agro-ecosystems. Yet, the quantification of ecosystem services poses a major challenge and requires in-depth knowledge, as well as value judgments. Ecosystem and social system complexity (and dynamics), possible tipping points, and high levels of uncertainty may juxtapose such attempts, and some have argued that it is even impossible to value nature (Farrell, 2009). In Contracts2.0 we do not take this strong position, but we will take great care in the communication of uncertainties when presenting monetary values of ecosystem services. Deliberate valuation techniques can help in making explicit the diverse viewpoints and judgments of heterogeneous stakeholder groups (Lienhoop et al., 2015).

Methodological implications and typical methods

In economics, laboratory public goods games are the most commonly applied method to identify the various factors driving **public good provision**. These experiments typically manipulate factors such as rewards or punishments for cooperation, group size, or endowment heterogeneity (see Zelmer, 2003 for a meta-analysis). Juan-Camilo Cardenas was among the first to apply such games to field populations in the context of resource use (Cardenas et al., 2000). Since then, the literature has been growing rapidly, and economic experiments (including public goods games) are also increasingly applied to study agri-environmental programs (see Palm-Forster et al., 2019 for a recent review and Bouma et al., 2019 for a recent example). Other methods include econometrics (using both micro-level household data as well as country level data).

Ecosystem services are often quantified in natural units through the use of bio-physical or ecological models used by natural scientists. The economic valuation would usually rely on the various methods used in environmental economics, i.e., revealed and stated preferences techniques, such as the travel cost method, hedonic pricing, contingent valuation, or discrete choice experiments. In Contracts2.0, we will among other things, use discrete choice experiments to estimate the willingness-to-accept and the willingness-to-pay of farmers, consumers and other decision-makers.

References

Extract from the Deliverable "Shared Conceptual Framework" (C20_WP1_D01_D1.1_UNIABDN)
For references see [Original Document]