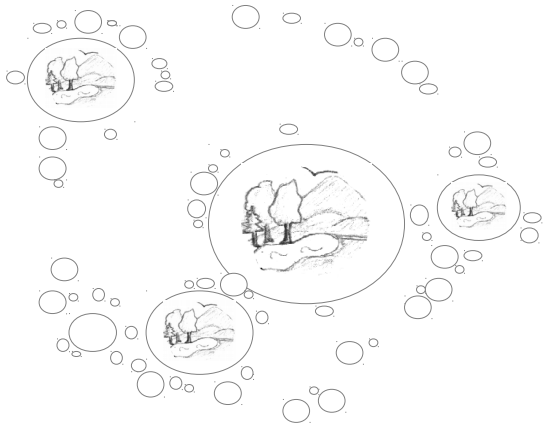
Leuphana University of Lüneburg
Faculty of Sustainability
Institute for Environmental Chemistry

Bachelor Thesis

DEFINING NATURAL RESOURCES AS COMMON GOODS



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Im Grunde
sind es immer die Verbindungen mit Menschen,
die dem Leben seinen Wert geben.

-

In the end,
it always are the relationships with people
that give live it's value.

-Wilhelm von Humboldt-

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Abbreviations

CG	common good
CPR	common pool resource
EF	ecosystem function
IASC	International Association for the Study of the Commons
MA	Millennium Ecosystem Assessment 2005
UNFCCC	United Nations Conferences On Climate Change

ABSTRACT

In the face of continued exploitation of the earth's resources with measurable drastic consequences to all life on earth and humanity's well-being, this thesis analyses how and to which extend natural resources can be defined as humanity's common goods. It is framed by the German IntRess project "exploring options for global resource use" commissioned by the German Federal Environmental Agency to generate a basis for evaluating commons management concepts. Common goods are characterised by a shared use and bear both the gift of benefiting from a resource and the responsibility to take part in it's preservation. The commons perspective is examined in this intensity as it bears the potential to turn the current situation in resource use back on the feet: towards an efficient economy to serve people and nature due to an attitude resembling strong sustainability. In the first part, chapters 2 & 3, basis of later definition is introduced with economical, international politics and ecosystem services' perspectives on natural resources on one hand side and, on the other hand side, the common goods discourses perspectives on historical, tragic, traditional and global commons. Shared common good properties are analysed and displayed in a framework of commons terminology, introducing the gradient "intensity of commoning" to distinguish between commons in becoming and settled commons. In defining and combining natural resources and common goods as of global significance in form of humanity's heritage, 15 cornerstone criteria are formulated. It is distinguished between the significance of embedded and extracted resources' services to humanity. In the second part, chapters 4 & 5, all defined natural resources can be identified as humanity's common goods of global significance by following a set of flowcharts generated from the definition. That indicates the resources' need to be governed and preserved locally in accordance with their global significance, if it is to be preserved as presents and future generations' essential foundation of life.

1. INTRODUCTION

> *A world without water, energy, agriculture and minerals is impossible to envisage. Increasingly, however, these same sectors are disconnected from the social fabric of life in countries with developed economies—the consumer society demands instant gratification, with scant regard to the resources which underpin supposed quality of life. In developing countries, however, the picture is distinctly different—these same sectors are the lifeblood of the economy, and their role is obvious to all. The 'disconnect' between these two perspectives is real (and growing) (J. Petrie 2007).*

This thesis is built on work-package 6a of the IntRess project as a basis for evaluating commons management concepts. It is the aim to further integrate the perspectives of I. collectively governed resources and II. of natural resources as common heritage of humankind into the international debate on a sustainable resource use.

The Project "IntRess - exploring options for global resource use" is commissioned by the German Federal Environmental Agency (Umweltbundesamt, UBA) and funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU) with project duration from October 2012 to January 2016. Amongst others, the governance of natural resources as common goods is to be researched, defined and discussed as one option for global resource use.

The normative key question, aiming at sustainable management approaches for preservation of the earth's endangered resources and humanity's fundamental dependence on them, is:

In how far can natural resources be defined as humanity's common goods?

This main question leads to a range of sub-questions, clustered after methodological steps, which indicate the approach on answering the above question.

I. *Reviewing: Which central perspectives can the discourse on natural resources contribute on the leading question, which can the commons discourse contribute?*

II. *Defining:* a) How can natural resources be defined?

b) How can common goods be defined?

c) How can natural resources be defined and identified as humanity's common goods – and what are implications of that?

III. *Identifying*: Which groups of natural resources can be identified as humanity's common goods?

The hypothesis is posed and to be tested subsequently to identifying,, that

> "*All existing natural resources can be governed as common goods. In how far that can be achieved depends on the degree to which resource governance is oriented on preservation of the common inheritance (cf. Helfrich et al 2014, adapted to question).*

IV. *Concluding*: In how far can this definition of natural resources as common goods be helpful to the challenges in reduce of resource extraction, preserve existing resources for future generations and govern the world's resources in a fair way?

In response to the sub-questions, the approach is to, firstly, introduce perspectives on natural resources (chapter 2); followed by perspectives on common goods and analysis of the common goods discourse (chapter 3). On that basis, in chapter 4, both natural resources and common goods are to be defined with regard to the value that the perspective can contribute to a sustainable resource use; to be then then combined to a valid definition of natural resources as common goods of humankind. Subsequently, The definition is to be transferred into a tool in form of a flowchart for transparent identification of common goods of humankind (chapter 5), which was finally applied in the construction of a table listing all natural resources that have been named as commons in a narrowed range of literature. Proceeding and findings, raised questions and validity are discussed in a critical evaluation (chapter 6) and subsumed in a conclusion (chapter 7). Description and of detailed proceeding is prefaced to every chapter.

For up-to-date information on natural resource policies, reports from national and international institutes and institutions are consulted. The "*Digital Library of the Commons"* of Indiana University offers open access to a substantial collection of international articles, papers and dissertations on the commons and the context of the discourse. It is consulted as central source for researching literature on commons definitions and identifying natural resources as commons.

The library is searched for all categories of natural resources listed by the UNEP International Resource Panel (2012), which are "water, land, energy and materials such as minerals, biomass and fossil fuels" as well as for literature mapping commons resources.

2. Perspectives on Natural Resources

As the point of interest is on natural resources, which are resources measurable by natural sciences, the challenge is to build the bridge to social science definitions of commons and collective action without escaping their respective specifications. In chapter 2, contemporary perspectives on natural resources are depicted from the viewpoint of international resource politics and the economical perspective of the value-chain and are combined to a definition suitable for policies of sustainable resource use (2a). To develop a method for transfer on this research definition on common goods and a closer definition of natural resources' properties, the Millennium Assessment Services, Human Well-being, and Drivers of Change"(cf. illustration 4), is analysed for its usefulness as a bridge between categories of ecosystem services - or resource services - and social aspects of commoning (2b).

a) Why Consider Natural Resources as Commons?

"More growth, prosperity, quality of life – an increasing burden on the environment", titles a chapter in the German Resource Efficiency Programme (ProGress 2012:18).

Natural resources, basis for human well-being, have been extracted and used in ways exceeding our planetary boundaries today. The current course of global resources use is no longer tolerable in respect of future generations or in terms of justice featuring global south and global north. In the countries of the global south is where most resource extraction is taking place, while most resource consumption is, currently by factor four, a privilege of the global north (ProGress 2012:10). We are facing complex global challenges in terms of social cohesion, ecological stability and economical prosperity already, and they will presumably increase if economic growth continues and world population, prosperity and quality of life continue their current developments. Therefore, reducing extraction and consumption of natural resources and raw materials is considered "one of the central challenges of sustainable society in the 21. century" (ibid.).

Why might it be helpful for that challenge to consider natural resources as commons? "Commons" are, according to Helfrich and Bollier (2012), the multiple forms of collectively taking care of a shared resource that make it possible to respect its value beyond use, and therefore safeguard resources for long periods of time. The term "common", originally referring to commonly used forests in England from 12th century onwards, was re-popularised by Garrett

Hardin in 1968 as “tragedy of the commons”, and criticized strongly by Elinor Ostrom and others for the use of the term without taking any form of communication between actors into account. Therefore, when using the term “commons” it is essential to make sure that everyone knows what discourse is being referred to as is the case with “sustainability”.

Here we have two central understandings of the terms that need to be clearly separated. In the last decades, various discourses from different disciplines have converged and interlinked, according to De Moor (2011), without achieving unity on the term “commons”. Especially natural resources of free access and global scale (global commons), which are frequently referred to in international political debate on responsibilities for climate change and protection of atmosphere and oceans, seem difficult to combine with the understanding of commons sketched by Ostrom and those following her perspective.

Fisheries and forests are two common goods frequently discussed in scientific literature. Others are pastures and meadows, watering systems, groundwater pools, lakes, oceans and atmosphere (Ostrom 2009), the so-called traditional commons. Furthermore, a row of non-traditional commons sprung up in the last twenty years, from the world wide web as digital commons to a reclamation of urban spaces, the urban commons.

Time for a global transformation is running short. We cannot afford to wait and see whether current policies are able to achieve a transformation. There is an uncountable number of buzzing networks and groups on local, regional and global levels, managing natural resources in one or another way as commons, as described by Elinor Ostrom and many others following her perspective – which might be able to not only remind us of older forms of managing resources, but point towards possibilities of a transformation towards sustainability in the relationship between people, societies and the resources they use. Let us have a closer look at the potentials in these community-based forms of governing natural resources – from a local to global scale, from commons “beyond market and state” to international “embedded institutions”.

According to the UNEP International Resources Panel 2012 , a sustainable use is a way of resource use that ensures “well-being of humanity, environmental health, and economic prosperity”, pointing to the three dimensions of sustainability after Tremmel (2003)[1]: social, ecological and economical dimensions currently referred to when sustainability is addressed. If one dimension is not respected in the use of a resource, that use cannot be termed sustainable.

In looking up how recent policies define a sustainable resource management, many relate to resource efficiency - the increase of a resources' unit's productivity due to technical optimisation - as does the German Resource Efficiency Programme (ProGress 2012). The impression arises that

1 cf. Michelsen & CSM (2012:70)

all efficient forms of resource use are broadly considered sustainable. Building a highly efficient two million KW highly land-consuming, water-driven power-plant in the rainforest, in a highly bio-diverse area of the Amazon, home to indigenous people – is that surely sustainable?

Designing more efficient mobile phones surely is a contribution to a more sustainable resource use, but it remains the consumers' choice to buy the newest model when their old one is still doing its job, and put it in the drawer, thereby undoing the gain in resource efficiency by increased demand[2]. Efficiency is addressing the production chain of a product, and can help to reduce resource consumption in each production step. But what lies before production? Resource extraction. And after production? Product use and re-use. Communities in those two sections may hold the key to change patterns of ecosystems' devastation through resource extraction, and of rebound[3] through increasing demand, as we were able to witness in the high speed development of new generations of mobile phones this last decade.

Efficiency, therefore, cannot be the only strategy on the pathway to a truly sustainable development. In order to get the economy into the green boat, it seems to be the easiest strategy to communicate but if we want to go further, other strategies cannot be ignored. The Club of Rome named four of them: increasing resource productivity with *efficiency*, or with consistency in replacing limited resources by others; reducing resource consumption with *sufficiency* and broadening awareness by *education* (Michelsen & CSM 2012:79). In their conclusion on a strong theory on sustainability, Ott and Döring named three key principles: *Resilience* as conserving natural capital, *sufficiency* as sustainable consumption and voluntarily simplicity, and *efficiency* as de-materialization (Ott/Döring 2004:338).

While solutions for a sustainable resource use of economies and global politics mostly focus on efficiency, the commons as multiple forms of collectively taking care of a shared pool of goods while respecting its value beyond use have been proven to safeguard resources for long periods of time in quite a different approach (Helfrich and Bollier 2012). An approach to sustainability that is based on multiple groups of people, which are governing the resources of their livelihoods considering the well-being of people, ecosystems and local economies. The difference of this approach lies in the orientation of the actors on all strategies of sustainability, not only efficiency, as the economic sphere is only one dimension serving the well-being of people and ecosystems - and not vice versa, as it seems to be the case in the utilitarian mindset is still widespread through global market rules and politics: that people and resources are to serve the sustainable

2 Frequently used example in context of globalisation and consumption behaviour (cf. Bollier 2014)

3 The *rebound effect* terms a situation when increased efficiency, on the one-hand-side, leads to cheaper and more sustainable production, while on the other-hand-side consumption of the resource and/or product is growing to a degree that swallows up any positive effect.

development of economy, interpreted as growth. The commons place that situation back on its feet: towards an efficient economy to serve people and nature. So, the commons are not only a way of organising sustainable resource use, oriented on human and natural well-being, they can also be seen as an attitude rather resembling the definitions of Ott and Döring's key principles of resilience, sufficiency and efficiency.

In the value chain perspective, natural resources are at the very beginning of all economic processes. Petrie (2007) stated that economics needed to change their perspective from focusing on the supply chain to the value chain or life-cycle perspective of a product. While extraction technologies are highly developed, recycling and re-use options that are prolonging natural resources' time of use are still operating in a niche. In the life-cycle-perspective, resources merged into products are valued as re-usable. For a better understanding of natural resources' role in economics, a generalised product supply-chain and product life-cycle are depicted below.

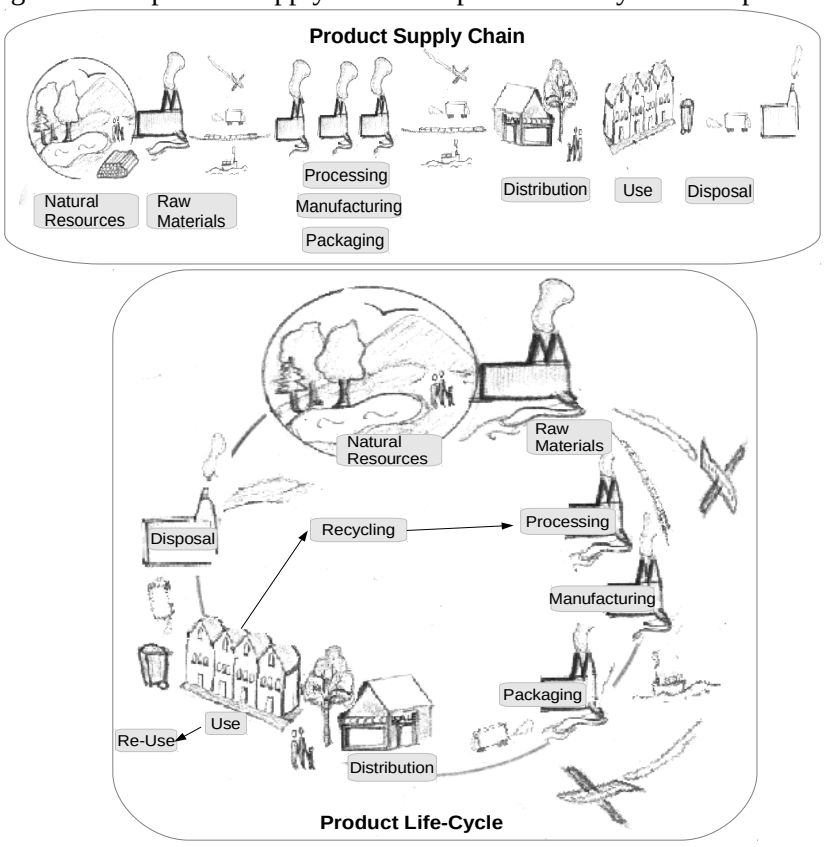

Illustration 1 (own source 2015, based on "the story of stuff" project): Product value chain and life cycle

The natural resources defined above as *Water, Air, Soil/Land, Biodiversity and Raw Materials* are exist on a multi-level scale with varying intensities of interdependent linkages. Thus, we have to consider complex multilevel resource systems.

A resource can be differentiated in resource system, resource pool and resource unit, as

illustration 2 depicts. A fish (resource unit) belongs to a species of fish (resource pool), which is one of many species (larger resource pool: all species) in a lake or river, which, in turn, are a child resource pool of the world's fish species (global resource pool) (cf. Gaston 2000)

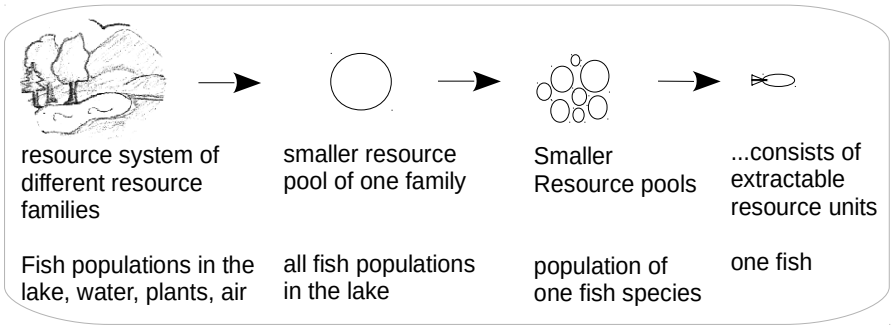

Illustration 2 (own source 2015): Resource System, resource pool and resource unit

Which part or parts of these value chain and life cycle perspectives are analysed in defining natural resources as common goods? As almost all stations of a good's value chain or life cycle take place after resource extraction, it is the very first step that is considered in the following; where the resources are still embedded in the environment or in the ground. Besides this very obvious location, it also is where the amount of extraction and regulations for a resource use are decided. That action is, in many modern day cases of globalised economy, not decided where the resource is extracted; and more often than not, without including the considerations of directly affected communities in the process. This is something to be kept in mind in further definition of natural resources as common goods.

B) A Systematics of Natural Resources

> *The well-being of humanity, environmental health, and economic prosperity depend on the way in which society uses and cares for natural resources, including water, land, energy and materials such as minerals, biomass and fossil fuels (UNEP International Resources Panel 2012: Synopsis)*

A definition of natural resources and their properties, usable for a combination with and identification of common goods, is to be found. In 3a), a systematics of natural resources is introduced. The question “Why consider natural resources (NR) as common goods (CG)?” is traced further in 3b), with a focus on the role of resource-people-interactions along the conventional product-value-chain we encounter in global production and distribution, thereby locating this papers' subject - natural resources as common goods - in the product life-cycle. In 3c), the Millennium Ecosystem Assessment Framework (2005, cf. 4) is presented as a method for identification of resource properties and bridge from resources' value to users' needs.

The word resource, deriving from the Latin word “resurgere”, can be translated as the means for performing an action. In the understanding of classical economics, resources are the three factors

of production: work, ground and capital. H*uman resources* or human capital (education, management qualities) provide power of *work*, *natural resources* or natural capital of *ground* provide goods for producing (e.g. wood, minerals, steel), and real capital in form of buildings, infrastructure, industry and tools provide the framework of production (Reller et al 2013).

In the terms of geo-sciences and sustainability sciences, natural resources are understood more broadly as all natural capital used in the past or potentially usable, including the environmental media water, air and soil as well as energetic, mineral, and biotic resources as plants and animals (ibid.). In the broadest sense, all ecosystem functions of earth and solar system usable by humans or funding human well-being are included (Schütz / Bringezu 2008., Millennium Ecosystem Assessment 2005, ICSU / UNESCO / UNU 2008 based on Wuppertal Institut 2009). Following the more concrete definition, the UNEP International Resources Panel (UNEP 2012) lists "Water, land, energy and materials such as minerals, biomass and fossil fuels" as natural resources.

How can natural resources be categorised?

In the German Resource Efficiency Programme (ProGress 2012), 3 lists the same as UNEP plus biodiversity: *Water*, *Air*, *Soil/Land*, *Biodiversity* and *Raw Materials*, *which are* are subdivided in *Biotic* and *Abiotic Materials*, with *Fossil Fuels*, *Ores*, *Industrial Minerals* and *Construction Material* as Abiotic and *Material Use*, *Food/Feedstuff* and *Fuel* as *Biotic Material*. The use of raw materials is considered as "closely connected with the use of (the) other resources such as water, land/soil, air, biological diversity and ecosystems (ibid.)" While ProGress (2012) is focussing on a more narrowed selection of raw materials, the research-question of this thesis is considering all natural resources, including biodiversity.

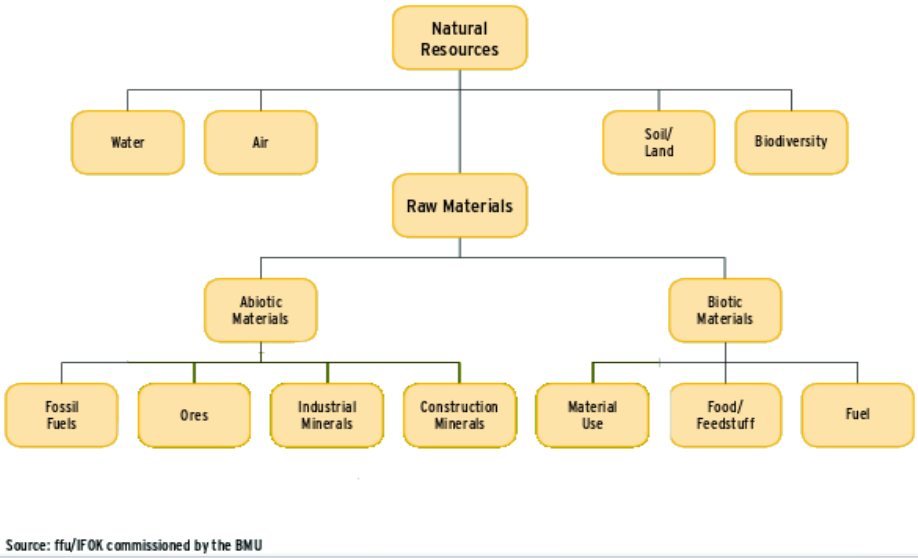

Illustration 3 (Diagram based on ffu/IFOK commissioned by the BMU, 2012): Diagram of natural resources and resources treated in ProGress

c) Millennium Ecosystem Assessment Framework

"Not everything is a commons, but almost all can become a commons" (Helfrich et al 2014).

It is aspired to create a "Flowchart" that can be applied to natural resources as a method of checking on services, properties and qualities of a natural Common Good. For easy handling it shall consist of a row of questions answerable with "yes" or "no", leading to an identification of on-leading questions. In order to later scan definition components further on their completeness, to steady the bridging from natural resources to the social components of commons and to further allow a categorization of the natural commons, a framework from Millennium Assessment (MA 2005) is introduced.

> *The MA is intended to be used (...) as a framework and source of tools for assessment, planning, and management; to identify response options to achieve human development and sustainability goals (...); (and) to guide future research. (…) The assessment focuses on the linkages between ecosystems[4] and human well-being and, in particular, on ecosystem services (MA 2005:xiv).*

Therefore it can be considered as a commonly known, central publication on the context of categorizing ecosystem services and bridging from natural resources to human well-being. As aiming at a sustainable development, it derives from a normative background.

Illustration 4 (MA 2005) schematically depicts socio-economic possibilities of influence on the inter-relations of *Ecosystem Services* and the *Constituents of Well-Being* based on them. It groups four *Ecosystem Services (Supporting, Provisioning, Regulating, Cultural*) in relation to five *Constituents of Well-Being (Security, Basic Material for Good Life, Health, Good Social Relations, Freedom of Choice and Action*) (Cf. Illustration 4).

Categorizing ecosystem services, the illustration prefacing the Millennium Assessment Synthesis Report (2005) needs to be interpreted as a illustration of services of resource systems, which are in this paper to be defined as common goods. The MA states that it

> *(...) deals with the full range of ecosystems—from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use, to ecosystems intensively man- aged and modified by humans, such as agricultural land and urban areas. Ecosystem services are the benefits people obtain from ecosystems(ibid).*

Ecosystems are herewith recognized as provisioners of material and immaterial goods fundamental for human well-being. They support, provide for and regulate the underlying necessities for live on earth and human livelihoods. In comparison, natural resources are, according to UNEP International Resources Panel Synopsis (2012), those resources that the well-being of humanity, environmental health, and economic prosperity depend on, including water,

4 "An ecosystem is a dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit (MA 2005: xiv)".

land, atmosphere, biodiversity and raw materials such as minerals, biomass and fossil fuels. Where "ecosystem services" are considered as embedded in a system by definition of the term, "natural resources" are here considered as pools of materials and energies interlinked with well-being of humanity, environmental health, and economic prosperity. Considering those similarities between the definitions, we can justly specify the meaning of the illustration on natural resource-systems services as equivalent to ecosystem services.

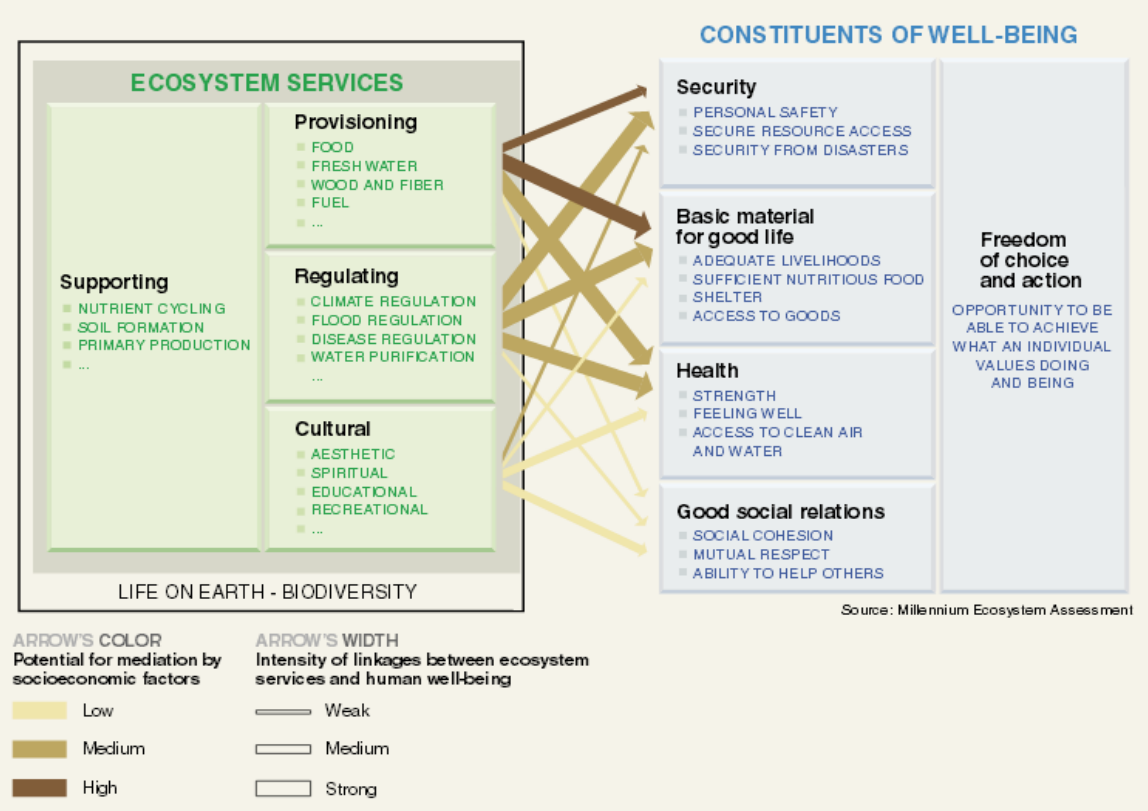

Illustration 4 (Millennium Assessment 2005): Linkages between Ecosystem Services and Human Well-being.

According to the illustration 4, the three ecosystem service categories *Provisioning, Regulating* and *Cultural* on the basis of the underlying *Supporting Services* are supporting in their turn, with varying intensity, the constituents of well-being, leading to *Freedom of choice and action*. All Ecosystem Services are depicted as integral components of *Live on Earth* and *Biodiversity.* By depicting human well-being as strictly dependent on these *Provisioning, Regulating, Cultural and Supporting* ecosystem services, as the illustration does, they are attributed to a significance empowering utilitarian societies to recognize ecosystem of non-use value as well as utility value.

"Food", "freshwater", "wood and fiber", "fuel" etc. are *provisioning* the material basics of livelihoods. *Regulating* are those services keeping climate, floods, diseases and water purification in balance. "Aesthetic", "spiritual", "educational", "recreational" and similar aspects of ecosystems are perceived as *cultural* services. "Nutrient cycling", "soil formation", "primary

plant production" and other underlying processes are named as *supporting* ecosystem services.

The five Constituents of Well-Being on the right hand side of the illustration are linked with varying intensity are linked to the three ecosystem services *Provisioning*, *Regulating* and *Cultural*, in their turn supported by the fourth group, the *Supporting* services. *Security* is sub-summing "personal safety", a "secure resource access" and "security from diseases". *Basic material for good life* represents "adequate livelihoods", "sufficient nutritious food", "shelter" and "access to goods". *Health* is nearer defined as "strength", "feeling well" and "access to clean air and water". *Good social Relations* are represented by "social cohesion", "mutual respect" and "the ability to help others". Altogether these four empower people and societies with the *Freedom of choice and action,* that is "the opportunity to be able to achieve what an individual values doing and being".

The intensity of linkages, as indicated by arrow broadness, from the *Provisioning* and *Regulating* services to *Security, Basic material for good life* and *Health* are depicted as much stronger than linkages from *Cultural services* (ecosystem service) or to *Good social relations (constituent of well-being)*. Those are also the ones with "Low potential for mediation by socio-economic factors," as indicated by the white colouring, whereas *Provisioning* services linkages to *Security* and *Basic materials for good live* are attributed with a high potential for mediation. That is the case, for example, "if it is possible to purchase a substitute for a degraded ecosystem service (…)" (Millennium Assessment 2005), so that in turn "low mediation potential" indicates that the service cannot be substituted. Considering those linkages, it is interesting to note that those relating to the direct handling with materials and use of resources are attributed a high potential of mediation by socio-economic factors, whereas all those relating to the *cultural* or collective aspects of resource services and well-being are attributed a low potential.

Summarising, natural resources are considered in this paper are, ad end of chapter 2, characterised as follows:

- as means for human actions and basis of human livelihoods provided by nature;
- consisting of the large-scale resources pools *Water, Air, Soil/Land and Biodiversity,* and the *Raw Materials sub-categorised* in Biotic and *Abiotic Materials*, with *Fossil Fuels, Ores, Industrial Minerals* and *Construction Material* as Abiotic and *Material Use, Food/Feedstuff* and *Fuel* as *Biotic Material (cf. ProGress 2012).*
- all ecosystem functions of earth and solar system usable by humans or funding human well-being related to the named material resources
- value for humanity, as living resource-pools embedded in ecosystems or as single resource units, can be closer described by the perspectives of provisioning, supporting, cultural and regulating ecosystem- or resource-services. While Resource extraction takes place at local level, use can be distributed globally.

3. Perspectives on Common Goods

To build a strong background for a definition of natural resources as common goods in chapter 3 the terminology of common goods is backtracked to their roots in ancient times. The differing use of the term until today is illuminated based on publications central to each in reference to each other; as are the historical common goods; the economical discourse on the "tragedy of the commons" based on Hardin; the community based discourse on commons and common pool resources (CPR) or common goods (CG) based on Ostrom; and the global politics discourse of the global commons (3 a). Based on that, cornerstones of the discourses are undertaken a qualitative analysis in direct comparison, along with the properties of resources in the different forms of commons. Thereafter, the terms of CG and CPR are defined in accordance with results and existing definitions. The dimensions of sustainability as categorized by Michelsen (2012) and as applied to the context of the commons by Soroos (1995) are drawn on as a normative reference point in order to evaluate to which degree definition properties might prove useful for continuing research on a sustainable management of common goods. The terminology of commons is, thereafter, placed on a gradient from low to high degree of sustainable resource governance as commons (3b). Cornerstones and minimum criteria for a commons definition, in context of sustainable use of natural resources, are distilled from that comparison and completed with aspects that can be depicted in a combining, normative framework of commons terminology (3c).

a) A Systematics of the Commons

As same or similar rural, community-based land management systems are existing all over the world, from German alpine grazing systems to Nepal's, Ecuador's or Ethiopia's meadows and forests, commons are assumed to be a resilient way of management; resilient in that it lasted over long periods of time in many rural places of the world where often an abundance of natural resources in good condition can be found and the poor are provided with livelihoods based on this community land.

The challenge in using the term "commons" is the hidden complexity of a not-homogeneous discourse.

> *Over time, and in particular since the middle of the twentieth century, the term 'commons' has been used in many ways. In the middle of the twentieth century, the common as a physical phenomenon started to be used repeatedly by scientists from other disciplines to indicate collective property (De Moor 2011).*

As De Moor(2011) lays out, the current situation calls for more clarity in the meaning and use of commons-connected terms. Therefore those will be analysed in the context of the authors who defined them. Literature on commons repeatedly names the following notably differing backgrounds (Bollier 2014, Hess 2008, De Moor 2012, Helfrich 2012):

I. The historical commons as irrigation systems and villages' common land regimes as recorded from 12th century onward in the European countries

II. The widely spread depiction of the "Tragedy of the commons" by Garrett Hardin (1968)

III. The commons Elinor Ostrom describes in her book Governing the commons (1996) as resource systems limited in space, and with a bottom-up formed institutional set-up, that are self-governed, that have well-defined access rules and other characteristics, with strong resemblances to historical commons

IV. The new commons as mapped by Charlotte Hess (2008) with a much wider array of non-natural resources, including the...

V. global commons, which define natural resources as common inheritance of humankind in a way resembling Hardin's description.

De Moor additionally draws two strands of discourse within this four: Commons based on Ostrom and a resembling perspective on historical commons, and the "Tragedy of the Commons" perspective based on Hardin and classical economics, sharing one perspective with the global commons approach.

Differences and properties of the terms of these four prominent backgrounds are first analysed as cornerstones of their specific use of the term "commons" and secondly brought together in a chart on common definitions so as to analyse their differences and similarities. On that basis, it shall be tested whether the four backgrounds can be subsumed into two, as De Moor indicates, and how these relate to each other in terms of sustainable resource use. Finally, a combining definition of common goods including all four backgrounds shall be built and confirmed.

A) A Systematics of the Commons

I. History of the Commons: Community Land

In ancient Rome, different types of goods have been distinguished: *res nullius*, no ones goods, usable by everyone as they want; *res privatae*, private goods of private ownership; *res publicae*, the public goods governed by the state as streets and public buildings; and *res communes*, common goods as every ones property provided by nature such as forests and rivers. Such as classification of goods still is valuable today (Helfrich et al. 2014). A related terminological source of the term "common" is to be found in the Norman word commun from munus. Traslated as a "gift "and "counter-gift", interpretable as"duty", the term translates as "Receiving gifts and respecting duties in community" (cf. Bollier 2014). In European lands, the variety of alternative namings for commonly owned or used land has led to "considerable confusion also among historians and has for a long time prevented scientific comparison of the emergence and functioning of commons (de Moor 2011:4): The British *open field, common meadow, common waste;* Dutch *markegenootschappen* or *meenten*; German *Allmende*, *Gemeinheit* or *Genossenschaften* (to name just a few). In shared historical understanding, it indicates a village's

community-land with all its forests and meadows, rivers and lakes husbanded and administered by the village community or a villagers association based on local tradition.

Text 1: European Villagers, from early 12th century onwards

*The European villagers started from the early 12th century onwards to formalise their cooperation in land usage and management by writing down regulations. These regulations were often highly sophisticated in their design, showing the awareness of the commoners in the dangers that lured in cooperation. They, for example, often used graduated sanctioning systems, not sparing those who didn't report freeriding either. In trying to prevent the commoners being seduced by the market, it was often prohibited to put cattle on the common summer pasture that had been bought on the early spring cattle market. The common was not a place to fatten up your cattle but it was an essential part of the mixed agricultural system as the manure produced by the cattle was indispensable for the arable land. (…) In plenty of occasions the number of cattle allowed on the common was restricted to the carrying capacity of the pasture, and if this number was not set in advance, the number of cattle could be regulated by using price mechanisms. Plenty of other examples of rules and practice could show that in their strive for a striking a balance between efficiency and utility the commoners autonomously designed an impressive set of rules they put adequately into practice (*De Moor 2007:2).

After a continuous process of protecting the common lands, loosing them to and claiming them back from local landlords from 1200 onwards, self-governed community land disappeared all over Europe around 1700 to 1880 with increasing industrialisation and a call for agricultural efficiency, which was thought to be achieved by privatisation in form of the so-called separation or distribution of community land (Schlosser 1998: 23 f.). Nevertheless, collective forms of local resource use remained alive in fragments in many rural village communities as informal local traditions such as collecting timber, mushrooms and berries in the forests, leaving some for others, for birds and animals and for recreation.

II. The Classical Economics "Tragedy of Common Goods" based on Hardin (1968)

Text 2: The "Tragedy of the Commons" - or "The Myth of the British Meadow" (Soroos 1995)

"Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy. (…) As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility ***to me*** *of adding one more animal to my herd?" (Garrett Hardin 1968:1244)*

The classic economics view on goods is a frequently referred to as starting point in commons discourses (cf. Hardin 1968, De Moor 2011). Goods are categorised in degrees of excludability and in forms of limitation on access to goods, and degree of rivalry as the degree to which a

person prevents others from using the same good by usage of one unit of the good in question. They are categorised into the traditional public goods and private goods, in the 70s extended by club/toll goods and open access/common pool goods (cf. Ostrom 1990, De Moor 2011, Vanni 2014, Helfrich in Helfrich et al 2012). Differences between especially the types of collective ownership, public goods and common goods, are blurred in the discourse on commons, making it necessary to define a clear differentiation between them so as to have a solid basis for discourse (Quilligan in Helfrich 2012).

		RIVALRY/SUBSTRACTABILITY	
		Low	High
EXCLUDABILITY	Low	Public goods	Open access goods/Common pool goods
	High-	Club goods Toll goods	Private goods

Illustration 5 (De Moor 2011): classical economics framework on types of goods categorised into excludability and rivalry of use/ substractability

Private goods are private property such as a family's house and garden, a farmer's fields and forests, a company's buildings and fabrication materials. They are, according to illustration 5, characterised by high rivalry: Only one person or family uses that car and you can only rightfully acquire by buying it (high rivalry). No one else has a rightful possibility of access – the key - to that good (high excludability).

Club or toll goods such as for example private club houses and grounds, theatres and daycare centres, are characterised by a high excludability, granting access only to members, combined with a low rivalry of use, as all members share the club goods' benefits (cf. Ostrom 2009).

Public goods are characterised, according to the illustration, by a low excludability as well as by a low rivalry of use. They are usually governed by the state to avoid the so-called "free-rider"-problem, as it is easy to take something from the public pool of goods without watching for fair distribution, as might be seen in garbage management of parks and logging regulations in forests governed by the public hand. Therefore, laws and legislative regulations for public goods' use are enacted on all levels of governing public goods. Looking into sun-light and breathing air are exceptional cases. They are a community's peace and national security, health-care, fire protection, weather forecasts, knowledge etc. (Ostrom 2009).

Common pool goods are characterised as goods of easy access with high level of rivalry. The high level of rivalry is seen as dividing point in comparison with public goods. Garrett Hardin (1968) vividly depicted the scenario of a meadow open to all herdsmen, where everyone strives for grazing as much cattle as possible to gain the highest personal use. As long as the number of herdsmen and cattle stays within the natural carrying capacity of the meadow, all is working well; but when population is growing and the number of cattle and herdsmen increases, the "commons"[5] is inevitably overused: That is "the tragedy of the commons". According to Hardin, a commons is a pool of goods, in his example consisting of the meadow's grass and ecological capacity, accessible and usable by everyone, which is in concordance with the current economics perception of common pool goods depicted in the illustration above.

This use of the term commons implies an understanding of individuals as naturally striving for maximum gain from the resources in their reach- that is the homo oeconomicus, solely and exclusively oriented on personal economical benefits. Rivalling individuals not communicating with each other and therefore not creating a common understanding of resource aims inevitably cause an extraction of goods higher than the socially and ecologically optimal degree, thus possibly leading to the devastation of the "common good" or "commons" (cf. Hardin 1968).

This classification of goods based on classical economics is based on forms of ownership: private, club, public or, in case of open access or common pool goods, no one's ownership. In classic economics, the Roman *res nullius* – no one's goods – and *res communes* – everyone's goods have been merged into one category considered to be at free disposal, based on Scott Gordon's sentence from 1954, "Everybody's property is no-ones' property", in face of the overfishing of the oceans. It can be said that the common goods, every-ones goods, have been wrongly understood to be no one's goods. That is to be considered as the real tragedy, and it is still happening in all the places worldwide where community land is sold to international companies by the state, often enough without granting the community any reparation – because it is considered to be no one's land (cf. Helfrich et al 2014).

The classic common pool good resembles that of the historical commons: the ground water, rivers and fisheries, the meadows and forests where all the cattle is brought for grazing and firewood is collected. These goods are free to take (open access), as they are not sold by men but provided by nature or cultural tradition, and once a tree is felled and the wood burned for heating, you cannot burn it a second time (rivalry). After researching historical commons, De Moor states that the "access to these resources could usually be restricted although this often proved to be

5 As the use of the term "commons" based on Hardin has been fundamentally criticised (e.g. Ostrom 1990), and Hardin himself corrected his statement later on, the classical economics understanding of the term is characterised by quotation marks.

difficult. and the use of the resources can be rivalrous" (De Moor 2011), thereby showing some tendencies towards Hardin's common goods definition.

Common pool goods share the characteristic of open access with public goods. Air, water, ground and soil are provisioning natural resources that are considered as resources under threat of overuse and therefore in need of some form of collective governance (Bollier 2014). Due to the close resemblance with natural resources, these goods are frequently termed *common pool resources* (CPR) — "resources that are substractable and difficult to exclude" (Hess 2008). As a development of the last decade, cultural inheritances such as language and religion are increasingly considered as social or cultural CPR belonging to the new commons, as goods before institutionalisation that should be a commons (ibid.).

Just as the 17th century British *common* or German *Allmende* indeed term community land and common property regimes, the word commons, first made popular by Garrett Hardin's "tragedy of the commons", resembles a commonly owned, but ungoverned common. For better differentiation to the historical common, the term commons in modern understanding is applied for singular as well as plural, because the community of commoners governing the resource is seen as inseparable from it. Critics, most prominently by Elinor Ostrom. insist that in historical common property regimes the resource is not no one's land but governed by a community, even though that is not part of the term itself.

III. Contemporary Case-Studies on Common Goods based on Elinor Ostrom

Text 3: On "common property regimes", India's Contemporary Rural Commons

As Gita Bharali reports about north-east India, the forests and fields surrounding a village, with all rivulets, ponds and lakes as well as pavements, settlement area and burial grounds are, after local custom and practice, with all the products these areas bring, common property of the villagers' community. It is governed by the villages committee, for instance, or a chosen village headman. In accordance with local use rights, every inhabitant has the right to go and collect timber, fodder, berries and herbs and graze the family's goats to a certain degree safeguarded by the community. Thus, sustainable use and maintenance of the villages' natural resources can be held in balance with sustaining basic needs of the community's poor (cf. Bharali 2011).

… and their enclosure.

When villagers in India share seeds and use traditional farming practices, they are integrating their needs for food with the natural cycles and features of the local ecosystem. this stands in stark contrast to a farming «economy» that looks to global prices, genetically engineered seeds, chemical pesticides and fertilisers and monoculture crops – all of which are designed to monetise agricultural production and maximise returns to capital. (…) One of the great, under-reported scandals of our time is how western corporations have brought industrialised farming methods to rural India. More and more farmers fell into deep debt as they became dependent upon proprietary seeds, volatile global markets and corporate farming methods, among other factors. The result has been an epidemic of nearly 200,000 farmer suicides in India since 1997 (Andreas Weber 2014:45).

Bharali describes what she calls “common property resources” governed by the villages committee or a village headman. According to Ostroms nobelprice speech 2009, a more appropriate and less confusing term is “common property regime”, as it clearly defines ownership as an attribute depending on the social system. Likewise, we have *private property regimes.* and *public property regimes.* A *common pool resource*, however, is - according to Ostrom (2009) - the resource under commoning.

These local commons of contemporary case-studies seem to resemble the historical commons. In the form depicted above, they are definable as common property ground in combination with forms of shared use as a local stewardship. Where the right of resource management is taken from the village community into governments (public) or a company's (private) hands and conventional stewardship is prohibited, that is termed *enclosure* of the commons. A protest song existing in at least six versions exists on that:

The fault is great in man or woman
Who steals a goose from off a common;
But what can plead that man's excuse
Who steals a common from a goose?
-Anonymous, in The Tickler Magazine, February 1, 1821.[6]

The meaning of this protest song on english enclosure can be interpreted as “Punishment is instant, when a goose is stolen from a commons. How can it be legal or excusable to steal the commons from the goose?”

One example from contemporary case -studies shall illustrate the nature of this background of commons.

Text 4: Nepal Irrigation and Institutions (NIIS) Project 1988-2002, described by Elinor Ostrom (2009)

In undertaking analysis of this large data set [collected earlier from written reports, author's remark.], Lam (1998) developed three performance measures that could be applied to all systems: (1) the physical condition of irrigation systems, (2) the quantity of water available to farmers at the tail end of a system at different seasons of the year, and (3) the agricultural productivity of the systems. Controlling for environmental differences among systems, Lam found that irrigation systems governed by the farmers themselves perform significantly better on all three performance measures. On the farmer-governed systems, farmers communicate with one another at annual meetings and informally on a regular basis, develop their own agreements, establish the positions of monitors, and sanction those who do not conform to their own rules. Consequently, farmer-managed systems are likely to grow more rice, distribute water more equitably, and keep their systems in better repair than government systems. While farmer systems do vary in performance, few perform as poorly as government systems – holding other relevant variables constant. (…) The earlier findings regarding the higher level of performance of farmer-managed systems was again confirmed using the expanded database containing 229 irrigation systems (Joshi et al. 2000; Shivakoti and Ostrom 2002).

6 cf. http://www.wealthandwant.com/docs/Goose_commons.htm

Where common pool goods based on Hardin are of open access without communication amongst users, resource-systems as researched and described by Elinor Ostrom as Commons in the 1990's are clearly limited in space and self-governed by an identifiable community of users safeguarding a range of clearly defined regulations of access and use based on tradition, shared values and know-how, thus preventing over-use (cf. Ostrom 1990, Quilligan in Helfrich 2012), very like the common property regimes of north-east India related to by Gita Bharali.

David Bollier (2014), following Ostrom's tradition, terms a commons a social system of taking on responsibility for renewable (biological) and non-renewable (mineral), feasible (raw material, rivers, land) and less feasible (atmosphere, internet) resources based on shared values and a common identity with little relations to market and state. That indicates ways of productiveness beyond the modern division into consumer and producer, as commoners are providing for themselves, each other and the commoned natural resource to some extend (Quilligan in Helfrich 2012). Therefore a commons is also a sector of economy and life generating value often taken for granted as natural reproductive services. He names forests and wildlife, fishing-grounds and water as the natural resources the largest number of small-scale commons focus on and as providing daily livelihoods for an estimated number of two million people worldwide (Bollier 2014). The optimal degree of resource exploitation was and is, as in the example from north-west India, regulated by means of reward or price; in other cases every member of the community has the right to consume a certain amount of resource units (cf. De Moor 2011).

In this interaction between resource and community, besides the feasible attributes (administrative and regulative elements institutionalised by a community as listed by Ostrom 1990, Bahrali 2012, Bollier 2014, Quilligan 2012) a range of normative values is attributed to the commons. The purpose of north-east Indian commons is, besides the secured and just access to local resources, in the maintenance of the areas economy, culture, social system and identity (Bharali 2012). Commons are a form of inherited or self-generated wealth in form of nature's gifts, civil infrastructure, cultural handiworks and knowledge (Bollier 2014).

Hess (2008) placed the specification somewhat differently in terming commons as a resource shared by a a group of people and characterised by it's vulnerability against privatisation, over-use and social dilemmata, therefore in need of management and protection. Herewith she takes up the economics understanding of a common good as endangered by allowing high rivalry and substractability at a low potential to exclude people.

According to Ostrom, the worlds' endangered resources do not necessarily need a collectivisation or privatisation in terms of ownership, as the economics goods model implies; instead, and here she points in one direction with Hess, a regulation by different types of what she terms

institutions of collective action is needed. She suggests this term to be applied instead of the term "commons", as it's use for forms of resources that are not not-self-governed already is widespread an causing confusion. Those i*nstitutions of collective actions* are "self-governed bottom-up formed institutions in contrast to large scale common pool resources that do not have a clear governance structure" (De Moor 2011: 18/19). They are the visible forms of commoners' interactions that enables them to safeguard the governed resources over a longer period of time, closer defined as principles of successful commoning. Principles for successful management of common pool resources were first set up 1990 by Elinor Ostrom and since then object of further developments. In her nobel-price speech on 8th of December, 2009, in Stockholm University, she presented a renewed version by her students Michael Cox, Gwen Arnold and Segrio Villamayor-Tomás, here sketched based on Silke Helfrich in Helfrich (2012). There principles can be seen in the Design principles of successful commoning (Ostrom 2009).

Table 1: Design Principles for Successful Management of Common Goods.

1. Boundaries	...are clearly set and accepted between legitimate users and non-users. ...are clearly set between a specific system of common pool resources and a larger socio- ecological System.
2. Congruency	Rules for adoption and reproduction of a resource are in accordance with local and cultural properties. Rules of adoption and reproduction are in accordance with each other: Distribution of value amongst users is proportional to the distribution of costs.
3. Community-Based Decisions	Most of the people directly connected to the resource system have the possibility to take part in decisions on changes in the regulations on use.
4. Monitoring of Resource and Users	Control on the resource must be sufficient to prevent misuse. Those in charge of supervision need to be users themselves or in accountability to them.
5. Gradual Sanctioning	...shall be in a adequate relation to the caused problem. It begins on low level and increases in severity on re-occuring violation of rules.
6. Mechanisms for Conflict Resolution	...are to be fast-working, cheap and direct. Local spaces exist for resolution of conflicts between users as well as between users and municipalities.
7. Recognition	A minimum degree of governmental recognition of users' rights is necessary for self-government.
8. Embedded Institutions	In cases where the common pool resource is closely interwoven with larger-scale resource systems, interlinked governance on several levels is required (poly-centric governance). [For example: self- governed groups/communities/associations → local government → co-working regional institutions → supra-regional governmental and non-governmental structures – S.H.].

A community deciding to set up regulations and, in doing that, creating *institutions of collective action* for the good governance of a resource by a process of commoning in any way, transfers the resource from being of open access to a commons. That is, primarily, not a question of ownership but of the form of governance. Addressing it the other way around, there can be no commons without a process of commoning, the negotiation of a common resource-management, by a community of commoners, the community's people (Ostrom 1990, Bollier 2014, Helfrich 2014). The crucial difference from Hardin's early description of the meadows tragedy, more correctly termed "tragedy of open access", where users are not communicating, not creating something common, but working only for their own benefit. While Hardin's commons is a resource - the meadow - and nothing more, a commons based on Ostrom is a resource plus a communicating community and its self-elected regulations as visualised by illustration 6 (cf. Ostrom 1990, Bollier 2014, De Moor 2011, Hess 2008).

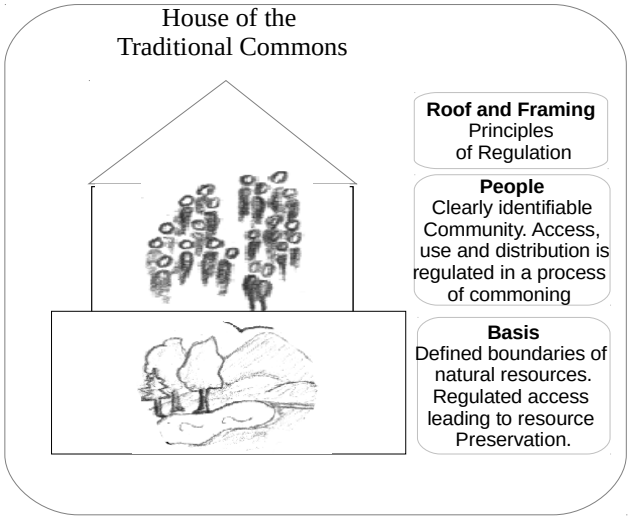

Illustration 6 (own source 2015, analogy based on Helfrich et al 2014): House of Traditional Commons displaying key elements of a commons-definition in tradition of Ostrom.

The functioning and principles of historical social practices of governing the common land, and those defined by Ostrom based on contemporary case-studies are nearly identical, as often indicated (Bollier 2014, Hess 2008, De Moor 2012 and 2007). In the following, the term "traditional commons" will be used to indicate commons that are working with Ostroms principles (2009). In how far this combined terming can be based on criteria, shall be analysed under 3.2.

IV. Commons beyond Natural Resources - New Commons based on Hess

In growing publicity of the term *commons since the 80's* it has been extended to several other

fields beyond economic goods of open access, common pool resources and commons in historical sense, with clearly defined boundaries, based on Ostrom. In claiming the streets as ground for common creativity and shared use, in up-springing community gardening and the collective development of open source software such as *Linux* and the overarching development of the community-based free-access internet encyclopedia *wikipedia* in multiple languages and 5,6 million articles in the English version, new forms of coming have been found and described, by Hess (2008), Bollier (2014) and many more as commons, though not always addresses with terms distinguishing them from the classical commons of the village's meadow.

In these forms of commoning, people claim or take over what is in public hand in the “reclaim the streets”-movement or urban gardening as *urban commons*, they develop and share digital resources and are building world-wide networks via Web 2.0 in the *digital commons*, they share and cultivate knowledge in *knowledge commons* as wikipedia or exchange of hands-on skills, know-how and recipes. The call for the right of free access to what is called the *cultural commons* – literature, multimedia, music and notes, especially in the web – has grown considerably in the last few years. Groups and networks of people engaging in these *new commons* claim back or generate anew what is treated as private property rights ensured by the market, such as copyright, private software and forms of knowledge distribution. Or they take on responsibility for what is seen as public ground in building play-grounds, decorating streets, network for sustainable tourism in landscapes of cultural value. All those forms of commoning are characterised by that they are, similar to traditional commons, acting beyond market and state, beyond private and public, and are nevertheless publicly acknowledged to some degree. They have, most commonly, no defined boundaries in users and grant free access. The resources of commoning- multimedia, public ground, knowledge- are not scarce in themselves, and they belong to the categories of, e. g., cultural, social or digital resources (cf. illustration 7).

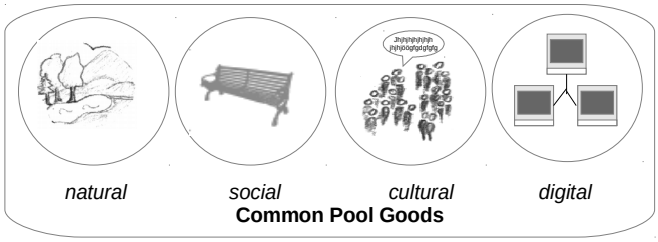

Illustration 7 (own source 2015, cf. Helfrich et al 2014): Categorisation of common pool goods beyond natural resources.

Hess (2008) analysed market, health, infrastructure, neighbourhood and knowledge commons in a mapping of new commons, among which she also lists traditional and global commons as only natural ones. by her interpretation, the term new commons sub-sums all resources named as commons from the 20th century onwards.

The traditional and global commons are, among those, the only ones consisting of natural resources. The traditional commons have already been introduced in reference to Ostrom. In the following paragraph, global commons and differences in their resource properties regarding traditional commons are introduced. They shall later on be transferred into a definition of natural resources properties that can define them as CG or CPR of global significance.

V. Humankind's Inherited Foundations of Life - Global Commons

Text 5: On Commoning the Atmosphere

"*The limits of the atmosphere as a sink of pollutants without serious consequences are not as easy to determine as the number of cattle that can be nourished by a village pasture. (…) furthermore, each type of pollutants is but one of many factors that contribute for a myriad of consequences for human health and the environment, (…) making it difficult to establish cause and effect relationships. Causal links are further blurred by the lengthy time lags between when a pollutant enters the atmosphere, and when it has an observable impact (...). Finally, the contributions that pollutants are making to environmental problems are more difficult to identify when there are few if any observable impacts, until a critical threshold is exceeded, after which the damaging consequences mount quickly*" (Marvin S. Soroos 1995:7).

Another "new" form of commons came into discussion in accordance with the increasing process of globalisation and an awakening of consciousness for global interrelations that led to a call for more social, ecological and economical justice at global scale. Humankind's foundations for life, natural resources of global scale and significance, are recognised to be in threat of overuse: the oceans and fresh water, atmosphere and climate, the moon and interstellar space; the diversity of species of crops, herbs and fruit-trees, of pollinators, cattle, flock and wildlife; provisioners of basic human needs. In economical terms, those natural resources are the natural capital regulating local and global ecosystems. Interrelations between single resources and resource systems are of central importance, as visible in the phenomenon of climate change.

These foundations of human life on earth are seen and addressed as "inheritance of humankind", that is to be governed, as stated by the Club of Rome 1972 in "the limits to growth", in terms of *inter-generational* justice for our children's children, and in terms of *intra-generational* justice among the people living on earth today. When the challenge of governing the world's resources in the ethics of sustainability is to be solved under participation of all humankind, the resources under question are, in the commons discourse, called *global commons (cf. Cairns 2003 in Hess 2008)*. The degree to which they actually are commoned can vary from nearly none – when attempts to build rules and regulations for management of, for example, the worlds soils on international level are just beginning – over a gradient of increasing commoning as a multilevel process on setting up regulations on the use of a specific resource, including governmental and non-governmental organisations from local to global level (cf. De Moor 2012).

In case of attempts in regulating climate change, the process of commoning the global commons of "climate-system" can be traced back to 1988, when the Intergovernmental Panel on Climate Change (IPCC), the scientific intergovernmental body on climate change under the auspices of the United Nation was set up at the request of member governments, and since then produces reports to support the United Nations Framework Convention on Climate Change (UNFCCC), which is the main international treaty on climate change, holding regular conferences for the establishment of a global commons after the negotiation in Rio de Janero's earth summit 1992. The objective of the UNFCCC is a

> *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (UNFCCC 1992: Article 2).*

With the establishment of trade with greenhouse gas emissions, as has been suggested by Soroos (1995), an interim solution has been successfully established, though in urgent need of revision. A set of goals agreed upon by the majority of member states (though not by all), which in their turn are representing the outcome of national multi- level negotiations. On that basis, the INFCCC can be considered as one example of commoning a global commons, the climate system, indicating that this form of governance on global level can require a decade or two until working solutions are established.

According to Bollier (2014) this is one of the key challenges of our time: to combine the knowledge about the bottom up commoning approach, as visible in the design principle's based on Ostrom (2009), with high level politics of top- down governance on national and international level. To which degrees these design-principles *(Boundaries of Resource and Community, Congruency of costs and Gains, Community-Based Decisions, Monitoring of Resource and Users, Gradual Sanctioning, Mechanisms for Conflict Resolution, Governmental Recognition and Embedded Institutions)* can be found in the commoning process of a global commons is to be researched in detail for every commons in question to assume the degree of commoning from an insider or outsider perspective and to be able to point out aspects where improvement is possible. Their parameter values can also serve as attributes to distinguish the global commons from traditional commons as researched by Ostrom and others.

In case of UNFCCC with the global commons "climate system", the *Boundaries of Resource and Community (*1st principle) are global, as is the case for all natural resources named above, and access is free within the boundaries of earth. ratifiers of the UNFCCC, however are a defined number of 196 countries. C*ongruency (*2nd principle) *as* distribution of costs in accordance with gains, has been subject of many discussions on the distribution of climate gas emission

reductions per country and monetary costs, where the industrialising countries claim a proportionally large share of costs from early industrialised countries as main contributors to global warming. It is a question of social justice every global commons will face in one or another way. *Decisions (*3rd principle) are, in UNFCCC and all democratically based governmental or non- governmental organisations (NGO's), taken by representatives of large numbers of groups and people. *Monitoring of Resource and Users (*4th principle) is institutionalised with the IPCC Reports; member state's monitoring is included to some extend. *Gradual Sanctioning (5th* principle) can only work, if member states agree to a system of sanctioning not installed yet. *Mechanisms for Conflict Resolution (6th* principle) seem to be not "fast and simple", which can be attributed to the complexity of international negotiation with 196 countries aspiring consensus with slow moving national backgrounds. *Governmental Recognition (7 th* principle) is given, as the UNFCCC holds conferences where only governmental representatives have a voice. The aspect "beyond market and state" is not fit, though a multitude of non-governmental and non-market groups are making their voice heard in the preface and at the conferences. Where the policies from UNFCCC reach down to national and local level and interweave governmental and citizens' institutions, we have a form of *Embedded Institutions (8 th* principle). Main dividing points from the principles is that the boundaries are of global scale for open access global commons of rivalry character and medium to high extractability, as are the classical economics "common pool resources": one molecule of O_2 can only be breathed once and is transformed, one gram of CO_2, once emitted, cannot be retrieved and touches the well-being of all life on earth by contributing to global warming; one litre of groundwater, once retrieved, takes it's time to renew and the reserves are not endless. The working traditional commons, however, are only accessible to a limited number of users with low rivalry due to that specific form of governance. The stronger a global commons is commoned, the more it probably resembles the traditional design principles based on Ostrom.

In the different background of commons definitions a number of similarities have become visible. Therefore it is assumed at this point of analysis that there is a shared understanding of the contemporary use of the term "commons" with varying specifications depending on the background the term is used in. The question is, what are specialisations, what is the shared basic? Can the design principles serve as revering point for the intensity of commoning? Can the classic economics classification be helpful for differentiation of the definitions specifications?

Summarising open questions on a shared definition of the term commons

...including the design principles

Which degree of commoning makes up a commons?

How much can a commons be interlinked with market and state before it stops being a commons?

If the common pool resource is degrading, can it still be termed a commons as long as there is a group of users attempting to common it?

Can a concept of a gradient from weak to strong commoning be helpful for classification and use of the term, and how can the steps of the gradient be defined accurately?

How can open access resources of global commons such as climate system be sustainably regulated?

Can large scale commons' ecological carrying capacity be estimated exact enough for a near-sustainable use at fluctuating number of users and their needs and habits?

How many users can actually take place in decisions to keep a commons working, and which degree of representation can still be considered as commons?

...including the classical economics resource properties

Is a common pool resource a fitting term for all resources of all forms of commons, or only for those of free access?

What significance is to be attributed to the form of ownership?

How can the criteria rivalry and excludability be adjusted to a more subtle definition?

These questions shall serve as flarks of inspiration for deeper understanding of commons in further analysis and remain open for now.

b) A Combined Commons Definition for Sustainable Resource Use?

What Goals does a Definition of CG Have to Fulfil? Common Goods seem to be, by shared understanding of all four background, only one component of a commons, besides a group of users and their interactions. In order to build a shared definition for resources as common goods, the attributes of *group* and *interactions* are to be analysed in comparison.

It is required to address the dimensions of sustainable resource use. Marcel S. Soroos (1995) names, in his paper on managing the atmosphere as commons, fife questions by which he tests a form of Commons Management. He asks for sustainable management in the ecological dimension (*avoid a tragedy*), the economical dimension (*efficiency* of costs) and the social dimension (*equity and fairness for past and future users*), and considers, as crucial point, the *feasibility.* After fulfilment of these criteria the shared commons definition shall be build.

> *From the environmental standpoint, the most critical question is whether the regime will be successful in conserving the resource domain. In other words: will it prevent a "tragedy of the commons"? (Soroos 1995:13)*

This first question is the central one for a usable commons-definition for sustainable resource use: *Has this way of managing a commons been proven to be successful in conserving resources?*

In the Frame, Soroos' criteria are formulated as guidelines for a commons definitions' usability in context of conserving natural resources.

Has this way of managing a resource been proven to...

...conserve the resource domain after adequate goals?	→ *ecological*
...find forms of maximum sustainable use (regulation)?	→ *cultural*
…be cost- efficient?	→ *economical*
…bring equity between present and future users?	→ *social*
...be feasible in implementation?	→ *practical*

As the aim is to form a combined definition framework of common goods that can depict traditional commons as well as global commons of formal embeddedness with market and state, the approach can only be a comparison of qualitative variables central to these backgrounds. These bases on the "common understanding" of the terms in use of central publications and are to be illuminated on a representative case. Representativeness is assumed for cases that are mentioned frequently in the discourse. The distillation of shared cornerstones therefore does not base on a range of in-depth case-studies, as is a usual approach in deriving attributes expressions in comparable settings, as, e.g., in research on the collective action theory. Ostrom (2008), in concluding a paper on "Social Cooperation in Collective Action Situations", states that it is almost impossible to identify and monitor the intensity and relationships of all relevant variables that increase collaboration in collective action situations. "Instead of looking at all the potential variables, one needs to focus in on well-defined but narrow chains of relationships (…)."

In considering definitions for natural resources as common goods, the process of *commoning* the common good reaches into collective action theory. So as to not get lost in the numerous variables addressed in commons- and collective action literature in a multitude of differing case-studies, it will be focused on central variables derived in earlier comparative research, knowing that there are much more relating to the same issue, whose inclusion would make a definition overly-complex at this step. If the framework derived here should prove helpful, they can be included later on.

For a better comparability and to distinguish the cornerstones of a shared understanding of commons from specialisations depending on the background the term is used in, the four commons' terms characteristics are to be listed alongside the key elements of their definitions. Resource properties are most concretely addressed in the economic goods framework criteria. To keep the comparison concrete, the characteristics are answered for the cases displayed for each background on basis on given references. Where no clear statement is given, the answer is assumed and marked as such. Expression intensities are to be seen as indication for the direction

of expression and not as absolute, as they are, in this small study, necessarily based on subjective estimation.

The degree of importance of a cornerstone is indicated by a numbering from 1 (central) over 2 (plays a role) and 3, (peripheral) to 4 (not mentioned). Due to their specificness, the cornerstones of classic economics "commons"-definition after De Moor 2011 (rivalry/extractablity, excludability and form of ownership) and of the traditional commons' eight design principles after Ostrom (2009) are listed in the left column. Subsequently, a combining definition shall be formed on that base and visualised in a flowchart.

Table 2: Degrees of Cornerstones Importance (1 to 4) and Specification in the Commons-Definitions

1 -central 2 -plays a role 3 -peripheral 4 -not mentioned	H = historical commons T = tragedy of commons O = Ostrom commons G = global commons			
Commons' Traditions Properties after Cornerstones	***Historical Common Property Regimes (H)*** *Europe's village commons from 12th-18th century* *De Moor (2011)*	***Economics' Tragedy of Common Pool Resources (T)*** *the open access meadow* *Hardin (1968)*	***Contemporary case-studies' Common Goods after Ostrom (O)*** *Nepal's irrgigation systems* *Ostrom (2009)*	***Global Commons (G)*** *climate system - UN Conferences on climate change* *De Moor (2011), Hess (2008)*
COMMON GOODS' RESOURCE PROPERTIES AFTER CLASSICAL ECONOMICS				
Form of ownership	Usually "Common property land" under a villagers' governance or private property with "common rights" 1	Central cornerstone, can be private, public, club or common/open access 1	Can be any property regime 3	Ethically seen as everyone's property as Inheritance of humankind 1
Degree of excludability	Usually clear number of users led to high excludability 1	One of two characteristics for identification of type. Commons: low. 1	Depends on intensity of commoning and strictness of regulation. Can range from high to low but works best with clear number of users, leading to high e. 2	Very low, as expanse is seen globally and regulation possibilities are (still) moderate 2
Degree of substractability/ rivalry of one resource unit and the common pool resource	Depends on intensity of commoning. Natural resources units are rivalrous, while the resource pool's rivalry is low due to commoning. 2	One of two characteristics for identification of type. common goods: high, as no regulations exist and goods are scarce. 1	Depends on intensity of commoning. Natural resources units are of high rivalry, resource pool of low due to commoning. 2	High, as no regulations exist and goods are scarce. 1

DESIGN PRINCIPLES FOR MANAGEMENT OF COMMON GOODS AFTER OSTROM (2009)	***Historical C.***	***Tragedy C.***	***Ostrom C.***	***Global C.***
1. Boundaries of Resource and Users clear defined?	Clearly defined area of land or resources' use-rights, clearly identifiable community of villagers' or families 1	unclear border of open access resource, no defined users. 1	Clearly defined area of land or use-rights, clearly identifiable community 1	global, access to atmosphere is free within the boundaries of earth, ratifiers of the UNFCCC: 196 countries 1

Design Principles for Management of Common Goods after Ostrom (2009)	***Historical C.***	***Tragedy C.***	***Ostrom C.***	***Global C.***
2. Congruency of Costs and Gains?	Continuously adjusted in a process of commoning 2	Not given 1	Continuously adjusted in a process of commoning 2	Conflicts on Congruency between industrialising countries and early industrialised countries on share of costs 2
3. Community-Based Decisions / high Degree of participation?	Users are participating strongly as commoners. 1	Legal Owners are deciding alone. Users are deciding alone. 4	Users are participating strongly as commoners. 1	Decisions are taken by elected representatives of nations and thereby large numbers of people, NGO's can give advice. Multi-level process of decision making, but not community-based. 3
4. Monitoring of Resource and Users?	Regularly Given 2	Not or only privately taken. 4	Regularly Given 2	member state's monitoring is institutionalised to some extend 2
5. Gradual Sanctioning?	Continuously adjusted in a process of commoning 2	Not existing 4	Continuously adjusted in a process of commoning 2	can only step into action, if member states agree to a system of sanctioning not installed yet 2
6. Good Mechanisms for Conflict Resolution?	Fast working, simple and oriented on a just and fair outcome 2	Not existing 4	Fast working, simple and oriented on a just and fair outcome 2	seem to be not working fast on high level representation due to complexity and slow moving national backgrounds. 3
7. Governmental Recognition?	Rights are accepted and /or ensured by local landlord 2	Not existing 4	Rights are more or less accepted and / or ensured by local government 2	Recognition on governmental levels as inheritance of humankind still is moderate. The management approches are governmental, therefore recognition of decisions taken is high. 4
8. Embedded Institutions?	Existing, where larger resource systems (rivers, inter-village forests) are related 1	Not existing 3	Existing, where larger resource (rivers, inter-village forests) systems are related 1	Yes, policies reach from international to national and local level and interweave governmental and citizens' institutions *1*

General Framework Criteria for Inclusion of Global Scale	***Historical C.***	***Tragedy C.***	***Ostrom C.***	***Global C.***
Form and level of governance?	self-governance by clearly defined community of users, directly or via representatives 1	Governance by economical custom of maximum profit in absence of ownership (market) 1	self-governance by clearly defined community of users, directly or via representatives 1	Multi-Level poly-centric governance of large-scale and/or inter-depending resource-systems by governmental and non-governmental institutions 1
Intensity of commoning is considered as...	High 1	Very low 1	High 1	Very Low – Medium, depending on resource 1

Criteria of Sustainability	*Historical C.*	*Tragedy C.*	*Ostrom C.*	*Global C.*
Cause for degradation of a common pool resource (ecological)	Dissonances in the adaptation of commons properties to the sociocultural and ecological context or enclosure of resource by market or state 2	Failure of the Individuals' role in the users' community 2	Dissonances in the adaptation of commons properties to the sociocultural and ecological context or enclosure of resource by market or state 2	Missing agreement on adequate international goals and regulation mechanisms 2
Instruments for preservation of the resource and preventing tragedy and effectiveness (ecological)	adaptation of governance to the sociocultural and ecological context in a process of community-based commoning. Highly effective. 1	Privatisation or governance by public hand, low or moderate effectiveness 1	adaptation of governance to the sociocultural and ecological context in a process of community-based commoning, Highly effective. 1	Multi-level poly-centric governance (still) moderate effectiveness 1
Cost-efficiency (economical)	Not mentioned, though after many similirarities to case-studies after Ostrom it can be assumed that local productive community based systems are highly efficient due to fast reactions on changing conditions. 4 (1)	Environmental and social costs for the intensive overgrazing are not integrated into individual calculations of gaining a higher profit. Therefore, Net cost-efficiency is bad. 2	*numerous case-studies showed higher level of performance of farmer's community-managed systems than of governments'* *2*	Externalised environmental costs are made visible and their increase is to be prevented by today's actions. high level of representation requires high level of resources in coordination 1
Rules /Regulations on fair access and resource use (cultural)	adequate and transparent regulation through commoning limit the accessibility and the possibilities of overuse 1	Do not work in open access regimes. Ownership can help install regulations 1	adequate and transparent regulation through commoning limit the accessibility and the possibilities of overuse 1	unregulated open -access-Regimes are starting point, adequate and transparent regulation through institutionalisation is aimed at 1
Equity as inter- and intra-generational justice of resource use: time-perspective and distribution (social)	Central foundation of the villagers livelihoods and grandchildren's well-being 1	Not achievable and not addressed as everyone is looking after personal benefit. 3	A central foundation of functioning coming has been identified as “trust” that is lost once principles of social justice are betrayed. 1	Is one central goal, but it proved difficult to establish, as the discussions on fair share of costs for adoption to climate change shows. 1

A closer look at the characteristics shows many similarities between the historical village commons and Nepal irrigation systems after Ostrom on the one hand side, and “tragedy of the commons” and the global commons “atmosphere” and UNFCC on the other, affirming De Moors analysis that those perspectives are quite similar. The numbering indicating the importance of a criterion in the backgrounds, however, differs significantly between all four. For closer examination, the results of table 2 are classified in a compressed version (cf. table 3). The “cause for degradation” - criteria is not displayed, as it is a vice-versa of the second ecological criterion.

Table 3: Levels of commons cornerstones importance in differing backgrounds and their expressions

Level of Cornerstones' importance (1 to 4) 1=central, 2=plays a role, 3=peripheral, 4=not mentioned H=historical c., T=tragedy of c.; O=Ostrom c., G=global c.						Level of Cornerstones' expression Double listing indicates a range.				
Background	Criteria	1	2	3	4	none	low	medium	high	other

Econ. Goods	1	*Ownership*	H T	G	O			O		H T	G
	2	*Excludability*	H T O	G				T G	O	O H	
	3	*Rivalry*	T G	O, H				H O		T G	
Design Principles	4	*Boundaries*	H O G	T				T	G	H O	
	5	*Congruency*	H	T O G				T G	G	H O	
	6	*Direct Decisions*	H O		G	T		T G		H O	
	7	*Monitoring*	H O G			T		T	G	H O	
	8	*Sanctioning*		H O G		T		T G		H O	
	9	*Conflict Resolution*		H O	G	T		T	G	H O	
	10	*Gov. Recognition*		H O		T G		T	H O G		
	11	*Embedded Inst.*	H O G		T			T	H O G		
Other	12	*Level of Governm.*	H T O G				T	H O		G	
	13	*Commoning Intensity*	H T O G					T G	G	H O	
Sustainability	14	*Ecological*	H T O G					T G	G	H O	
	15	*Economical*	H G	T				T G	G	H O	
	16	*Cultural*	H T O G				T			H O	
	17	*Social*	H O G		T		T		G	H O	
Sum							3T	2 H, 12T, 3O, 8G	2H, 3O, 8G	13H, 1T, 12O, 2G	1G

In the following, the congruency of seemingly similar backgrounds is analysed after distribution of criteria In the following, the congruency of seemingly similar backgrounds is analysed after distribution of criteria expressions. CPR properties and form of governance are to be defined more precisely.

"Traditional Commons"

Can historical common property regimes (H) and contemporary case-studies after Ostrom (O) be viewed as one type of commons, as De Moor (2011) and Hess (2008) indicate?

Only once, in the question of "ownership", are historical commons and commons after Ostrom not bearing the same expression of criteria. From these 17 criteria, only 14 are "high", 2 are "low" (rivalry and level of governance) and 1 "medium" (embedded institutions). This suggests strongly to consider them as similar forms of commoning, especially as the ownership in commons after Ostrom varies and thereby includes "common property", as is mostly the case in historical commons. Concluding, historical commons and contemporary case-studies after Ostrom can be addressed in combination. A term frequently used in comparative literature (cf. Hess 2008) is *traditional commons*, in that the traditional use of the term addresses historical and contemporary commons restricted to natural resources, as well as the meaning of "typical" or "exemplary".

Traditional commons in this combined sense show a high potential for sustainable resource use (criteria 14 to 17), high intensity of commoning and a high degree of concordance with the design principles, whereas all of the criteria listed as "high" for the optimal case can change with changing situations. Once, for example, the wood prices are rising fast, a community governing a forest, in need of money, may decide to change their usual regulations, take out a higher than usual degree of wood themselves or either give the forest to rent or even sell their common good, thus re-defining the modes of access, use and maybe property. The management principles of Ostrom and modes of traditional commoning can hence not grant a long-time sustainable resource management, due to influences from the outside such as changes in a goods' market price and demand, or national economic situation, or personal factors, all of which can lead to drastic changes in the commons environment and make fast adoption necessary to avoid tragedy by enclosure of some kind. But, thanks to the close, shared relationship with the commoned resource, they can strongly increase the possibility in comparison to private or public management, as a multitude of case-studies after Ostrom (2009) strongly indicate.

"Commons in the Becoming"

Can open access common pool resources (T) and global commons (G) be viewed as similar, as De Moor (2011) indicates?

From the 17 criteria, *open access common goods* and *global commons* bear similar expressions in 9 cases from which 8 are "low". Otherwise global commons bear 9 times a "medium", 2 times a "high" and 1 "other" expression (in "property"), whereas the tragedy's expression is 3 times "not given". Similarities of these two backgrounds are therefore less strong than depicted by De Moor (2011), where they are named as one "tradition". However, both show a significantly differing distribution of criteria expressions compared to the *traditional commons*, as both show a oppositional expression in resource properties in that they are defined as open access regimes (2) with low excludability (3). Both show lower expression of the criteria on management (4-11) and sustainability (14-17) and an oppositional expression of the general critera "governance" (12) and "commoning" (13). This leads to the picture of a gradient of increasing intensity of sustainable management, or commoning, on which the *tragedy of open access goods* is on the far left hand side, without any regulations; while the *global commons* range from low to medium, depending on resource and perspective, with quite some communities calling for collective management and a more or less intense search for forms of sustainable regulative instruments is in process. Both bear the potential to become commoned more strongly, thus slowly recovering from "tragedy", as soon as users' communities decide to do so. These two backgrounds could therefore be termed *commons in the becoming* or *emerging commons*.

They are characterised, besides the criteria named above, by being interwoven with market

(private use, endangered by overuse: tragedy) and state (global commons: national and international politics and sciences), whereas the traditional commons are said to generate a *common wealth* "beyond market and state" (Bollier 2014, Soroos 1995).

A Gradient of Commoning

A gradient of commoning as socio-cultural organisational process, which establishes a resources' common governance and regulation, can be drawn between these two commons perspectives. On the one hand-side, there are the emerging *commons in the becoming, or ermerging commons*, possibly striving from tragedy to sustainability. On the other hand-side, there are the *traditional commons* in constant adoption to changing situations to prevent abandonment, misuse or enclosure of the CG as door openers towards *tragedy*. The tragedy-situation depicted by Hardin is not yet a commons under commoning, as there are neither users' community nor regulations for a sustainable use. Once both are given – and be it, in the beginning, only the users willingness to communicate and to do something for preservation of the shared resource; be it only the recognition of the resource as of common value – the open access resource becomes a common good and can develop towards traditional commons characteristics (see illustration 8). Global commons and other emerging commons are defined differently, as their global significance and danger of overuse in combination with need of regulation for their preservation are central characteristics. They are open access goods, when the need for commoning is identified. In the terming of the resource in a commons, no differences are made between the four backgrounds. Where differences occur, they are a question of resources systematic scale, not of definition.

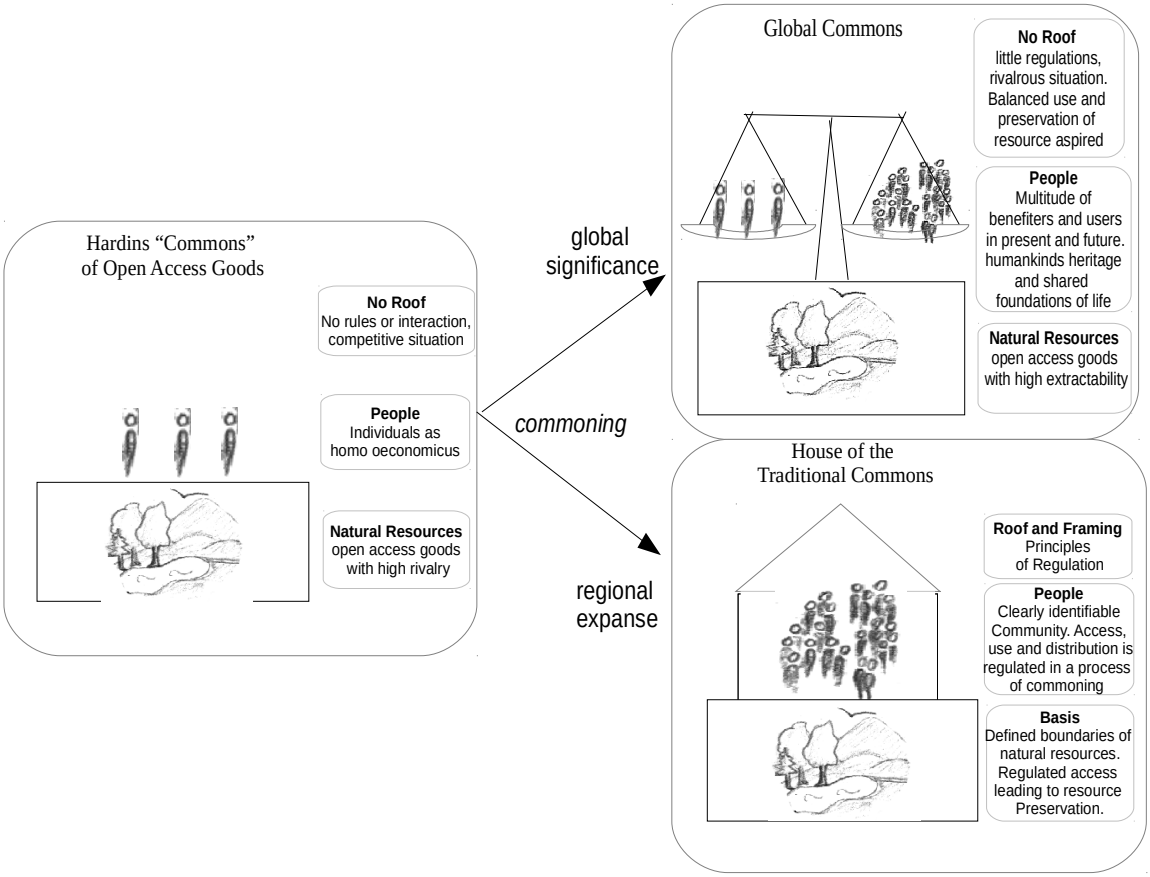

Illustration 8 (own source 2015): Commons properties in terms of resource, people and regulations

Summarising, global commons and traditional commons differ in two central aspects visualised in illustration 8: the use-related properties of the resource and the scale the commoning is aiming at. While global commons begin to exist once the need for preservation of a shared resource of global significance is recognised, traditional commons are established common governance structures that concentrate on a regional scale. The global commons properties listed above in illustration 8 on the upper right can be interpreted as the properties of a CG or CPR of global significance extracted from the review of commons discourse in 3a. They will be of value for extended definition of CG properties of global significance and combination with natural resources` services in chapter 3a and b.

c) A Framework of Commons Terminology

For a deeper understanding of resource's position in commons, a framework of commons terminology is to be built. For that aim, principles are identified that can indicate the intensity of commoning and are applicable on commons' market – state relations as well as local to global scale of commoning. This methodological step is an excursion into commons terminology which is not essential to definition of natural resources as CG's. Yet, it may provide deeper insights on the ways in which natural resources are interrelated with users community and scale of management.

Based on table 3, the importance for a combining definition of the commons-definitions' cornerstones depicted in the criteria is evaluated. Those criteria without a mark “1” are given less attention, those with four marks of “1” the highest. Where a central cornerstone is formulated in a way excluding one or more backgrounds, it shall be re-formulated in accordance with literature so that all central criteria in one definition flowchart. For good comparability, the results from criteria evaluation are collected in the criteria's table.

Cornerstones for a Combined Commons Definition in the *Economics' Goods Framework*

The criterion *ownership* (1) cannot be an indicator for commoning intensity, as commons after Ostrom can be governed commonly in a sustainable way in any of the forms of ownership given by the classical economics framework. In the definition backgrounds where property does play a role, certain rights necessary for building a commons are associated with common property. However, these can be given to a community whatever the property regime is. Schlager and Ostrom (2005, after Hess 2008:34) name different types of rights as involved in commons property that are closely related to several other criteria listed above:

- *Rights of access and extraction* (4) *Boundaries of group and resource*
- *Rights of management of a resource* *(5)Congruency, (6) Direct Decisions, (7)Monitoring, (10) Governm. Recognition*
- *Rights of exclusion and alienation* *(2)Excludability, (8) Sanctioning*

Those rights on a resource, given to a community of commoners by the lawful owner or granted in other ways, enable commoning; the first two groups of rights are, as shows a comparison with table 3, vital for a shared use and and the later two vital for securing the resource from free-riders. The criterion (1) Ownership can, therefore, hold a key to rights necessary for commoning, where those rights are not given in other ways. The related criteria among the design principles (2, 4, 5, 6, 7, 8, 10) and the helpful grouping after three groups of rights shall be considered closer under “management principles”.

The criterion *excludability* (2) plays a central role for H, T and O Commons as means to prohibit free-riding. In Global Commons the situation is vice versa, as *everyone's* rights of access - for recent and future generations – is to be ensured and considered. Nevertheless, the *excludability* does play a rather central role in the global commons as well.

Rivalry (3) or the degree to which the use or consumption of one resource unit excludes others from using the same resource unit, depends in traditional commons on the intensity of commoning. While then natural resources units are rivalrous, the resource pool's rivalry is low when commoning intensity is high. In emerging commons, it does play a central role, as the high rivalry leads to tragedy, where no governance is installed.

The Classical Economics Goods Framework as introduced in 3 a) is characterised by the two variables high or low excludability and rivalry. As these seem to fluctuate from low to high, from open access to regulated access depending on the degree of commoning, a more detailed depiction is needed, as models do have a power of defining reality, it is dangerous to keep to models as simplified as the economics goods one as an absolute depiction of reality. In her analysis on common goods properties, De Moor (2011) introduces a much more realistic depiction of goods properties that allows the depiction of possibilities of changes in goods forms of governance from one type to another due to technical or institutional innovations or changes in goods availability and value (9).

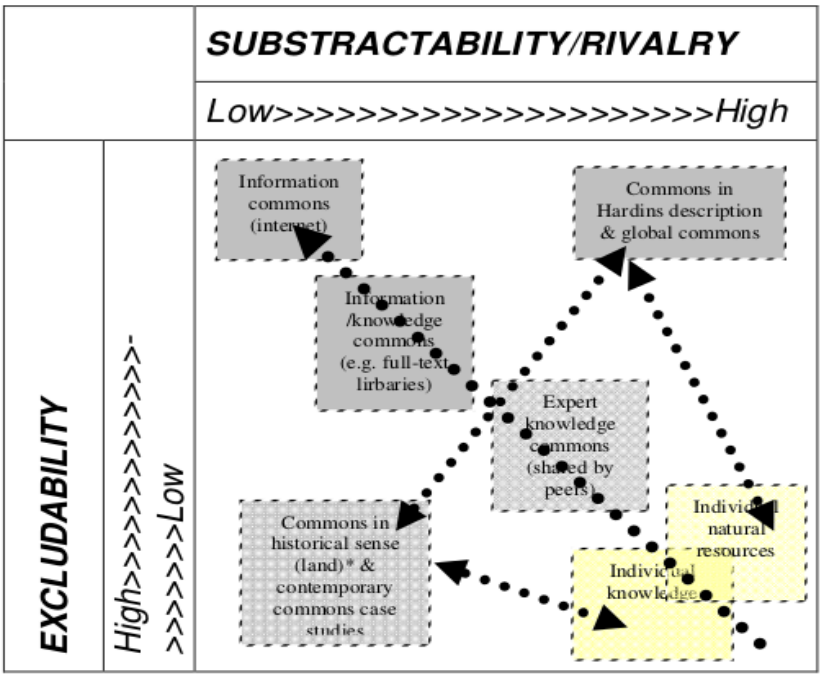

Illustration 9 (De Moor 2011): New and traditional commons in the goods´ framework after type of resources.

For example, the goods properties of air have, in the establishment of Kyoto Protocol, been supplemented by a monetary level (ibid.). In the illustration, the goods that have been defined here as *traditional* and *emerging* natural resource commons are depicted in the lower left and upper right; *traditional commons* at a low rivalry and high excludability in the lower right as historical and contemporary case-studies, and *emerging commons* as open access goods and global commons in the upper right. The gradient of commoning drawn between them can hence be pictured in diagonal, starting from the upper right at open access and high rivalry, moving towards the lower left with increasing degree of commoning. On changing conditions the natural commons can move alongside this gradient. Therefore, the closer analysis of goods criteria gets to the same result as De Moor(2011), although the global commons, e.g. the UNFCC, aspire a

reduced rivalry and certain excludability to prevent free-riding by installing regulations for a sustainable shared resource use, while the “tragedy” has no regulations what so ever, so that the global commons more correctly are to be depicted slightly to the left below “tragedy”.

It remains the question of naming the commoned resource. The term *common pool resource* (CPR) is used frequently in the emerging commons, where it replaced older terms such as *common pool good*. The *open access good* from classic economics framework is only to be justly applied to regimes of absolute open access. As soon as the possibility of commoning is considered, the term CPR is more adequate and also more frequently used. In research tradition after Ostrom, CPR indicates “resources that are substractable and difficult to exclude” (Hess 2008). Common good (CG) is a traditional term for all goods and resources under commoning, that is to say, under *traditional* commoning. But where does a CPR end and a CG start? What term lies in between or can cover the whole gradient? The same situation is faced in all cases of criteria on a gradient of two poles. Where does one become the other?

A firm answer cannot be given at this point, as we deal with several criteria, whose exact measurement proves to be challenging, and all the more so in theoretical analysis. That interpretation is to be answered from case to case.

Summarising, economics' criteria on resource properties can be noted on a row of gradients as follows:

- Gradient of systematic scale: Common Pool Resource ↔ Common Good
- Gradient: open access and high rivalry ↔ regulation and sustainable governance as commons
- Gradient: open access good ↔ CPR ↔ CG
- Rights of access, extraction and management of and exclusion and alienation from a resource

Cornerstones For a Combined Commons Definition in Management Principles of Ostrom

Design Principles after Ostrom are, primarily, providing guidelines for a successful management of commons. However, these are rather difficult to apply on open access regimes. The lap from emerging commons to best practice management commons, as described by the principles, is a large one, and maybe not achievable for global commons. In five of the eight principles could the level of expression of “atmosphere as global commons in UN-conferences” be noted as medium, in the other three it was low. This indicates a need for management principles of a broader range of expression to build a combining definition, and to relate them more strongly to resources' properties.

From the eight design principles after Ostrom, 5 were given a “1”: Boundaries of resource and users' group, Congruency, Direct Decisions and Monitoring (4-7), and Embedded Institutions (11). They are to be transferred into an overarching definition. (8), (9) and (10) play a role in a good management of commons, but not the first, therefore they shall not be included in that form

as cornerstones of an extended commons framework. In the perspective of rights necessary in commoning (Schlager and Ostrom 2005, after Hess 2008:34), the criteria (2, 4, 5, 6, 7, 8, 10) are related to, of which (8) and (10) are related to the rights to exclude and alienate users from a resource that can be categorised as sign of advanced commoning rather than a baseline criterion.

An appealing perspective for further considerations are the elements that are stated as belonging to a commons: Resource, Community and Institutions of Collective Action (cf. 6: "house of commoning"). In how far are they related to in the design principles? - As the table shows, Of these, (4) relates to the Resource; (4), (5) and (6) to Community, (7) and (11) to the Institutions of Collective Action.

Table 4: Characteristics of Common Goods on a Gradient.

Formulations are based on Helfrich et al 2014 and adapted to global commons: from the form "Traditional commoning instead of emerging or no commoning" to "no commoning – emerging commoning – traditional commoning." Original can be found in appendix.

Community of Users' Resource Management	*Open Access Resource*		*Traditional Common Good*	*Related components of commons*
(4) Boundaries	*An open access resources' boundaries are not defined, it is submitted to free-riding.*	↔	*Boundaries of a specific common pool resource or resource system under commoning are clearly set. An identifiable group of legitimate users is taking care of a resource durably used in common.*	*Resource and Community*
(5) Congruency	*The value is concentrated on few, costs are externalised; the resource is consumed or held back from other rightful users.*	↔	*The value is fairly distributed according to costs.*	*Community*
(6) Decision making	*Handling of resource is directed by individuals or others, users are not asked to participate*	↔	*Handling of resource is self-organised as far as possible and represented where necessary; all users can take part in decisions.*	*Community*
(7) Monitoring	*Rivalry is the only rule agreed upon.*	↔	*Commoners agree upon adequate and transparent rules and monitoring.*	*Institutions of Collect.. Action*
(11) Embedded Institutions	*TheThere are no forms of embedded institutions governing the resource in ways ensuring collective rights.*	↔	*Where the CPR is closely interwoven with larger-scale resource systems, interlinked governance on several levels exist (poly-centric governance), for example: self-governed groups/communities/ associations → local government → co-working regional institutions → supra-regional governmental and non-governmental structures.*	*Institutions of Collect. Action*

Cornerstones For a Combined Commons Definition in General Framework Criteria

The criteria *Level of Governance* (12) and *Commoning Intensity* (13) both show highest importance for all backgrounds and can therefore be considered as central to a combining definition framework on emerging and traditional commons. Derived from considering the global commons' properties of supra-regional and international forms of governance, both show similarities with (10), *Governmental Recognition*, and (11), *Embedded Institutions,* and the question after *formality* of institutions' character.

The *formality* does not necessarily coincide with the *level* of governance, as regional institutions for adoption to climate change can be of governmental formality, whereas international networks of transition towns formality, in terms of governmental recognition (10), can be considered as much lower. In this cases, *formality* is defined as to “comply with standards” set by market and state; whereas *informality* is a divergence from these same standards; in other words, a

distinction is made between a constitutional or institutional[7] structure (formal) and a collective structure (informal) of resource governance.

A high level of governing a commons (12) – from local users to regional, super-regional and international, as named by Silke Helfrich (2012) as interwoven *Embedded Institutions* (11) – can, but needs not to, geographically, coincide with the expanse of common goods biophysical *Boundaries* (4), and can, but needs not to coincide with a high degree of formality. However, coinciding expressions in these criteria are assumed to be frequent. These criteria, (4), (11), (12), and the *Degree of Formality*, interlinked with *Governmental Recognition* (10), are all part of a macro - perspective on a commons in that they describe it's embeddedness in the biophysical, institutional and governmental environment.

Commoning Intensity (13), definable as the qualitative sum of of the management principles' expressions, is a criterion of the micro-perspective in that it relates to the directness of decisions (6), the system of rules and regulations for resource use and distribution (congruency, 5), the monitoring (7) and sanctioning (8), and mechanisms of conflict resolution (9). As result of a commoning adequate to biophysical and institutional surroundings, rivalry over resource units is lowered and the excludability increases, as limited use-rights can be granted. Open access goods can thus be transformed to common pool resources and common goods. These are mirrored from macro-perspective by commoners rights' of access, management and exclusion (cf. Schlager and Ostrom 2005 after Hess 2008:34), which can coincide with ownership. These micro-perspective criteria can also be termed as intensity of collective choice arrangement (Ostrom 2010).

Fluctuating changes in the commons' biophysical and social surroundings of the macro-perspective are closely related to collective decisions on micro-perspective, and the first may, to a certain extend, determine the degree to which commoning can be realised[8]. The two criteria *Level of Governance (12)* as macro-perspective on the embeddedness of governance and *Intensity of Commoning* (13) by a community as correlating micro-perspective have herewith been showed to be closely interlinked with all management principles and criteria of economics goods. But in how far can they indeed represent them? In how far can they be depicted in an extended framework of commons that can distinguish between the open access resource, an emerging commons and strong forms of traditional commoning?

Correlations of Commons Definitions after degrees of commoning

In all backgrounds, the dimensions of sustainability are addressed, showing that all of them can

7 "Institutional" is here applied as adjective to indicate towards forms of governmental institutions. Institutions of collective actions, as defined by Ostrom (2009), can be found in informal as well as in formal commons.

8 On this point, a need for deeper research can be assigned.

be said to a have a normative orientation on sustainability. In order to include the normative aspect into the framework, gradients of all identified cornerstone criteria, leading from high potential of tragedy to high potential of sustainable governance of CPR, are aspired.

Intensity of Commoning (13) by a community as micro-perspective can represent the criteria named above, as all of them can be place on a normative gradient leading from high potential of tragedy to high potential of sustainability; the criteria of resource regime less than that of management, so that it might be sensible to separate resource regime and commoning. Though they are closely inter-related, a commoning may also be able to preserve a CPR away from the diagonal gradient between excludability and rivalry. In case of the global commons, it is yet unsure to which degree they indeed can be commoned in traditional way, but there may be other ways to preserve a resource under adequately limited personal use rights than strong commoning. The *Degree of CPR Preservation* (due to adequately limited use and access) can be placed on a similar gradient.

The *Institutional Levels and Aspects* of commoning, as the macro-perspective, cannot be that clearly positioned on a gradient towards sustainability. It becomes clear that further research is needed here. In the extended commons' framework of combined cornerstones (cf. 10) the axis of macro-perspective aspects therefore is the only one that is explicitly *not* set on a normative gradient. Grey arrows show the pathways items supposedly move along in case of constitutional changes.

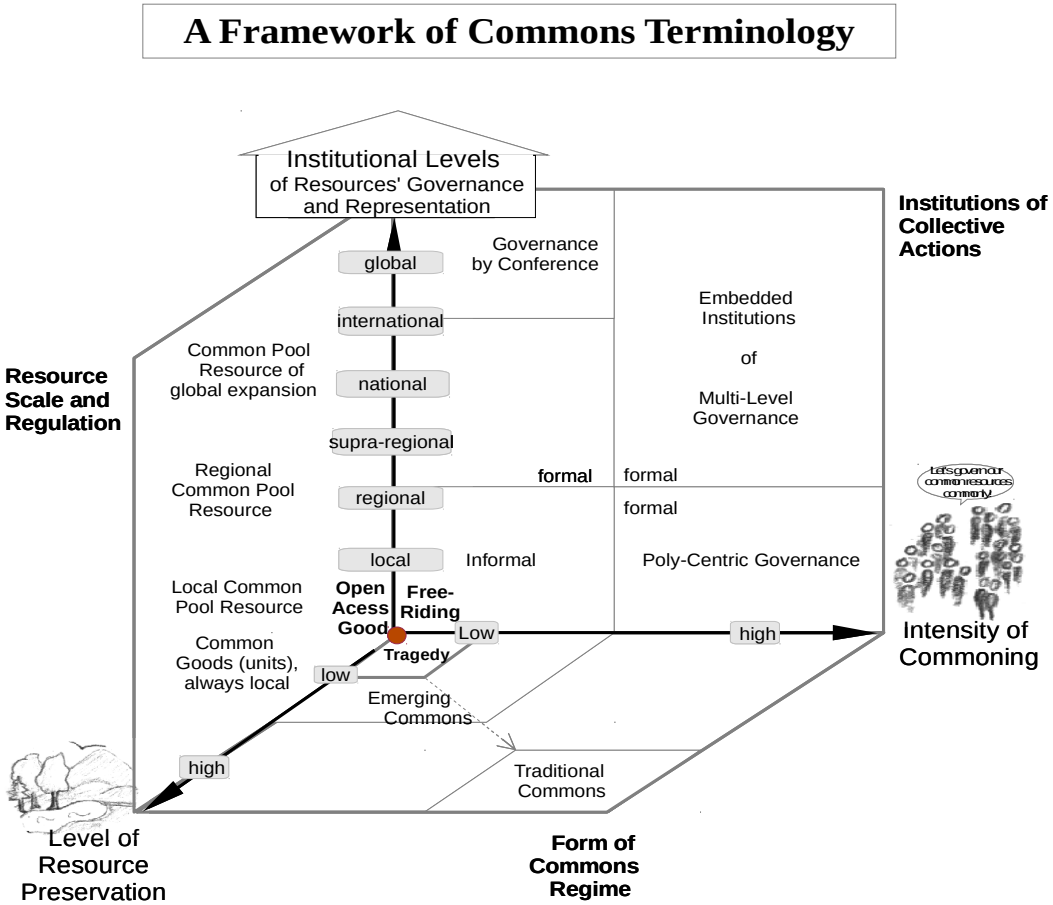

Illustration 10 (own source 2015): A framework of commons terminology.

> *X-Axis: "Intensity of Commoning:" as qualitative sum of a communities internal criteria for an effective commons´management after Ostrom 2009 (adequate regulations, fair rights of CPR use and access, …) Y-Axis: "Institutional Level of Resources´s Governance" as resources´ and institutional scale from local to global. Z-Axis: "Level of Resource Preservation" as consequence of the levels of a resources´extractability/rivalry (degree to which one person excludes another by consumption of one resource unit) and excludability (degree to which the access to and use of the resource can be regulated un*der the current socio-economic conditions).

10, "An Extended Common Goods Framework", shows the frame in which Commons are to be found. It is held by the axes Intensity of Commoning (x-axis), *Level of Resource Preservation* (z-axis) and *Institutional Level of Resources´s Governance* (y-axis), of which the first two, ranging from low to high, follow normative scales oriented on sustainability. The pane *Form of Commons Regime* spanned up between (x) and (z) ranges from low to high in two dimensions. The two other panes, *Resource Scale and Regulation* (dimension of resource) on the left and *Institutions of Collective Actions* (dimension of institutions) on the right, both range from local to global scale (y-axis), and from low to high preservation (due to regulation) (z-axis) or low to high commoning intensity (x-axis).

The range of expressions a term is valid for is visualised by the expanse of area it is depicted in.

In the three panes, *Emerging* (including global commons) and *Traditional Commons*, as well as the Open Access Meadows, and their belonging terms for resources (CPR, CG, Open Access) and examples of governance-forms of Institutions of Collective Action (*Governance-by-Conference*, informal to formal *Poly-Centric Governance*, *Free-Riding*) are located . Every pane displays the three terms expressions in one of the dimensions "resource", "community" or "institutions". The range of expressions a term is valid for is visualised by the expanse of area it is depicted in. "Tragedy" of natural resources of open access is located in the area where both intensity of adequate commoning and preservation due to regulations are low (red dot), that is where no common choices are taken for the resources good governance, and it is not adequately regulated and thereby preserved in another way. "Tragedy" as ecological collapse of a resource can occur in the range from local (village meadow) to global scale (atmosphere). The outer boundaries of these three terms on "Tragedy" mark the space where the commons begin.

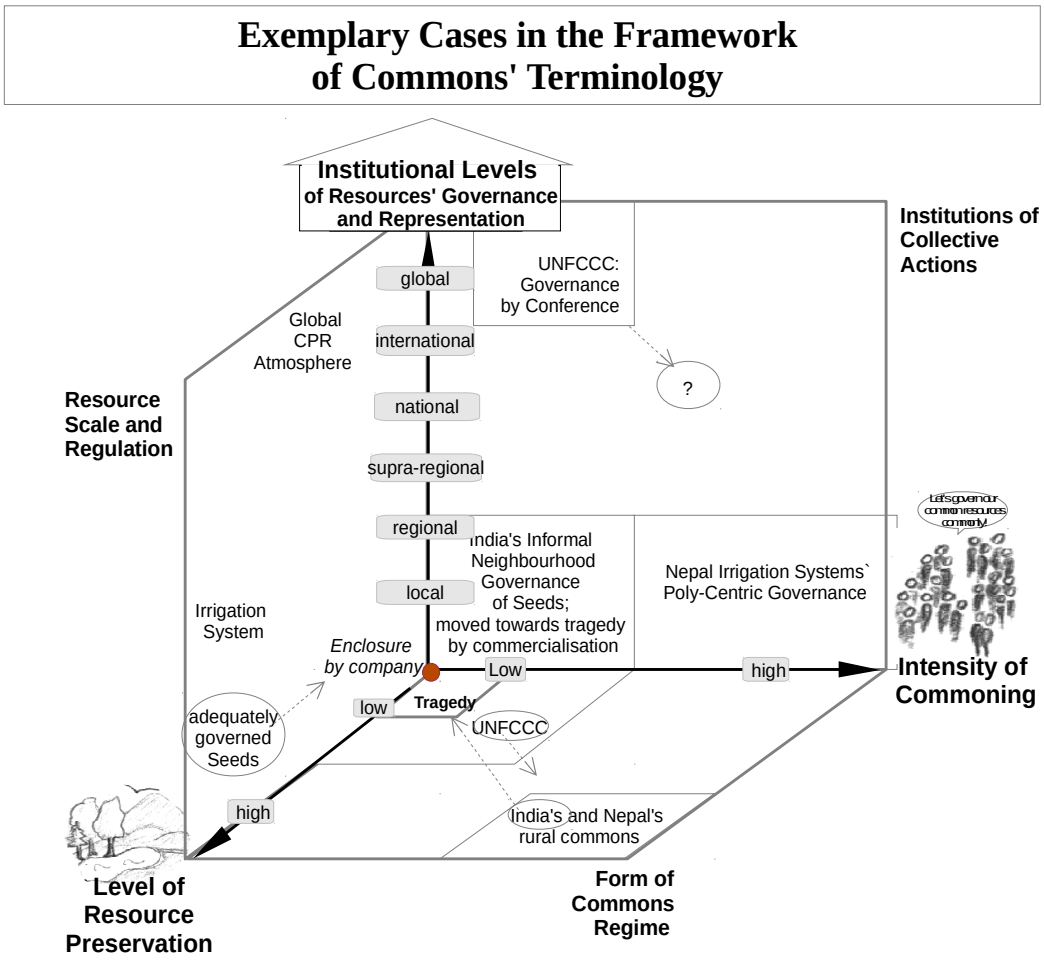

Illustration 11 (own source 2015): Three exemplary cases in the Commons' Framework.

The United Nations Conferences on Climate Change (UNFCCC), India's rural seed commons (Bharali 2008, Weber 2014) and Nepal's irrigation Systems (Ostrom 2009) are displayed in 11. Their Form of commons regime, Resource Scale and regulation and Institutions of collective actions are depicted in the coordinate system. Dotted arrows indicate the direction of change that either already happened (enclosure of seed commons) or is aspired (higher degree of decisions implementation on lower levels in UNFCCC, e.g., in form of higher embeddedness of institutions and clearer boundaries of use).

Summarising the findings of this subchapter, the construction of a framework on commons terminology could provide a deeper insight in the complexity of the interrelations in natural resources preservation, process of commoning, attributes of access and extractability, and scale of resources expanse and level of management.

Especially the level of resource boundaries and regulation is of interest for development of a definition of natural resources as CG, as they are determinable resource properties that can lead to identification as CG or CPR. Same is valid for the form of commons regime, global, emerging or traditional commons

The *Levels of Resource Preservation* (linked with excludability, rivalry and ownership), *Intensity of Commoning* and *Institutional Level* can only be determined for cases of commons, and not for one type of resource in general. With a comparative study of a high number of cases per resource would be needed to generate a representative insight on these. As they are no essential aspects for identification, these axes are not considered further in the flowchart for definition of natural resources as common goods.

4. Bringing Together: Natural Resources and Common Goods

In chapter 4, the two strands perspectives on natural resources and perspectives on common goods are brought together and combined into the aspired definition on natural resources as common goods. In order to compare and combine the ecosystem service approach and the commons approach as two contemporary discourses concerned with a sustainable resource use, the commons definition criteria derived in chapter 3 are sorted into the Millennium Assessment Framework 's categories of ecosystem services and constituents of well-being. Resource services of common goods, according to the descriptions of common goods, are classified along the four ecosystem services in 4a. Based on the reviews and analysis of chapters 2 and 3, and considering the concordances of 4a, natural resources and common goods will be defined in 4b. Resource properties of global commons are to be discussed and defined in 4c in direct answer to the main research question. Subsequently, in chapter 5, the defined criteria are transferred into a tool for transparent identification of natural resources as common goods.

a) Combining Perspectives with Millennium Assessment Framework

For a deeper insight in Common Goods and Common Pool resources characteristics, they shall be addressed under the ecosystem-services of Millennium Assessment (2005). In how far are provisioning, regulating, cultural and supporting services named in the reviewed comparative literature on commons? Where are gaps in the commons perspective, or where might the perspective of ecosystem services be unsuited for a transfer on commons?

Alongside the Ecosystem services, references are placed that either are noted under the verb of the service (e.g., *provision*) or expresses in a similar meaning, or references on similar types of exemplary goods to that listed under the services. The table is to be seen as an exemplary qualitative comparison of service properties.

Table 5: Millennium Assessment Ecosystem Services in Common Goods and Common Pool Resources

Service of Resource (Millennium Assessment 2005)	*Traditional Common Goods' / Common Pool Resources' Services*	*(Global) Common Goods'/ Common Pool Resources' Services*
Provisioning *food* *freshwater* *food and fibre,* *fuel* ...	Traditional commons provision... - an estimated two million people as productive local, regional and global Systems (Bharali 2011) - material and immaterial livelihoods (Bollier 2014) - forests' services: fuel wood , timber, herbs, wild vegetables and fruits (Bharali 2011)	CPR atmosphere provisions... - oxygen - sink for industrial by-products from burning coal and oil - possibilities of transportation (Soroos 1995:5)
Regulating *climate regulation* *floods regulation* *diseases regulation* *water purification* ...	CPR's regulate... - ecosystem functions - nutrient cycling (Hess 2008)	CPR's regulate.. - ecosystem functions - Food Security - atmosphere (Hess 2008) - climate (Soroos 1995)
Cultural *aesthetic* *spiritual* *educational* *recreational* ...	CPR... - are local resource-systems clearly located and limited in space - based on traditions, norms and habits of regulation and use; "customary laws and rules on (...) resources and on their protection and benefit-sharing " (Bharali 2011, Quilligan 2012) - "provide sustenance that includes people's culture, economy, social systems and identity" (Bharali 2011)	CPR... - can not fairly belong to one or few alone - Global C.: Common inheritance of humankind. (Quilligan 2012)
Supporting *nutrient cycling* *soil formation* *primary production* ...	Supporting CPR's.. - are not addressed in comparative literature of Bollier 2012, Bharali 2011, De Moor 2011, Hess 2008, Helfrich et al 2014, Ostrom 2009.	CPR supports... - ecosystem functions and – services - Biodiversity (Hess 2008)

For almost all Ecosystem services of MA common goods' and common pool resources' equivalents could be found easily. However, there seem to be differing points between the two. Traditional Commons provisioning aspects are widely and often addressed, as are the

provisioning aspects of global Commons. Provisioning services can be suggested to be the main reason for installation of commons, as they give response to basic and feasible human needs such as food for humans and cattle, material for building houses or furniture, drinking water, clothes, materials that provide warmth by burning, and transportation. Thus, material and immaterial livelihoods of many people are provided for on the basis of traditional commons, and e.g., oxygen and waste disposal by the global CPRs atmosphere and oceans.

Regulating Services of commons mirror the ones named by MA, with the distribution of local to regional services in the traditional commons and large scale or more general services as food security and climate termed as global commons. In CG, they are especially addressed in context with loss of regulating services and ecosystem functions due to enclosure of local commons, as, for example, in the reduction of soil stability in response to introduction of artificial fertiliser.

Cultural Services are addressed frequently in CG's description as one central aspect of traditional commons “nature”. As the commons itself may be seen as a cultural form of resource governing, this is not surprising. In CPRs, however, the characteristics coming closest to cultural services in the MA-sense is the perspective of humankind's inheritance, and much is written about issues of justice in distribution of easily accessible or enclosed CPRs. It can be assumed that cultural services are less prominent in CPRs due to a lower intensity of commoning and cultural processes. In Traditional Commons, cultural traditions are stabilising and framing the socio-cultural process, that in it's turn evolve further in close interaction with the governed commons. The weaker this bond of commoning between community and resource, the weaker probably are the cultural services that reach consciousness and discourse.

As for supporting services, the situation appears to be vice-versa: for CG's, no reference whatsoever could be found in the researched comparative literature, while they are quite frequently addressed in larger scale and especially global CPR.

Summarising, the resource services named for traditional commons are mostly provisioning and cultural, whereas global commons are named with all four services in rather equal distribution. This constellation might mirror the services distribution between CG (mostly named in traditional commons) and CPR (mostly named in global or emerging commons). CG, as extractable resource units, are supporting and regulating to a much lower degree than pools of common resources (CPR) or systems of CPR; whereas even an extracted CG gives temporarily limited cultural and provisioning services. E. g., a freshly cached trout (resource unit) provides a good meal, and the habit of smoking the salmon before eating is creating a cultural connection between fish and human. The same Framework can be displayed on commons socio-cultural characteristics along the MA constituents of well-being.

Table 6: Millennium Assessment Constituents of human well-being in common goods and common pool resources

Constituents of Well-Being (Millennium Assessment 2005)	*Common Pool Resources' Attributions to Human Well-Being*
Basic material for good life	CPR is important sources of livelihood (both tangible and intangible) to rural households in general and to the rural poor in particular (cf. Bharali, G. 2011:1, Bollier 2014)
Security	CPR is vulnerable towards privatisation, over-use and social dilemma, so that it requires protection to persist. ***Commoners*** **...**"develop their own agreements, establish the position of monitors, and sanction those who do not conform to their own rules. Consequently, (…) they keep their systems in better repair than government systems" (Study on irrigation systems, Ostrom 2009) ***Regulations*** are based on use-rights, tradition and culture (Bharali 2011, De Moor 2011) clearly defined and transparent, so that access and use are limited to an optimum between provisioning for human needs and ecosystem functions, e.g., in form of a long-term stewardship, allotted units per capita or price-mechanisms ...so that all entitled people s rights of access, use an benefaction from natural services in present and future can be ensured.
Health	"Medical and Health Commons" as a New Commons (Hess 2008) Commons provide regulating ecosystem services that are essential for human health, e.g., atmosphere (Soroos 1995)
Good social relations	**Commons** are evolving under the sociocultural **process of commoning,** taking place in a community of a resources users with the aim to preserve the resource's services and manage it in a just and sustainable way (cf. Ostrom 1990, Quilligan 2012, Bollier 2014) with an attitude of "I am co-responsible for what I co-use" (cf. Bollier 2014) are situated beyond a modern devision into producers and consumers (cf. Quilligan, J. 2012) can only be managed through social relationships and shared knowledge (cf. Bharali 2011) and a minimum of shared values and sense of community (cf. Bollier 2014) decentralized and collaborative structures avoiding centralization of power (cf. Bollier 2014)
...lead to freedom of choice and action	Commoning enables a self-governance of the spaces of daily live provide an inherited or self-generated wealth for present and future generations (cf. Bollier 2014)
Human-Resource-Interrelations	A Commons preserves, cares, reproduces and expanses commoned resource systems, resource pools and resource units (cf. Hess, C 2008) At the core, a commons *is* a form of human-resource- interrelation oriented on a sustainable long term co-existence (cf. Bollier 2014, Quilligan 2012)

Commons' contributions to health are less in focus of the commons discourse than other components of well-being are. To secure individuals' and communities' foundations of live and rights of access and use, however, and how this can be achieved collectively, is central to the discourse.

The Millennium Assessment ecosystem services' framework proved as a helpful perspective in, firstly, characterising CG and CPR, and secondly the constituents of well-beings' resemblances in the commons. For the deeper consideration of common goods' and common pool resources' services, and especially for application in contents of international politics a differentiation between medium scale CPR and CPR in Global Common Goods as inheritance of humankind is needed.

b) Defining Natural Resources, Defining Common Goods

In defining, it is related to correlations or differing aspects in the other perspective. Consequently, the resource definition will already be in consonance with common goods resource categories, and the Common Goods definition will, in the goods aspects and aspects of use, be in consonance with natural resource terminology.

Defining Natural Resources based on Chapter 2

Natural resources have been defined as means for human actions and basis of human livelihoods provided by nature; namely the large-scale resources pools *Water, Air, Soil/Land and Biodiversity*, and the *Raw Materials sub-categorised* in Biotic and *Abiotic Materials*, with *Fossil Fuels, Ores, Industrial Minerals* and *Construction Material* as Abiotic and *Material Use, Food/Feedstuff* and *Fuel* as *Biotic Material (cf. ProGress 2012).* All ecosystem functions of earth and solar system usable by humans or funding human well-being related to the named material resources are also considered as possible natural common goods. Their value for humanity, as living resource-pools embedded in ecosystems or as single resource units, can be closer described by the perspectives of provisioning, supporting, cultural and regulating ecosystem- or resource-services. While Resource extraction takes place at local level, use can be distributed globally (cf. Chapter 2).

Can the same be applied to resources under commoning?

> *In a generic sense, a resource is something that is useful to humans. It may either be present in nature or be produced by humans. Natural resources that are used as commons are of many types, which have implications for how they may be used or managed. Resources are usually thought of as being physical substances that under normal conditions are in the form of a solid, such as coal or minerals; a liquid, such as petroleum or water; or a gas, such as helium or natural gas. Resources may be stationary, such as coal and forests, or mobile and thus fugitive, such as whales. Some resources are living such as fish, grass, and trees, while other others are inanimate, such as hard rock minerals (Soroos 1995:2).*

As Soroos lays out, the resource definition used in traditional commons is consistent with the above one. Resources' general properties can, based on that concordant definitions, be addressed for closer definition by a range of questions. Is a resource feasible or non-feasible? When it is feasible, it can be located in the categorisation of natural resources as belonging to Water, Air, Soil/Land, Biodiversity and Raw Materials. When it is not feasible, it can be identified as an ecosystem function related to one or more of these. The form of service a natural resource or ecosystem service provides to human communities can be determined by a grouping into provisioning, supporting, cultural and regulating resource- and ecosystem services.

However, this definition of resources and goods fails to properly distinguish between living entities - a tree in the forest with the ecosystem functions he contributes to as foundation of life - and the chopped, move-able raw material wood valued in economics. This missing differentiation hinders an easy resource identification.

The chopped tree has an economic value as biotic raw material. The living tree has a value to all humankind by providing oxygen and biomass from timber and leaves besides cultural, supporting and regulating functions. Once the tree is felled, all his present and future ecosystem functions and services except one last providing service (use of the wood) are lost to humanity.

Therefore, the flowchart for resource-identification has to be distinguished further: it is not the *feasibility* that divides ecosystem functions (EF) from resource units of raw materials, water, air, soil and biodiversity (which, in itself, is much more a EF than a resource unit, even though it is recently listed among them). Rather, it is the *extraction*, or *removal*, from the resource pool that defines the tree as a usable unit of biotic raw material. The service of a resource, the tree, removed from its resource pool, can only be of *temporarily provisioning* character, whereas a living tree is supporting and regulating the foundations of live on earth and provides cultural and provisioning services in present and future, as long as it lives.

Defining Common Goods based on Chapter 3

The aspects of interest for a definition of resources as common goods are

- A defined expanse of resource pool (CPR) containing resource units (CG)
- An identifiable community of users
- An identifiable process of commoning, where a shared aim in resource preservation and regulations for a sustainable use and governance of the CPR are discussed and chosen.

Where these three criteria can be found, we have a commons, as visualised in 12 At this point, the level of resource preservation, commoning and formation of Institutions of collective actions are unknown.

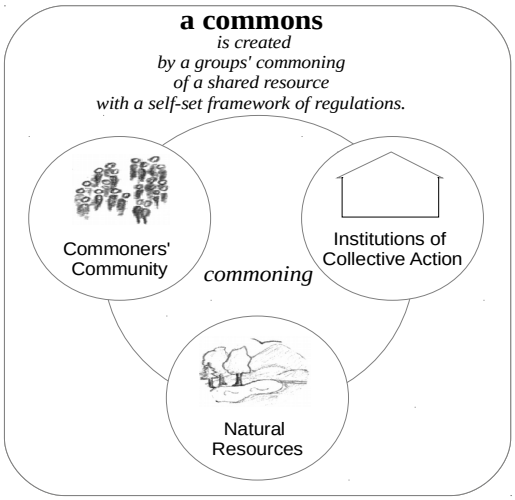

Illustration 12 (own source 2015): Basic Definition of a Commons. If one component is missing, the resource is not (yet) a common good.

Rules and Regulations are under continuous adoption to changing situations the higher the intensity of a clearly identifiable group of users' commoning is. Commoning is definable as the qualitative sum of the collective aspects of the commons management.

The difference between the terms CG and CPR can best be defined by their systematic scale, in accordance with the systematic scales of resource pool and resource unit (2, 13), as it is frequently, though not always, used in that differentiation. “The common pool resource itself is made up of resource units, and it is what individuals appropriate or use from resource systems” (Vanni 2014: 2). Besides, a strong tendency is, that CPR are described as open access resource pools (Ostrom, 1990:30), deriving from the economic goods framework. As the resource in a commons, however, can change in terms of excludability and extractability from weak to strong commoning and in interdependence with external factors, a consistent term is needed that can cover the whole gradient of commoning and varying accessibility. Therefore, for further definition, CG and CPR are herewith defined as different systematic scales of one resource in a commons, as visible in 13. When it is referred to one of the two terms, the other's existence is implied.

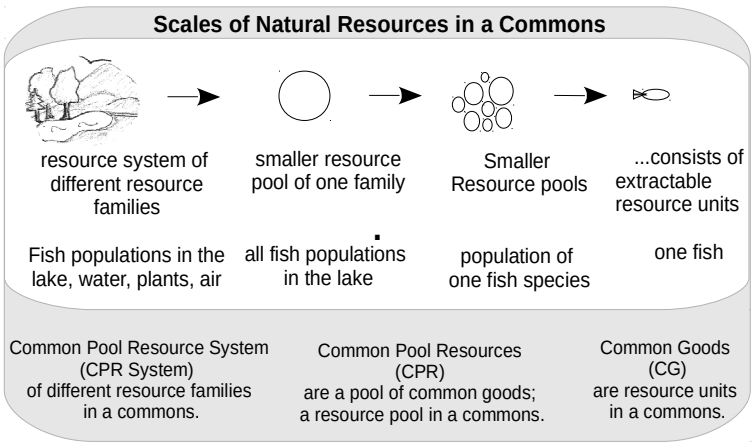

Illustration 13 (own source 2015): Scales of natural resources in a commons

For all resources that can be identified or have been described in literature as commons by the three components of a commons, with the natural resource sub-dividable into CG and CPR as one of them, criteria are to be collected to indicates if a CG is in need of being governed as Commons due to danger of overuse for combined definition in 4b. Therefore, CG and CPR's general properties as listed in table 3 and discussed in 3b and c are collected in the following.

Some properties of Global Commons' Resources can vary: e.g., the renewability (renewable or non renewable) and the scale of resource-pool (local, regional, global). A range of consistent cornerstones of CG properties is to be found that can, later, clearly indicate a resources need for governance as Global Commons.

While traditional commons' definition is closely interlinked with a community and the socio-cultural process of commoning a resource, the emerging and especially the global commons are those CPRs that are *in need of being governed as Commons due to danger of overuse,* as became visible in the descriptions of Chapter 3a and the comparative table 3. The interrelation of commons' resources and commons' perspectives can, for better understanding, be depicted as visualised in illustration 14

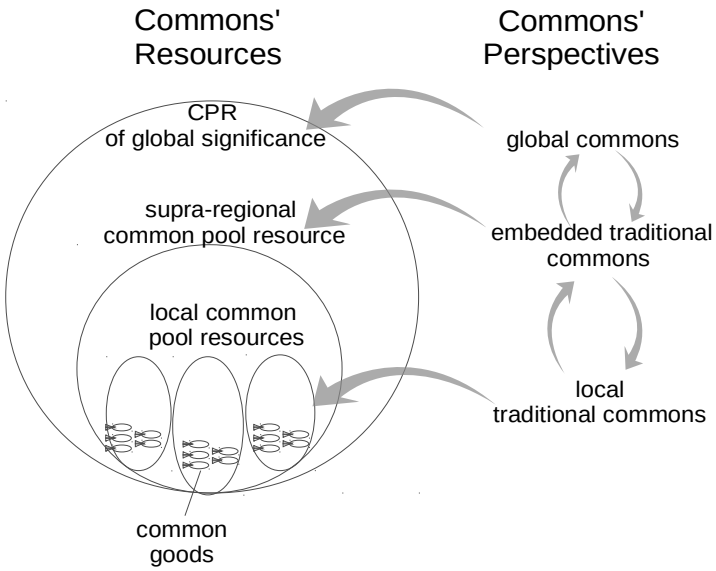

Illustration 14 (own source 2015): commons' resources and commons' perspectives from local to global level

CPR's need for governance is, as collected in the comparative Table 3 from the global commons column, indicated by that they are...

- Not defined by the economics forms of ownership (1), but by that they are *foundations of life on earth and therefore heritage of all natural persons of present or future.*
- Of *low Excludability,* associated with *open access* (criteria 2, 4)
- Of *high Rivalry,* indicating a relative *scarcity* (criterion 3).

In the management principles, they are characterised by

- *Incongruence* between singular users and present and future benefiters from resource services (criterion 5)
- Of *little or emerging regulations* (criterion 6, 7, 8) and *low degree of collective choice and community s organisational structure* (4=community, 9=sanctioning, 13=commoning).
- Formalisation on governmental levels as *inheritance of humankind* still is moderate. Management approaches are mostly governmental, therefore *recognition of formal decisions is usually high* (10, 11).

From the sustainability criteria, they are characterised by

- *Danger of overuse* (ecol.)
- *Externalised environmental costs* (ecol. - econom.)
- *Missing agreements on adequate international goals and regulation mechanisms*, which is aimed at (socio-cultural)
- *Equity* as inter- and intra-generational justice of resource use and distribution is central goal, but *not adequately established due to open access situation (social)*

From all those, only the criteria considering resource properties shall be considered further. This are, besides that they are *in need of being governed as Commons due to danger of overuse,* the economical ones (1-3).

In the management principles (4-11), a doubling with the sustainability criteria's expressions is frequent, so that they are combined in further progress. To cover all central areas of global commons resource properties, the above criteria are reformulated so that they are resource properties and sorted into the dimensions of sustainability in table 13.

c) Defining Natural Resources Cornerstones in Common Goods

Defining Common Goods of Global Significance

As for ecosystem services in global commons resources, 4a) showed that the resource services named for traditional commons are mostly provisioning and cultural, whereas global commons are named with all four services in rather equal distribution. It is due to that property, *due to present and future* regulating, and/ or supporting and/ or provisioning ad/ or cultural ecosystem function(s) that they are considered as *essential foundation of life on earth, while extracted units provide only one last provisioning and cultural service.* Once extracted from the resource pool by human action, most or all continuous ecosystem functions are limited or lost (a felled tree.)

The terminology and concept behind the *common heritage of all humankind*[9] is derived from a background of the human rights movement. Therefore, and for the sustainability issue of social justice, a rights criterion is to be integrated in the definition. Bollier and Burns propose the "human right to a clean and healthy environment" (Bollier, Burns 2014). As a *resource* and *resource service* perspective is needed here, the right can be reformulated and addressed as "human right to adequate and just benefit from natures' provisioning, regulating, cultural and supporting functions of present and future". Human Rights are, by UN declaration, valid for all natural present and future persons (cf. UN 2014). Those can not fairly belong to a limited group of people alone. The social justice aspect is defined more concretely by naming the functions.

In closer consideration of some properties it became clear that they can change under adequate sustainable governance, while others are persistent. If these changeable properties have varied at a later point in time, that does not indicate the CPR should loose its defined status as global commons. When the accessibility, need for regulation and danger of overuse decrease, that rather indicates a move along the gradient of commoning towards a more sustainable resource governance. All properties listed below define, in sum, a natural resource as a CPR that is to be governed as humankind's common heritage.

Table 7: Definition of CG/CPR of global significance in 11 criteria

Dimensions of Sustain.	CG/CPR of Global Significance is Defined by:	CG/CPR of Global Significance is Identifiable by:	Persistent under Resp. Gov.
Ecological/	Essential foundation of life on earth	Regulating, supporting, provisioning or cultural Ecosystem service(s) of global significance.	yes
Natural Resource Attributes		The sum of all natural global commons indicates nature herself (natural capital)	
	Immovable	once moved by human action, supporting and regulating ecosystem functions are limited or lost	yes
	Not substitutable / unique	Resource-specific services and ecosystem-functions are not substitutable and not re-installable	yes
	Substractable	consists of extractable or usable resource-units	yes
	Scarce and depletable	limited number of extractable or pollutable resource-units, until resource pool is depleted or its services are lost	yes

9 Also frequently termed as *heritage or inheritance of mankind*, which is termed here as *humankind* or *humanity* to include all humans, not only the men.

Socio-ecological	System of nature – human interrelation	Inter-relations between the ecological and man-made system (services, rules, regulation)	yes
Juristic / Philosophical	Common heritage of all humankind	belongs to all natural persons present and future as every-ones' foundation of life. Its services can not justly belong to a limited number of people.	yes
	Benefaction is Human Right	Benefaction from the resources' provisioning, regulating, cultural and supporting functions is Human Right.	yes
Socio-economical	Common Responsibility to Preservation	Right to access and benefaction is ethically correlated with the duty/responsibility to preserve the resource.	yes
	Rivalry	Common users maintain access in a rivalrous manner	yes
	multiple groups of involved people	multiple groups of people benefit from ES, multiple groups of people make use of resource units	yes
	Free accessibility and use	low excludability, free or scarcely limited	yes
	Unjust distribution	among humanity (little regulation of access, use and distribution) → not (yet) governed in an adequate (collective) way	no
Ecologic -economical	Endangered by overuse	Ecosystem services are decreasing or have decreased from their earlier condition	no
Socio-ecological	Lack of responsible governance/ management	Users scarcely communicate their actions; aims for preservation, regulative rules, monitoring of use and sanctioning do not ore only scarcely exist.	no

When a CG is extracted from it's resource pool, its services change. They no longer are regulating and supporting interrelate resource systems, sometimes in addition to provisioning and cultural services; now, they only supply provisioning and, sometimes, cultural services; e. g., a fish taken out of the lake and killed for preparation and cooking or smoking. Then, prepared for eating, the fish provides one last service: provisioning food. Other extracted raw materials, biotic and abiotic, can be used over a longer period of time (wood for furniture...) or periodically due to recycling (scarce metals, plastic, paper...) or when users hand the raw material on to others (second, third...hand). Due to these facts, one unit of CG can also be used by several users (wooden table, stone in the pavement), which reduces it's scarcity. Considering the earlier example of the fish more closely, his remainders become compost or waste and can, therefore, provide for a second circle of human needs, e.g., as fertilizer for degenerated soils. These aspects of composting and possible re-usability, if not contaminated in some way, are shared by all biotic resources. In the abiotic resources, some forms of use can remove the resource permanently from

human reach (burning of oil for generation of energy), as does contamination in case of the biotic extracted raw materials.

Therefore, all extracted natural CG are characterised by ad least a service of provisioning character; can be used in periodical cycles several to many times by more than one user, unless the form of use removes it from human reach and/or transforms it into a contaminant. However, one unit can not be reused without undergoing a transformation that, if it is conducted by natural processes, takes a period of time.

This characterisation differs drastically from that of De Moor's definition of natural common goods as of either low excludability (open access situation) or high excludability (one person excludes all others, in strong commoning or under private possession), and high substractability (extraction of the resource is easy, either due to missing adequate regulations and rivalrous use; or because no rivalry exists and the resource is abundant – then, commoning is not needed). This definition of CG properties is, however, oriented on a gradient of commoning, which is of limited value for a definition of extracted CG in need of governance as Commons due to properties of resource and use. Based on this considerations, table 7 is to be reformulated according to the properties characterising extracted common goods essential to humanity.

Table 8: Definition of CG/CPR of global significance in 11 criteria

Dimensions of Sustain.	CG/CPR of Global Significance is Defined by:	CG/CPR of Global Significance is Identifiable by:	persists under resp. gov.
Ecological/ Natural Resource Attributes	Of essential significance to humanity	provisioning or cultural Ecosystem service(s) meet basic human needs	yes
	Moveable	once extracted by human action, supporting and regulating ecosystem functions are limited or lost	yes
	Not substitutable / unique	Resource-specific services and ecosystem-functions are not substitutable and not re-installable	yes
	Substracted	Is an extracted and usable resource-unit	yes
	Scarce and depletable	limited number of use-cycles or pollution resource-units, until resource unit is depleted or its services are lost to humanity for the time being	yes
Socio-ecological	System of resource – human interrelation	Inter-relations between the ecological and man-made system (services, rules, regulation)	yes
Juristic / Philosophical	Common heritage of all humankind	belongs to all natural persons present and future as every-ones' foundation of life. Its services can not justly belong to a limited number of people.	yes

	Benefaction is human right	Benefaction from the resources' provisioning, regulating, cultural and supporting functions is Human Right.	yes
Socio-economical	Common Responsibility to Preservation of usability	Right to access and benefaction is ethically correlated with the personal users responsibility to preserve the resource.	yes
	Rivalry	Common users maintain access in a rivalrous manner	yes
	multiple groups of involved people	multiple groups of people benefit from ES, multiple groups of people make use of resource units	yes
	Free accessibility and use	low excludability, free or scarcely limited	yes
	Unjust distribution	among humanity (little regulation of access, use and distribution) → not (yet) governed in an adequate (collective) way	no
Ecologic -economical	Endangered by overuse	Ecosystem services are decreasing or have decreased from their earlier condition	no
Socio-ecological	Lack of responsible governance/ management	Users scarcely communicate their actions; aims for preservation, regulative rules, monitoring of use and sanctioning do not ore only scarcely exist.	no

Table 9: Definition Cornerstones of Extracted and Embedded Global CG

For IntRess, Global Common Goods are defined as:		
	Extracted CG of Global Significance	Embedded CG and CPR of Global Significance
Criteria of resources' natural characteristics 	Essential for satisfaction of human needs Movable Replaceable Substractable Scarce and depletable	Essential foundation of life on earth Immovable Not substitutable/ unique Substractable Scarce and depletable
Criteria of resource-human interaction 	Common heritage of all humankind System of nature – human interrelation Benefaction from P and C services is human right Common Responsibility to Preservation	Common heritage of all humankind System of nature – human interrelation Benefaction from R and S services is human right Common Responsibility to Preservation
Criteria of use 	Multiple groups of involved people *Free accessibility and use* *Rivalry* *Unjust distribution*	Multiple groups of involved people *Free accessibility and use* *Rivalry* *Unjust distribution*

	Endangered by overuse *Lack of responsible governance/ management*	*Endangered by overuse* *Lack of responsible governance/ management*

*T*he criteria of resource-human interaction and the criteria of use are a consequence of the Common Pool Resources' natural characteristics. Both the criteria of resource-human interaction and the criteria of use are a consequence of the CPRs' natural characteristics of unique. The last fife criteria of use indicate lack of responsible governance and change under a governance as commons.

In sum, the 15 criteria indicate an urgent need for adequate regulation and preservation of a natural resource by local to global commons management approaches; by defining it as essential for life on earth and common heritage of humankind. For simplification, CG/CPR of global significance are, in the following, termed as *global CG* and extracted CG essential for satisfaction of human needs as *CG by human rights*

In the following, the cornerstones of tables of 8a, 8b, and 9 are to be transferred into a tool for identification of specific natural resources as global CG.

5. Identifying Natural Resources as Humanity's Common Goods

First, in 5a, a resource definition flowchart will be generated based on the results of chapter 4; secondly, a commons flowchart is developed in 5b. The considered criteria will be limited to the ones that have shown as most central and well identifiable. In a transfer onto the specific resource categories water, air, land, raw material and ecosystem functions, these will be researched in commons literature and identified according to the flowcharts. Thus, table 13 will display all defined natural resources and list whether they have been named as common good in literature already, with the purpose to identify them as humanity's common goods. Subsequently, results are evaluated and the hypothesis posed in the beginning is to be tested in the light of table findings in 5c. Findings' further indications are laid out in 5d, before it is advanced to critical discussion in chapter 6.

a) A Flowchart of Humanity's Common Goods

The aim of 5 a is to transform definitions into a Flowchart for identification and closer characterisation of natural resources, thereby defining them as humanity's CG under consideration of both resource properties and commons properties.

Flowchart Construction

The aim of a flowchart generally is to lead from one easily measurable criterion to another, less easy measurable or visualise existing interrelations of the contents. In this flowchart, a first

question (grey pane) is posed and a range of possible answers displayed (white panes). The choice of one leads to another question or indicates a closely related term. To the right side, in the last panes after a row of questions, central criteria are identified. The usefulness in this arrangement of definition results is, I., that it is easily correctable or extendible at new insights. II., it is a very helpful tool in grouping and characterising large groups of data with a transparent scheme.

The core question to be answered is whether a resource under consideration is to be governed as global commons. That is the case (in short) when a resources' services are of global significance and the persisting CPR criteria listed in table 10 can be found to a degree of medium of higher.

In order to check on the global CPR resources criteria. the characteristics of the right hand column of table 8 are to be identified beforehand. Resource criteria are sufficient, as the criteria of resource-human interaction and the criteria of use are to be seen as a consequence of the criteria of CPRs' natural characteristics. The Identification criteria are transformed into variables. Criteria from 8a and b, on embedded and extracted resources, are not displayed repeatedly, as they only differ in expression. Identification variables are thus inherent in table 10 identification variables.

Table 10: Variables for Identification of Embedded CG/CPR of Global Significance

Resource Criteria	**Characteristics for Identification**	**Variables**
Essential foundation of life on earth	Regulating, supporting, provisioning or cultural Ecosystem service(s) of global significance	Ecosystem service(s) and their significance: **R, S, P, C / global significance.** While P and C services can be of local significance, R and S services are interrelated with the ecosystem earth and thereby fundamental for life on earth. → valid for Resources which show at least the catagories of **provisioning and supporting services**
Immovable	once moved by human action, supporting and regulating ecosystem functions are limited or lost	An extracted good/ an extracted resource unit loses it regulating and supporting services. → *Valid for all **Resource Pools and -Systems***
Not substitutable/ Unique	Resource-specific services and ecosystem-functions are not substitutable and not re-installable	only local ecosystems can be reinstalled, and even here ecosystem functions are not the same in a reforestation as were beforehand in, e.g., an old-growth, so-called *ancient* forest (cf.). Resource systems or pools of larger scale can not be reinstalled without massive loss of ecosystem functions and services.

		→ *valid for all* ***Resource Pools and -Systems***
Substractable	consists of extractable or usable resource-units	→ *valid for all* ***Resource Pools and -Systems***
Scarce and depletable	**l**imited number of extractable or pollutable resource-units, until resource pool is depleted or its services are lost	*all* Resource Pools, Systems or Service's of planet earth are of limited units due to the planet's boundaries. → *valid for all* ***Resource Pools and -Systems***

Ecosystem functions and services themselves, such as energy, biodiversity or nutrient cycling, are inherent in resource pools and -services of global significance, so that they, when named directly, can also be considered as natural heritage of all human kind.

Summarizing, CG/CPR of global significance can be identified as following:

A. When a considered natural resource...

I. bears irreplaceable regulating and supporting services (R, S), and

II. is of the systematic scale of resource pool or -system or ecosystem function,

...it is defined as a global CPR of essential significance for life on earth and therefore to be governed as common heritage of humankind.

B. When a considered natural resource...

I. bear at least a provisioning *or* cultural service (P, C), and

II. is of the systematic scale of extracted resource unit

...it is defined as a CG by human rights whose use is to be distributed fairly by governance as common heritage of humankind.

By this definition, all embedded resources of the earth are Common Pool Resources that are to be governed as common heritage of humankind. Flowcharts as a tool for identification of CPR of global significance are therefore to classify resources into services (R, S, P, C) and systematic scale (Resource Unit, Resource Pool, Resource System, Ecosystem Function).

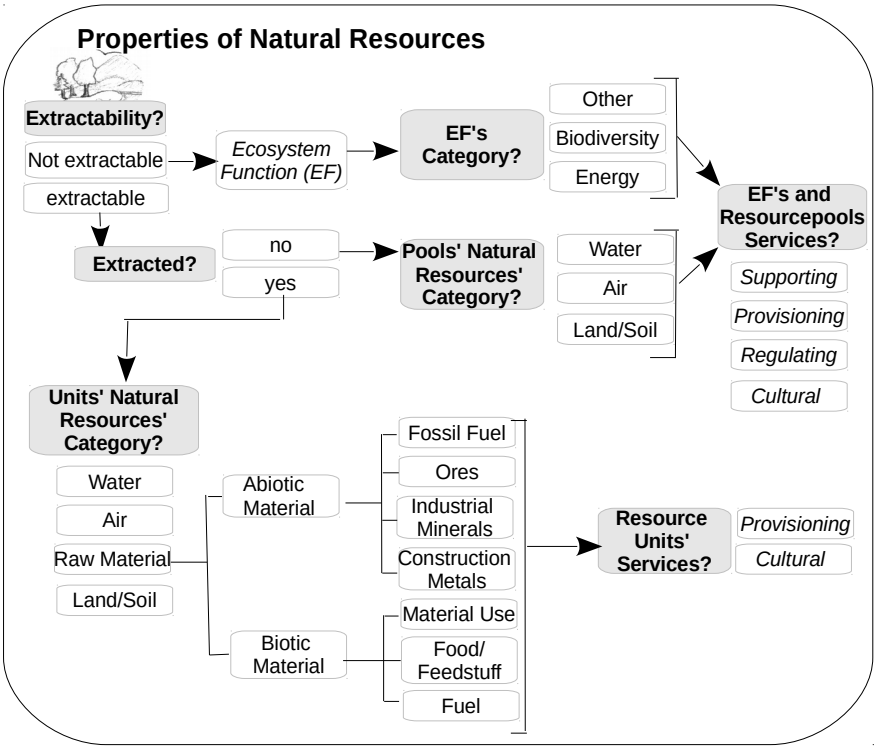

Illustration 15 (own source 2015): Flowchart for identification of systematic resource scale and services

In the next step, Resources of at least regulating and supporting services (R, S), and of the systematic scale of resource pool or -system or ecosystem function are defined as Common Resources. The extracted CG, now outside the definition of global CG/CPR, are displayed as units that are to be governed as CG by human rights locally.

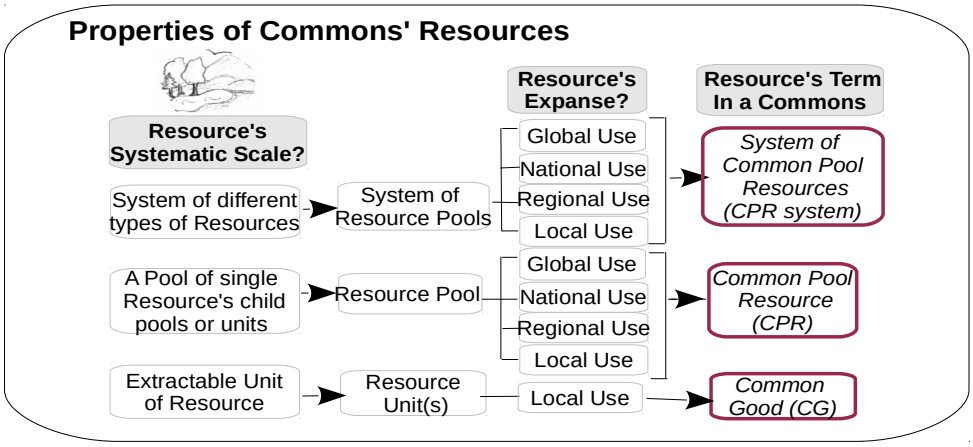

Illustration 16 (own source 2015): Flowchart for resource identification as Common Goods and Common Pool Resources

Now, the two resources' flowcharts are combined into one, as resource scale and terming of common resource is correlating.

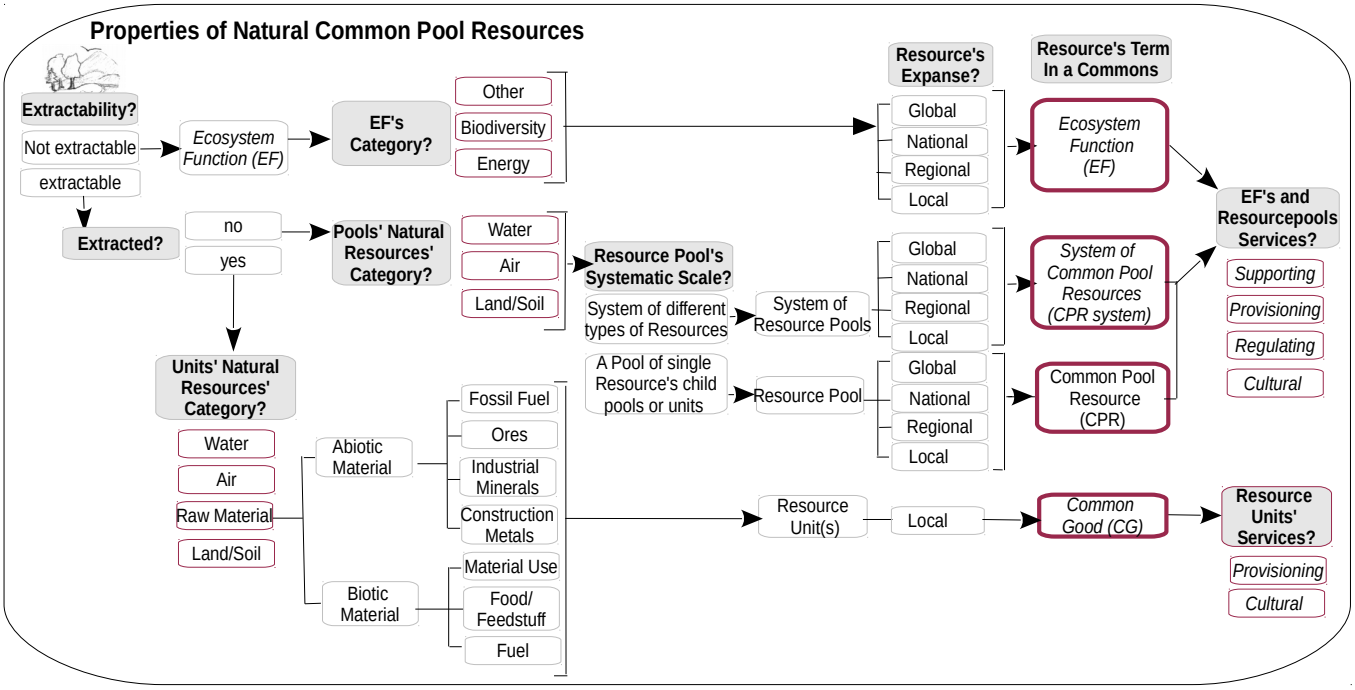

Illustration 17 (own source 2015): Combined Flowchart of resource properties for identification.

Extractability → Category of Natural Resources → Systematic Scale → Expanse → Term under Commoning → Services

In the final step, the intensity of CPR's collective governance and correlating terms are depicted.

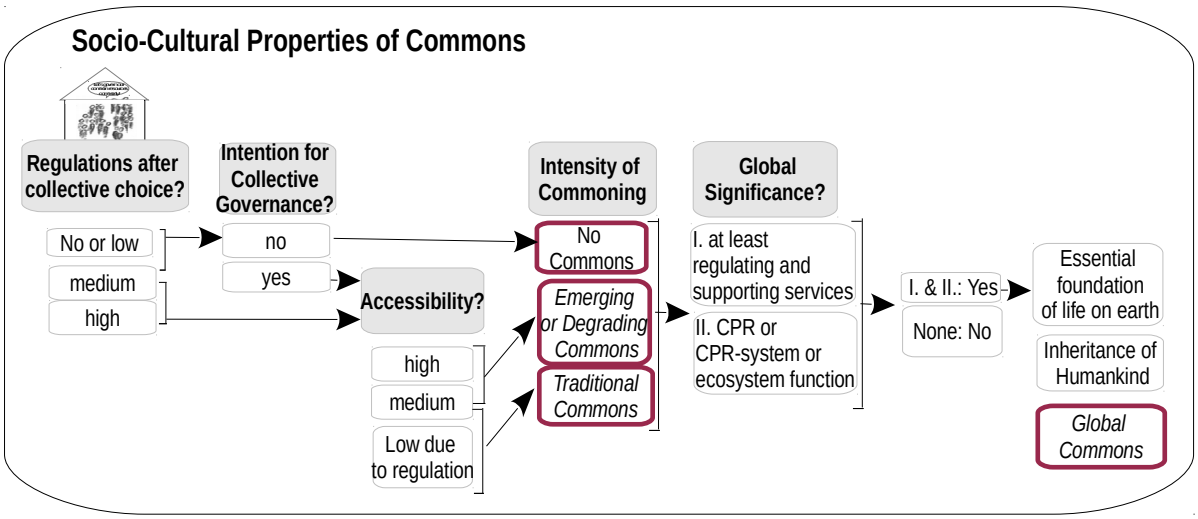

Illustration 18 (own source): Flowchart of CPR's collective governance and correlating terms

The Flowcharts 17 and 18 indicate a transparent proceeding for CPR's and global commons identification. Subsequently, the criteria of use and resource-human interrelation are to be tested for secure identification of the current situation of the global commons. As that is only possible

on a case-study level in many of the named resources, and as the criteria expressions of use may vary from case to case, this last step can not be included in this paper's table of identification.

B) Identification and Classification (Table)

In accordance with the flowcharts, the table lists the following columns:

The Columns 1., 2., und 3., *Resource category; systematic type of common resource and it's physical expanse* display resource's *characteristics.* The columns 4. and 5., *Resource's services* and *services' description and threats*, are considering the resource- human interrelation. The columns 6. and 7., *Scale of commoning* and *type of commons* display characteristics and terms of management.

The resources catagories (air, water, land, raw materials, ecosystem functions) have been researched for in the Indiana Digital Library of the Commons. If one single positive indication is found, a resource is listed in the identification table as such and closer identified on central properties as commons. Where no properties are directly named, they are assumed based on a general understanding of resource-use, global distribution, boundaries, and commons' properties according to the flowcharts. If a natural resources is not listed below, that does not indicate it is no common good or common pool resource of some kind; it only indicates that is has not been considered as such in the researched literature.

It is of special interest which resources are identified as CPR of Global Commons and which as Common Goods. Further, it might become visible whether scale of use and scale of commoning show correlations. Scale of use includes the range of distribution and thereby differs from the scale of a units extraction, which is always, and necessarily, a punctual an therefore local process.

A challenge in identification of CG and CPR is to distinguish between the listing of resources that *should* or *potentially could* be governed as commons, and those where first steps are actually taken. While those resources with a history in being commoned are listed with the term “traditional commons”, a distinguishing between those on the verge of tragedy, or still without any forms of commoning, and those with emerging Institutions of collective actions can hardly be made here, as that requires a much deeper research on every single resource.

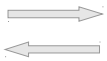

Table 11: Properties and Services of Resources under Commoning

Common Pool Resource	**Type and Scale of Common Resource**	**Services**	**Description of Use or Service**	**Scale of Use**	**Scale of Commoning**	**Type of Commons**	**Ref.**
-Water -Air -Soil/ Earth -Land (scapes) -Raw Materials -Services	*-Common Good(CG) -Common Pool Res. (CPR) -Ecosystem-function (EF)*	*Provis. (P) -Regul. (R) -Cult. (C) -Supp. (S)*	*Resource specification, sectors of use, services, Dangers*	*-global -intern. -national -supra-reg. -regional -local*	*-global -internat -national -supra-reg. -regional -local*	*-Global C. -Emerg. C. -Trad. C.*	*In Digital Library of the Commons, Indiana University*
Water							
Oceans	*CPR System Local to global*	C,R,S,P	*Fish-Grounds, Watercycle, Tourism...*	*local to national.*	local to global	*Global C. Emerging C.*	Lee, Z. (1995)
Rivers, steams, lakes	CPR-Systems, supra- n./ CGs, local	C,R,S,P	Fish-Grounds, Water cycle, Irrigation...	local to national/ local	local to internat.	*Emerg, C. Trad. C. Global C.*	Bharali, G. (2011)
Ocean floor plus its geomorphology	CPR-System, global	R,S,P	All minerals found under land masses are likely to be found under water.	Local to global.	global	*Global C. Emerg. C.*	Lee, Z. (1995)
Deep seas	CPR-System, global	R,S,P	Still interrelations of oceans' ecosystem functions and deep-seas are unclear, but strongly assumed.	Local to global	global	*Global C. Emerg. C.*	Hess, C. (2008)
Ocean waste disposal	EF global	R,S	Assimilate a share of society's wastes (overuse)	local	Local to national	*Global C. Emerg C.*	Lee, Z. (1995)
Marine transportation	EF global	R,S,P	Marine currents transport nutrients, warmth, seeds and species; e. g., gulf stream. Is assumed to be interrelated with global climate (IPCC). human transportation via shipping	global	global	*Global C. Emerg.C.*	Lee, Z. (1995)
Wetlands, Watersheds	CPR-System regional	R,S,P	Watersheds: an area of hydrological linkages. significant positive impacts on water table, perennially on wells and water availability. requires coordinating by public participation.	regional	regional	Global C. Emerg. C.	Berge, E.; Carlsson, L. (2003) Khajuria, A.; Yoshikawa, S.; Kanae, S. (2014)
Coral banks	CPR-System local to regional	R,P,C,S	Severely endangered by global warming of the oceans. Highly biodiverse,	local to national	Local to global	Global C. Emerg. C Trad. C.	Fleischman et al. (2013)
Fisheries	CPR-System Local to internat.	P,C	In lakes and rivers, Aquaculture, at n. coasts and in oceans.	Local to global.	Local to internat.	Traditi C Emerg. C.	Bharali, G. (2011)
Fish populations	CPR-Units Local to global	P,R,S	Recent danger of overuse: collapse of fish populations. Regulating effects in the food nets.	Local to global	Local to global	Global C. Emerg. C Trad. C.	Bharali, G. (2011)
Fresh water; Surface/ Groundwater basins	CG to CPR-Sys. Local to supra-reg.	P,R,S	one of the most fundamental Goods for human plant and animal life, increasingly scarce.	Local to supra-reg.	Local to national	Tradit. C/ Emerg C/ Global C	Ostrom, E. (1990) Bharali, G. (2011) Commons Abundance Network (CAN)
Drinking water	CG Local	P,R	one of the most fundamental Goods for human life, increasingly scarce.	Local to supra-reg.	Local to national	Tradit. C/ Emerg C/	De Moor, T. (2011)
Irrigation systems	CG to CPR-System, local to supra regional	S,P,C	Continuous management required. Nepal irrigation system large – scale case-studies	Local to supra-reg.	Local to national	Tradit C.	Ostrom, E. (1996), (2009)

Common Pool Resource	Type and Scale of Common Resource	Services	Description of Use or Service	Scale of Use	Scale of Commoning	Type of Commons	Ref.
Brackish Water	CG, Local to regional	S,P	Fresh Water merged with salt water from oceans in coastal areas. Ecosystem functions.	Local	Local to regional	Trad. C.	CAN
Estuarine Water	CG, Local to regional	S,P	Ecosystem	Local to regional	Local to national	Trad. C. Emerg. C.	CAN
Mangroves' coasts	CG-CPR, Local to supra-regional	P,C,S,R	Ecosystems of high importance in cost protection and for biodiversity	Local	Local to national	Trad. C. Emerg. C. Global C.	Beitl, C. (2014)
ICE (glaciers, permafrost, ice caps)	CPR, Local to supra-regional	S,R,P	receding due to global warming, monitoring taking place	Local to supra-regional	Local to global	Global C. *Emerg. C.*	CAN
Air and Atmosphere							
Clean Air	CG, local	P,S	Sink for industrial gases and provisioner of oxygen	local	Regional to national	Trad. C. Emerg C.	De Moor, T. (2011)
Air quality (Filter)	EF, global	R,S,P	e.g., local installation of clean-air zones in German cities	Local to global	Regional to national	Global C. Emerging. C	Berge, E.; Carlsson, L. (2003)
Climate system	EF, global	R,S,P	Provides conditions for agriculture. Global Warming brings multiple effects on inter-related natural systems.	Local to global	local to global	Global C. Emerg. C.	De Moor, T. (2011), Hess (2008)
Ozone layer	CPR, global	R,S,P	Protects earth from UV. depleting effect of specific gases.	global	global	Global C. Emerg. C.	Fleischman et al. (2013)
Outer space	galactic	C,S	Discourse on deposition of, e.g., nuclear waste or leave defect satellites in space	global	global	Global C. Emerging C.	Hess, C. (2008)
Land and Landscapes							
Cultural landscape	CPR-System Local to national	C,P, R, S	World cultural heritage sites, Tourism. Traditional land- use systems are partially central to local ecosystem sevices, e.g., ground water recovery below heath land	Local to international	Local to national	Tradit. C. Emerg. C. Global C.	Hess, C. (2008)
Water run-off	EF, local	R, C	Regulation, e.g., by horizontal orientation of plantation rows, hedges or channels is of importance In agriculture for preservation of fertile soils in areas of high rainfalls	Local to regional	Local to regional	Trad. C	Berge, E.; Carlsson, L. (2003)
Coasts	CPR-System supra-regional to supranat.	R,P,C,S	Coastal Protection Against Storms, Fishing grounds and regions of high biodiversity, Tourism	Local to internat.	Local to internat.	Trad. C Emerg C. Global C	Berge, E.; Carlsson, L. (2003)
Waste Land	CPR-System	P,R,S,C	Land not usable or not used for cultivation, e.g., stony mountain-slopes. Habitat to wildlife, shrubs, herbs and other goods. Important role in local ecosystems.	Local	Local	Trad. C (Decrease) Global C.	Bharali, G. (2011)
Agricultural Land	CG local	P,R,S,C	Where industrial agriculture is introduced, rural commons change dramatically. Service of soil fertility is essential for humanity's food supply (cf. also FAO publications, Via campesina)	Local to international	Local to international	Trad. C (Decrease) Emerging Global C.	Bharali, G. (2011)
Grazing Areas, Maedows, Pastures	CG local	P,R,S,C	Where industrial agriculture is introduced, rural commons change dramatically. Can supply soil with new nutrients.	Local	Local to national	Trad. C (Decrease) Global C.	Bharali, G. (2011)
Grassland	CG local	P,R,S,C	Where industrial agriculture is introduced, rural commons change dramatically.	Local	Local to national	Trad. C (Decrease) Global C.	Bharali, G. (2011)

Common Pool Resource	Type and Scale of Common Resource	Services	Description of Use or Service	Scale of Use	Scale of Commoning	Type of Commons	Ref.
Forest	CG local	P,R,S,C	Common Property Forest Regime in Slovakia, Forest Management in Madagascar. Local Distribution of goods, global R and S services	Local. to global.	Local to national	Trad. C Global C.	Kluvánková-Oravská, Tatiana (2011); Raik, Daniela (2007)
Urban (residential and commercial) land	CG local to regional	P,C	Economical sphere, marketplaces, Reclaim the streets movement → Public space	local to national	Local to national	Emerg. C.	Commons Abundance Network (CAN)
Landscape as integrated land-use	CPR system local to regional	P,C,R,C	Multiple ecological services and cultural/ agricultural uses	local to national	Local to national	Emerg. C. Global C.	Commons Abundance Network (CAN)
Land used for industrial manufacturing and energy generation	CG local to regional	P,S	(Renewable) energy and manufactured goods from one piece of land are interlinked with the national surrounding by goods' distribution	local to national	Local to national	Emerg. C.	Commons Abundance Network (CAN)
Land for nature preservation Protected Areas	CPR system, local to super-regional	P,R,S,C	Ecosystem, local use, Tourism.	Local to international	Local to international	Tradit- C Emerg. C. Global	Commons Abundance Network (CAN), De Moor, T. (2011)
Antarctica and the Arctic	supra-regional	P,R,S,C	Massive reserves of minerals are assumed below the ice of antarctic. Glaciers play a role in world climate system.	Internat.	National to Global	Emerg C. Global C.	Hess, C. (2008)
Terrestrial Biomes -Tundra: ant/arctic -Taiga -temperate forests -Subtrop. deserts and oasis -Tropical forests and savanna -Evergreen rain-forest	CPR Systems supranational	P,R,S,C	Bio-formational zones of specific climate and vegetation. Slow zonal shift of warm climates towards zones of cooler climates brings challenges for animal and plant species of low migration potential. Monitoring taking place, e.g., formation of deserts.	supranational	National to Global	Global C. Emerg. C	Commons Abundance Network (CAN)
Raw Materials: Abiotic							
Fertile soils	CG as R-units/CPR Local to global	S,P, C, R	As Food Security is a Global Good, so are fertile soils, especially with decreasing stocks of mineral fertilizer, especially phosphate.	Local to global	Local to global	Tradit. C. Emerg. C. Global C.	Hess, C. (2008)
Mining for ores	CG/CPR Local to local to regional	P,C / S,R	Mining under participative process in Mali. Inverted R and S services in the absence of environmental impacts on ecosystems on top of ore deposits due to mining activities that did not take place yet (cf. Yasuni Initiative)	Local to international	Local to international	Emerg. C. Global C.	Keita, A. et al (2008) Alcosta, A. (2012)
Rare earth	CG/CPR local to regional	P,C / S,R	Mining for rare earth inflicts severe ecological and social problems in mining areas.	Local to international	Local to international	Emerg. C. Global C.	CAN

Common Pool Resource	Type and Scale of Common Resource	Services	Description of Use or Service	Scale of Use	Scale of Commoning	Type of Commons	Ref.
Gems	CG/CPR local to regional	P,C/ S,R	Mining for rare earth inflicts severe ecological and social problems in mining areas. Problematic of "blood diamonts"	Local to international	Local to international	Emerg. C. Global	CAN
Oil	CG/CPR local to super-regional	P,C / R,S	Goods Extraction and distribution mostly handled by companies. Inverted R and S services as absence of environmental impacts on ecosystems over oil deposits not yet extracted (cf. Yasuni Initiative)	Local to international	Local to international	Emerg. C. Global C.	Berge, E.; Carlsson, L. (2003); CAN
Coal	CG/CPR local to super-regional	P,C/ R,S	Extraction and distribution mostly handled by companies. Market good. inverted R and S services in the absence of environmental impacts on ecosystems on top of ore deposits due to mining activities that did not take place yet (cf. Yasuni Initiative)	Local to international	Local to international	Emerg. C. Global C.	Berge, E.; Carlsson, L. (2003)
Peat	CG/CPR local to regional	P,R,S,C	market good and local common good, regulative ecosystem functions	Local to international	Local to international	Emerg. C. Trad. C	Berge, E.; Carlsson, L. (2003)
Clay	CG/CPR. local to super-regional	P,R,S,C	market good and local common good, regulative ecosystem functions	Local to international	Local to national	Emerg. C. Trad. C	Berge, E.; Carlsson, L. (2003)
Sand	CG/CPR local to super-regional	P,R,S,C	Different sands are used large-scale in economy for construction and fracking. Rapid increase in demand from 2010 to 2015. building of groundwater.	Local to international	Local to national	Emerg. C. Global C.	Berge, E.; Carlsson, L. (2003)
Gravel	CG/CPR local to regional	P, R	market good and local common good. Function in ecosystems.	Local to international	Local to national	Emerg. C.	Berge, E.; Carlsson, L. (2003)
Stones	CG/CPR local to regional	P, R	market good and local common good	Local to international	Local to national	Emerg. C. Trad.	Berge, E.; Carlsson, L. (2003)
Nutrients (F,S,P..)	CG/CPR local to regional	P,S,C,R	Phosphate rock is a scarce good of high importance for industrial agriculture	Local to international	Local to national	Emerg. C. Global C,	Cordell, D. et al. 2009
N, P, Co2 sink	SE local to global	P,R,S	All Soils can be sinks for nutrients from rain or fertilizer in the process of saltification, which correlates with a loss in fertility.	Local to global	Local to global	Emerg. C. Global C	Berge, E.; Carlsson, L. (2003)
land used for waste disposal	SE local to regional	P,R,S	Waste exports into less-regulated countries are common economical habit. Humanity's waste is humanity's' inheritance.	Local to global	Local to global	Emerg. C. Global C	Berge, E.; Carlsson, L. (2003); CAN
Raw Materials: Biotic (Food etc.)							
Wild Vegetables	CG, Local to surpra-national	P,C	All that can be harvested in the forests, along footwalks and pastures	Local to national	Local to national	Trad. C.	Bharali, G. (2011)
Wild Fruits	CG, Local to surpra-national	P,C	All that can be harvested in the forests, along footwalks and pastures	Local to national	Local to national	Trad. C.	Bharali, G. (2011), Berge, E.; Carlsson, L. (2003)
Berries	CG, Local to surpra-national	P,C	All that can be harvested in the forests, along footwalks and pastures	Local to national	Local to national	Trad. C.	Bharali, G. (2011)
Herbs	CG, Local to surpra-national	P,C	All that can be collected in the forests, along footwalks and pastures	Local to international	Local to global	Trad. C.	Berge, E.; Carlsson, L. (2003)

Common Pool Resource	Type and Scale of Common Resource	Services	Description of Use or Service	Scale of Use	Scale of Commoning	Type of Commons	Ref.
Resin	CG, Local to surpra-national	P,C	All that can be collected in the forests, along footwalks and pastures	Local to national	Local	Trad. C.	Berge, E.; Carlsson, L. (2003)
Fungi	CG, Local to surpra-national	S,P,C	All that can be collected in the forests, along footwalks and pastures. Play a role in nutrient cycling.	Local to national	Local to regional	Trad. C.	Berge, E.; Carlsson, L. (2003)
Dead Wood	CG, Local	P, R	All that can be collected in the forests, along footwalks and pastures	Local	Local	Trad. C.	Berge, E.; Carlsson, L. (2003)
Timber	CG, Local	P, C	All that can be collected in the forests, along footwalks and pastures	Local	Local	Trad. C.	Berge, E.; Carlsson, L. (2003)
Shrubs	CG, Local	R,P,C	All that can be harvested in the forests as fodder for cattle	Local	Local	Trad. C.	Berge, E.; Carlsson, L. (2003)
Windfalls	CG, Local	R, P	All that can be collected in the forests	Local	Local	Trad. C.	Berge, E.; Carlsson, L. (2003)
Biodiversity							
Plants species	EF, local to global	R,S,P,C	Genetic diversity, resilience.	local to global	local to global	Tradit. C. Emerg. C Global C.	Commons Abundance Network (CAN)
Wild animals, game	CG, local to supra-national	R,S,P,C	Genetic diversity, resilience, interrelated food webs, Endangered by loss of regional ecosystems and mono-cultures	local to global	local to global	Tradit. C. Emerg. C. Global C	Commons Abundance Network (CAN)
Domesticated animals	EF, local to global	R,S,P,C	Genetic diversity, resilience, multiple cultural and providing services to and co-evolution with humans. Endangered by standardized markets	local to global	local to global	Tradit. C. Emerg. C Global C.	Commons Abundance Network (CAN)
Crop species	EF, local to global	R,S,P,C	Genetic diversity, resilience multiple cultural and providing services to and co-evolution with humans. Endangered by standardized markets	local to global	local to global	Tradit. C. Emerg. C Global C.	Commons Abundance Network (CAN)
Ecosystem Services	EF, local to global	P,C,R,S	Are to be found in all Ecosystems in resource interrelations	local to global	local to global	Tradit. C. Emerg. C Global C.	Berge, E.; Carlsson, L. (2003)
Genes	EF, local to global	R,P,S,C	Genetic diversity, resilience, is at the core of a healthy reproduction of species	local to global	local to global	Tradit. C. Emerg. C Global C.	Berge, E.; Carlsson, L. (2003); Hess, C. (2008)
Species richness	EF, local to global	R,P,S,C	Basic supporting element of all ecosystem services	local to global	local to global	Tradit. C. Emerg. C Global C.	Berge, E.; Carlsson, L. (2003), (Millennium Assessment 2005)
Plant seeds	EF, local to global	R,P,S,C	Genetic diversity, resilience	local to global	local to global	Tradit. C. Emerg. C Global C.	Müller, C. in Helfrich, S. (2012)
Pollination	EF, Local to global	P,R,S,	by Wind, Insects, Birds, Weeds. Endangered due to increase of pesticides	Local to supra-regional	Local to global	Emerg. C. Global Commons	Berge, E.; Carlsson, L. (2003)
Energy							

Common Pool Resource	Type and Scale of Common Resource	Services	Description of Use or Service	Scale of Use	Scale of Commoning	Type of Commons	Ref.
Sunlight	EF, local to global	R,S,P,C	Generation of energy via solar panels, also regulates and supports plant-growth, health. Free accessible. Not endangered and only limited in time by seasons and weather.	Local to supra national	can only be harvested; locally to globally	Global C., but no actual need for commoning	Moor, Tine de (2011)
Wind energy	EF, local to global	R,P,S,C	used for sailing, generates of wind power. can only be harvested locally	Local to international	Local to global	Global C., but no actual need for commoning	Commons Abundance Network (CAN)
Water energy	EF, local to global	R,P,S,C	Hydroelectric energy from rivers, tides, ocean currents (ocean thermal energy conversion…). Harvesting requires technical installations, e.g., in case of dam lakes, that affect other services. of also across borders. Not only used for generation of energy, also a means of seed transportation.	Local to international	Local to international	Global C.	Commons Abundance Network (CAN) Lee, Zhu (1995)
Geothermal energy	EF, local to global	P,R,S,C	Long Transportation is inefficient, therefore only local. Not only used for generation of energy, also supplies regions with emerging warmth as, e.g., on Island.	Local to regional	Local to international	Global C.	Commons Abundance Network (CAN)
Energy from burning wood	EF, local to global	P,C	Long Transportation is inefficient, therefore only local.	Local to regional	Local to regional	Tradit. C	Commons Abundance Network (CAN)
Energy from organic waste	EF, local to global	P	Biogas. Regional due to long ways of transportation	Local to regional	Local to regional	Tradit. C	Commons Abundance Network (CAN)
Energy from oils	EF, local to global	P	One of the main sources of energy, and of climate change.	Local to global	Local to global	Emerg. C.	Commons Abundance Network (CAN)
Animal power	EF, local to global	C,P,S	Horse, Cow, Donkey, Camel, etc.	Local	Local	Tradit. C	Commons Abundance Network (CAN)
Human power	EF, local to global	C,P,S		Local	Local	Tradit. C	Commons Abundance Network (CAN)

c) Table Evaluation

Table 12: quantitative appearance of type of resource and type of commons

Common Pool Resource	Type and scale of Common Resource	Type of Commons
Grouped into -water -Air -Soil/Earth -Land	*-Common Good(CG) -Common Pool Res. (CPR) -Ecosystem-function (EF) (multiple criteria possible)*	*-Global C. -Emerg. C. -Trad. C. (multiple criteria possible)*
CG	*41*	
CPR	*40*	
EF	*24*	

Common Pool Resource	Type and scale of Common Resource	Type of Commons	
Glob C		*38*	
Emerg C		*37*	
Tradit C		*45*	*Absolute*
n			*78*

While completing the table, some characteristics showed themselves.

One is, that the term Global Commons is, much broader than expected, applied on resources that are highly endangered of overuse (the oceans' fish-populations), enclosure (plant seeds) or drastic change, as currently proposed on coral banks or climate system. A range of Resources was listed with four services; they are probably taking in a central role in human livelihoods and likewise good governance appears here more important than elsewhere. Those services with a range of commoning from local to global level show, the are, to some degree established as commons, whatever th management principles may be. These two groups shall be given a deeper look: those with four services and those with high embeddedness from local to global scale of commoning.

Can all natural resources be governed as common goods?

The following hypothesis has been posed in the beginning:

> *All existing natural resources can be governed as common goods. In how far that can be achieved depends on the degree to which resource governance is oriented on preservation of the common inheritance (cf. Helfrich 2014, adapted to question).*

Natural resources categories have been defined as

> *means for human actions and basis of human livelihoods provided by nature; namely the large-scale resource pools Water, Air, Soil/Land and Biodiversity, and the Raw Materials sub-categorised in Biotic and Abiotic Materials, with Fossil Fuels, Ores, Industrial Minerals and Construction Material as Abiotic and Material Use, Food/Feedstuff and Fuel as Biotic Material (cf. ProGress 2012). All ecosystem functions of earth and solar system usable by humans or funding human well-being (chapter 2).*

Table 15 lists the identified natural Common Goods and CPR along these natural resources, so that the hypothesis can be tested..

Table 13: Evaluation of named CPR/ CG Identified by Flowchart

Natural Resource	*Listed as Common Pool Resource/ Common Good*	*Type of Commons*	*References*
Large-Scale Resource Pools and Components			
Water	Oceans; Rivers, steams, lakes; Ocean floor plus its geomorphology; Deep seas; Ocean waste disposal; Marine	**6 Glob/Em/ Trad** 1 Glob/ Trad 5 Glob/ Em 3 Em. / Trad.	Berge, E.; Beitl, C. (2014); Berge, E.; Carlsson, L. (2003); Bharali, G. (2011); Commons

	transportation; Wetlands, Watersheds; Coral banks; Fisheries; Fish populations; Fresh water; Surface/ Groundwater basins; Drinking water; Irrigation systems; Brackish Water; Estuarine Water; Mangroves; ICE (glaciers, permafrost, ice caps)	3 Traditional --- 18	Abundance Network (CAN); De Moor, T. (2011); Fleischman et al. (2013); Hess (2008); Lee, Z. (1995); Ostrom, E. (1990, 1996); Khajuria, A.; Yoshikawa, S.; Kanae, S. (2014)
Air	Clean Air; Air quality (Filter); Climate system; Ozone layer ; Outer space	**4 Global/ Em.** 1 Em. / Trad. --- 5	Berge, E.; Beitl, C. (2014); Carlsson, L. (2003), De Moor, T. (2011); Fleischman et al. (2013); Hess (2008)
Soil/Land	Cultural landscape; Water run-off; Coasts; Waste Land; Agricultural Land; Grazing Areas, Meadow, Pasture; Grassland; Forest; Urban (residential and commercial) land; Landscape as integrated land-use; Land used for industrial manufacturing and energy generation; Land for nature preservation; Protected Areas; Antarctica and the Arctic; Terrestrial Biomes (-Tundra: ant/arctic, Taiga, temperate forests,Subtrop. deserts and oasis, Tropical forests and savanna, Evergreen rain-forest)	1 Global **5 Glob/Em/ Trad.** 3 Glob/ Trad. 1 Glob/ Em. 4 Em. / Trad. 2 Emerging ---- 16	Bharali, G. (2011); Berge, E.; Carlsson, L. (2003); Commons Abundance Network (CAN); De Moor, T. (2011); Hess (2008); Kluvánková-Oravská, Tatiana (2011); Raik, Daniela (2007)
Raw Materials			
Abiotic			
Fossil Fuels	*Oil, Coal*	**6 Glob./ Em./ Trad** 2 Glob./ Em. 3 Em./Trad. 2 Em.	Berge, E.; Carlsson, L. (2003); Commons Abundance Network (CAN)
Ores	*rare earth, Ores*	---- **13**	Commons Abundance Network (CAN)
Industrial Minerals	*Ores*		*Keita, A. et al (2008)*
Construction Material	Peat, Clay, Sand, Gravel, Stones		Berge, E.; Carlsson, L. (2003)
Biotic			
Material Use	Windfalls, Resin	**10 Traditional**	Berge, E.; Carlsson, L. (2003)
Food	Wild Vegetables, Wild Fruits and Berries, Shrubs,		Bharali, G. (2011); Berge, E.; Carlsson, L. (2003)

Feedstuff	Herbs, Fungi		
Fuel	Dead Wood, Timber, Windfalls		Berge, E.; Carlsson, L. (2003)
Ecosystem functions			
Biodiversity	Plants species; Wild animals, game; Domesticated animals; Crop species Ecosystem Services; Genes; Species richness; Plant seeds; Pollination	**8 Glob./ Em./ Trad** 1 Traditional --- 9	Berge, E.; Carlsson, L. (2003); Hess, C. (2008); Müller, C. in Helfrich, S. (2012); Commons Abundance Network (CAN)
Energy	Sunlight, Wind energy, Water energy, Geothermal energy, Energy from wood, Energy from organic waste, Energy from oils, Animal power, Human power	4 Global 1 Emerging 4 Traditional --- 9	Commons Abundance Network (CAN); De Moor, T. (2011); Lee, Z. (1995)
SUMM		5 Global 25 Glob/Em/Trad 3 Glob/Trad 13 Glob/Em 6 Emerging 9 Em./Trad. 18 Traditional _____ 78	

The only natural resource not listed in the researched literature as commons, but part of definition, is “natural gas”. “Industrial minerals” and “ores” are only named under the aspect of “mining” in specific papers, not in the general reviews by CAN, Hess or Berge/Carlsson. Not fitting firmly inside this sheet of natural resources are the Common Goods “Nutrients S, N, P”; and “gems”. Apart from that, all natural resources, as defined earlier, have been named as common goods or common pool resources in the researched literature. Where a common good is identified, there always is a, at least local, common pool it belongs to. In most cases of global commons (41), there is some kind of commoning described to be taking place, at least locally. The scale of emerging commoning reaches from local to global. Only in 4 cases, no commoning for resource preservation is noted (yet): these are natural energies of sun, wind, water and warmth of the earth.

All abiotic materials are here defined as extracted and used units of CG as well as CPR, that is as pools of the same resource before extraction. Regulating and supporting services in this cases lie in the absence of environmental impacts and the preservation of ecosystems on top of ore deposits due to mining activities that did not take place yet (e.g., Yasuni Initiative). They can be addressed as inverted R and S services. It is this aspect which identifies all pools of abiotic materials as global commons, despite the indirectness of R and S services.

In many forms of resource extraction, not only the resource itself looses its services; interrelated resource-systems (air, water, land, biodiversity) can be drastically affected, as is the case in, e. g., mining or construction of water basins for harvesting of water energy. Combined management approaches for interrelated resources are therefore inevitable for commons preservation from regional to global scale. Summarizing, all categories of natural resources are identified as common goods, as common inheritance of humankind. There is no obstacle in the process of defining and identifying that contradicts the hypothesis. It can be concluded, until proven different:

All existing natural resources, embedded and extracted, can, and are to be, governed as humanity's common goods. In how far that can be achieved depends on the degree to which resource governance is oriented on preservation of the natural common heritage of humankind.

Illustration 19 (own source 2015): Natural resources' of global significance under local commoning .

Summarising, all natural resources, extracted or embedded, are defined as humanity's common goods. They need to be governed and preserved locally in accordance with their global significance.

D) Definitions' Implications

It became clear, that traditional commons hold a strong potential for sustenance of natural

resources where they are operating on a level that still provides possibility for collective choice. The more complex the interrelations of resources and degree of representation are in governance of global commons, the more challenging it seems to be to establish ways of successful resource governing. A regional governance in accordance with international aims for preserving handling of humanity's CGs bridges from one to the other and, in combination, might indeed be able to preserve our planet's foundations of life. That is not achievable in a continued division between the space of the commons, and the market state, though that division is often stressed in traditional commons discourse, attempting to give the commons a visibility as entity of different functioning. To some extend that is more than valid, as the commons perspective on resources has the potential to turn resource use back on the feet – to the benefit of people living now and in future, away from orientation on an efficiency oriented on maximisation of economic benefit.

Answers are to be found in Institutions that represent and empower these local voices, as they can be essential drivers of a small scale change with the potential to reach on the flame for doing things just a little bit differently – in a commons way. These questions can not only be addressed alone or by top-down structures. They will only be possible to answer in the single case, concretely, again and again, by the people who it considers. And their answers are to be taken into account when we really want to set out on that pathway of a sustainable development of humanity's interactions with the common wealth of nature.

What the worlds' endangered resources need, is, therefore, a rethinking in the way we build and take part in institutions, as Ostrom stated 2009. Solutions can not lie beyond market and state alone, as the traditional commons say. As the world community confirmed its commitment to the "if" of a more sustainable way of interacting with resources, the current, and very challenging step is the "how". How we can govern our resources in a way that brings extractors, local people, distributors, and users closer together in the questions of "How do we want to govern our inherited resources, the *common wealth of humanity,* so that the next seven generations of children[10] can life?"

6. Discussion of Methodology and Findings

In critical evaluation, approach, methods and findings of the chapters 1. to 5. are reflected along the central steps of reviewing and analysing (chapter 2, 3), defining and combining (chapter 4) and identifying chapter (5) (6a). Further, need for further research that arose in the process is specified along the same structure (6b). Following the evaluation of the methodology and open questions, the validity of, especially, the definition of all natural resource pools as global

10 Refers to a saying that is to be found in many indigenous cultures, that it is the present generations gift and duty to preserve the inherited wealth of nature for the next seven generations (cf. Grandmotherscouncil.org:for the next seven generations).

commons is assessed (6c). Finally, after these critical questions have been answered, it is turned towards the relevance of this paper's findings and contributions to I. the international politics discourse on a sustainable use and governance of natural resources, and II. the commons discourse in general and the global commons discourse in particular (6d).

A) Methodology

Have the approach and applied methods proven adequate for the purpose of defining natural resources as common goods? Did they bring useful results? These questions shall be answered in the following. In doing so, the aim of this sub-chapter is not to paraphrase every small methodological step taken or every interim finding, but will rather focus on those steps where formulated aims were only reached after detours and the proceeding might have been more constructive or results better founded.

The approach was to, firstly, introduce perspectives on natural resources and, secondly, define a definition for further use (2); followed by perspectives on common goods and formulation of a common goods definition (3), so that these could be combined in the Millennium Assessment framework of ecosystem services and transferred into a tool, in form of a flowchart, for identification of common pool resources of global significance (4), which was finally applied in the construction of a table listing all natural resources that have been named as commons in a narrowed range of literature (5). To evaluate this proceeding, it is reflected step by step.

Methodology of Review and Discourse Analysis of Natural Resources (2) and Common Goods (3)

The perspectives on resources with backgrounds in classical economics, international resource policies, flows of goods and ecosystem assessment focussed on these economical-ecological perspectives. Social or cultural aspects were only considered as side-aspects or consequences of, e. g. , local extraction and global distribution by international companies. A more holistic perspective on resources was introduced with the Millennium Assessment framework of human well-being as depending on ecosystem services.

The approach on common goods was executed as a qualitative analysis of the contemporary commons discourse based on publications central to each, with the aim to combine and, where necessary, precise their understanding of common goods. In commons definition in chapters 3b and c, the comparing of cornerstones based strongly on categories addressed by De Moor and Ostrom and compared cornerstones expressions listed in reference to only a handful of authors. For a in-depth discourse analysis, a higher number of authors per background or a more careful selection of central publications would have been necessary. Scanning and analysing all uses of the terms “Common Good” and “Common Pool Resource” might provide a less subjective, more direct approach than the one followed in this paper.

The path towards the definition of common goods was illuminated only in the proceeding to a framework of commons terminology, over a long walk through variables derived from the differing commons perspectives' cornerstones. Methodical proceeding strayed from defining common goods towards, firstly, defining the perspectives' shared framework of commoning, and only secondly came to definition of common goods. This excursion into commons discourse analysis appears somewhat of-the-path from the main question and required a roughly twenty pages. However, as common goods are only one component out of three that define a commons, and these other two components in turn provide attributes to the common good, these differing backgrounds require consideration. In building the framework of commons terminology, several qualitative criteria were included, whose exact handling is impossible without quantified criteria. Therefore, the grading of the four exemplary cases in the framework was, necessarily, of limited accuracy and, instead, oriented on tendencies.

Methodology of Defining (4a) and Combining Natural Resources and Common Goods (4b)

What *was* said in natural resources' and common goods' perspectives is transformed into what *needs* to be said in a definition of common pool resources for strong sustainability. Where definitions remained on stage of displaying and combining in chapters 2 and 3, the transfer to a natural resources definition of common goods takes place here. The comparative tables, with Millennium Assessment ecosystem services or components of well- being in the left side column and common goods correlating properties on the right hand column provided an interesting inside in appealing similarities of these two concepts and deepened understanding for later definition and identification. It was only conducted exemplary, subsuming singular characteristics or examples of commons discourse, and might provide a more holistic and much deeper picture as a more detailed listing. At this step in the process of combining, however, a higher degree of abstraction was helpful for later specific definition of CPR. In the CPR- definition's transfer into a tool of identification (4b and c), the focus is on the distinguishing between embedded and extracted resources services' in commons of global significance. Aspects of global justice in access and distribution are named in the definition cornerstones, but not taken over into the flowcharts: as resource-human interrelation criteria and criteria of resource use were considered as consequences of the resource criteria. This simplification was a necessary step to reach later applicability of the identification flowcharts on natural resources in the frame given by the research question, focusing on resource and goods properties rather than on social aspects. However, for a holistic integration of the CPR definition as global commons, these neglected socio-cultural aspects of resource access and distribution are to be further illuminated in the relation with global human rights. Flowchart construction itself can be evaluated as excellent method that is, firstly, easily understandable and correctable, and, secondly, as a very handy tool for clarifying an identification process.

Methodology of Identifying (5)

In table 13 for Identification of natural resources as common goods, the columns of scale were introduced more due to the impression that they might further illuminate the interrelations between expanse of resource pool, scale of use and scale of commoning. However, they are no criteria in the identification process itself, were scale appears as a related aspect, yet not of central importance for identification of a resource based on the flowcharts, as this or that type of commons. A close correlation between global scale of use and global commons is very probable, even inherent in the global commons definition by the criterion “global significance”, but was not introduced as such, as table evaluation does not consider correlations between variables. It would require a coding in numbers and, e. g., calculation of specified variables' (scales of use – scales of commoning) correlation coefficients with the program “r”. In table 13, a separated column for global commons would increase visibility of this central characteristic, especially as global

commons do not indicate the intensity of commoning or it's degree of acceptance, as emerging and traditional commons do.

It proved difficult to specify specific resources' services, e. g., that of land use types, on a general scale based on comments in the references, as services, especially regulating and supporting, were rarely addressed. For deeper insights, an in-depth research on the resources services provided by land under different types of use would be required. Therefore, the categorising of natural resources services was, in this paper, more based on a common understanding of ecosystem functions in combination with the key drivers of change named by MA (2005:xvi) than on specific literature. Table 13 could be added more accuracy in listing the MA findings on use of specific ecosystem services, as is given, e. g., on the pages 53 ff. which was skipped as neither description of use nor threat. Finally, subsequent to the evaluation of identification table 13, the hypothesis could be reflected and no contradictions were found (5c).

Summarizing, the approach of reviewing and analysing both discourses, subsequently defining both terms and, in the next step, combining them, a tranfer into a tool for identification, and identifying itself coulod supply the findings aimed ad. However, a similar approach would most likely benefit from a more specific methodological procedure to strengthen objectivity in the qualitative analysises behind natural resources definition of common goods.

B) Risen Questions

Need for Further Research in Reviewing and analysing

In the concluding definition of natural resources properties'(2), the distinguishing between extracted and embedded (living) natural resources is derived from the ecological perspective on their services, as displayed in Millennium Assessment (Illustration 4). To what extend such a definition is applicable in cases of economical daily use of resources remains to be tested.

In comparing CG properties of tragedy, traditional and global commons (3b&c) the term “commoning” became visible as a central sociocultural process in the establishing of commons. In conclusion of 3b, the intensity of commoning was recognised as a gradient of two poles, which assisted in understanding the vice-versa perspectives on resources of tragedy or global commons on the side of low, or weak commoning and traditional commons on the side of high, or strong commoning. However, how the process of commoning can be defined more precisely, and by which management principles the commoning intensity in a commons can be estimated for better comparability and deeper understanding of resources' governance as common good remains in need of a in depth study. That need for a more in-depth work on commoning is also named by Silke Helfrich (Helfrich et al. 2014). Where exactly an emerging commons can be termed as a traditional commons or in how far a global commons can reach the intensity of

commoning associated with traditional, smaller scale commons remains open due to the, in this paper, only sketched definition of commoning.

In all cases of qualitative criteria on a gradient of two poles, such as questions of scale (local to global), of commoning (low to high intensity), or of accessibility or ecological constitution of a resource pool, more detailed indicators are required for comparative analysis. The CG and CPR are here depicted in resemblance to *resource unit* and *resource pool*. Both terms of CG and CPR have been and are depicted in the common goods framework on the upper right corner with high rivalry and low excludability. Yet, it seems to have become common to rather apply the term “CG” in small-scale settings with local regulation of goods' extraction, and “CPR” in larger scale resource settings. Further quantification of results in definition-building of common goods is needed to strengthen the derived qualitative findings .

Need for Further Research In Combining

All natural pools of resources could be identified as CG or CPR, but on identification of ecosystem functions, some questions remain open. Ecosystem functions beyond human reach, such as sunshine or wind energy, do not bear the criteria of substractability and depletability. Their resource functions can not be endangered by humankind as far as physical knowledge goes. However, it can not be denied that every human being has a right to benefit from sunshine. As the resource itself can not be depleted, other, human-related global commons properties still are valid. To keep people in underground buildings over long periods of the year against their will is thus not only an act of robbed freedom, but also a exclusion from what we can title the human right to sunshine. The question remaining here is, how can these non-depletable resources, that fit all other criteria of a common pool good of global significance and heritage of humankind be addressed as such in an adequate way, or, spoken differently, are the criteria valid for such cases – essential foundation of life on earth, uniqueness, common heritage of humankind and multiple groups of involved people – sufficient to define a second type of global commons CPR, which are not in need of preservation by common efforts, but rather to be recognised as human right to access?

This aspect leads to a related, but more philosophical question on the handling of the definition of CPRs of global significance. In implementation, what should be considered first, *preservation* of natural resources' services, or the satisfaction of basic human needs by granting access to resources as human rights? Neither can be forsaken without causing serious harm to either present or future generations of human beings, or, reaching out into another fundamental question, that of other species' needs and ecosystems' value in themselves. In responsible governance as global commons, an optimum point between both resource preservation and fair distribution of extracted goods is to be constantly adapted to situation of the resource and

peoples' needs. *How* in detail that can be done for complex interrelated resource-systems and fluctuating numbers of users is one of the central questions for future resource management.

The key result of this paper, the definition of natural resources that are to be governed as global commons, is a result of combined definitions of natural resources services' on the one hand side and commons' resource properties on the other hand side. As the global commons origin is, besides the commons discourse, in the human rights movement an by terminology closely related to global human rights, a next step is to show ways how this papers' definition of global commons resources can be more closely adapted to international human rights and thus find inclusion in international law discourses. These neglected socio-cultural aspects of resource access and distribution are to be further illuminated in the relation with global human rights.

- *Need for Further Research in Identifying*

In table 13 of chapter 5b, threats to the identified CG and CPR are listed, whereas their current conditions have not been researched for in detail, as the focus was on the identification based on the flow-charts, where level of CPR preservation is no criterion. Information of that kind is, however, of interest for a more detailed impression of the challenge that is implied by sustainable governance of the identified CPRs as global commons. Such information is available, e. g., in the MA (2005) on ecosystems and resource pools developments up to 2005 and future trends' prognoses.

c) Validity of Findings

With a view towards the evaluation of methodology, how valid is, especially, the definition of CPR as global commons?

Use of the terms commons, CG and CPR differ within the limited number of reviewed literature, differ even within one perspective (global, traditional, tragedy). Internationally, applied terms are of even higher diversity, e.g., the term common property resource used by Bharali (2011). Due to this diversity in discourse, this work does, and can, neither claim to give a balanced overview over all aspects concerning common goods' properties in the partially contradicting discourses on historical commons, national phenomena of traditional commons, and new natural commons as the global commons; nor a final definition of CG and CPR properties. Concluding, the validity of details, such as the exact terming of one aspect of common goods, is not to be seen as absolute due to diversity of commons discourse and limited examined set of literature. Yet, considerations about the resource properties of resource-human-interrelation and their global significance are as valid as they can be based on a qualitative analysis of a very limited amount of literature, that is, however, of central significance to the discourses understanding.

The informational value of the key finding, the definition of the resource properties, by which natural resources are identifiable as common inheritance of humanity, has shown to be high, considering the theoretical identification of resources in table 13. Yet, it is not indifferent to identify specific resource properties as well, which provide indications on challenges in the CGs governance as global commons.

D) Scientific Relevance

Which findings of relevance can this paper contribute to I. the international politics discourse on a sustainable use and governance of natural resources, and II. to the commons discourse?

I. As for the international commons' discourse, where resources properties are classically approached via economic goods or collective action theory, these paper provides a strengthening of CG and CPR properties' and services' understanding in commons from an ecosystem services' and natural resource properties' viewpoint. Furthermore, it draws a direct correlation from the clearly defined set of 11 CPR characteristics with GCs' and CPRs' global significance for humanity. The similar terms, CG, CPR and commons, are, in the discourse, applied for resources in commons that are to be governed due to their essential significance to humankind and life on earth and for resources in well-established commons. As their properties change in commons development from the first to the second, the analytic distinction of the term CGs use in calling for a resources' commoning and addressing a resource under commoning is made explicit. The careful handling of these terms can not be stressed enough, otherwise the commons discourse is endangered to loose significance in terms that can signify all and nothing. As a personal preference, the visualisation of frequently used, but complex terms in pictures is a possible way to address that challenge. Concluding, this papers' approach of in-depth analysis of natural CGs' position in commons of differing perspectives and definition of central terminology with orientation on global significance is new to the discourse. Here, this paper could begin to fill that gap and encourages further research.

II. As for the international politics' discourse on a sustainable governance of natural resources, the defined groups of natural resources have, in this paper, been considered as passive means, extracted or embedded in resource systems, which gain their value from the fact that they serve humanity in that they provide for, regulate and support our basic needs and livelihoods. In this perspective, the viewpoint of ecosystem services is introduced to resources, hereby directly addressing the ways in which they serve as means for human actions, even while embedded in a resource system. What is left aside in consideration until now is, that in western civilisations, natural resources provide for much more than basic human needs, and consequences are more than visible, e.g. in the drastic decrease of the earth's biodiversity. Thus, an imbalance is continuously created between what is taken from common resource pools and what is given for

their preservation. A widespread misconception is, that we can protect some specific resource pools and leave all others to exploitation, as though one could re-balance the other. To some extend that may work. But such routines of resource interactions are but a gradual change in global economies overall destructive consumption pattern. For the aim of a sustainable resource use, the challenge is to transform all resource use – and the way we consider resources. The term "resource", directed to a living tree as biotic biomass, is either to change in meaning or in use, so that it incorporates the value of living or embedded resources.

That is the contribution this paper provides to the discourse on sustainable resource use: All natural resources that regulate and support life on earth, and are embedded or inherent in resource pools or -systems, are defined as global CPR and thereby as common heritage of humankind. As table 13 showed, the definition is valid for all existing pools and units of natural resources, biotic and abiotic. By that, natural resources are attributed the values they provide before extraction. The attribution of human rights values to resources after extraction in definition of human rights CG, and as is included in Definition of natural resources as humanity's CGs, are, considering resources intense economic value, of similar importance.

7. Concluding: a Commons Perspective on Natural Resources

The papers approach and findings are assembled for a concluding overall impression.

This thesis is built as a basis for evaluating commons management concepts for work-package 6a of the IntRess project. In the face of continued exploitation of the earth's resources with measurable drastic consequences to all life on earth and humanity's well-being, it is analysed how and to which extend natural resources can be defined as humanity's common goods. Common goods are characterised by a shared use and bear both the gift of benefiting from a resource and the responsibility to take part in it's preservation. The commons perspective is examined in this intensity as it bears the potential to turn the current situation in resource use back on the feet: towards an efficient economy to serve people and nature due to an attitude resembling Ott and Dörings key principles of strong sustainability. In chapter 2, economical, international politics, and ecosystem services' perspectives on natural resources are introduced and Millennium Ecosystem Assessment's Illustration laid out as a valuable tool to bridge between resource- and common good definitions. Subsequently, an analysis of the common goods discourses perspectives of historical, tragic, traditional and global commons is conducted. Interrelations and shared principles are analysed and displayed in a framework of commons terminology (chapter 3). On that basis, in chapter 4, natural resources are defined broadly as

> *the means for human actions and basis of human livelihoods provided by nature; namely the large-scale resources pools water, air, soil/land. They are extended by all ecosystem*

> *functions of earth and solar system usable by humans or funding human well-being (biodiversity, energy) and the extracted raw materials sub-categorised in biotic and abiotic materials. Their value for humanity as living resource-pools embedded in ecosystems or as single resource units is given by provisioning, supporting, cultural and regulating ecosystem- or resource-services (MA 2005). While local resource extraction reduces services to the provisioning and takes place at local level, benefit from supporting and regulating services is of global significance.*

Subsequently, a commons is defined as

> *a system of resource governance consisting of I. a resource pool (CPR) defined expanse of containing resource units (CG); II. an identifiable community of users; and III. an identifiable process of commoning, where a shared aim in resource preservation and regulations for a sustainable use and governance of the CPR are discussed, adapted and installed. The terms CG and CPR are defined as resource unit and resource pool of one resource in a commons.*

All findings were combined into a valid definition of natural resources as humanity's common goods, indicating the need for adequate regulation and preservation by local to global commons management approaches. Consisting of 15 criteria in three groups, the cornerstones are:

> *Criteria of resources' natural characteristics (Essential foundation of life on earth, Immovable, Not substitutable/unique, Substractable, Scarce and depletable); Criteria of resource-human interaction (Common heritage of all humankind, System of nature – human interrelation, Benefaction from R and S services is human right, Common Responsibility to Preservation); and Criteria of use (Multiple groups of involved people, Free accessibility and use, Rivalry, Unjust distribution, Endangered by overuse, Lack of responsible governance/management).*

For simplification, CG/CPR of global significance are, in the following, termed as global CG/CPR, and extracted CG essential for satisfaction of human needs as Human Right CG. The definition of CG Cornerstones was in 5a transferred into variables and, after their discussion, further reduced for application as an instrument of identification in form of two flowchart.

> *When a considered natural resource I. displays at least regulating and supporting services and is of the systematic scale of resource pool or - system or ecosystem function, it is defined as a global CPR and is to be governed as heritage of humankind.*
>
> *When it II. bear at least a provisioning or cultural service (P, C), and is of the systematic scale of extracted resource unit, it is defined as a CG by human rights whose use is to be distributed fairly by governance as common heritage of humankind.*

In table 13, all defined natural resources are displayed in 6 criteria according to the flowcharts and examined for in the digital library of the commons. All defined natural resources were identified as either global CPR or CG per human right. Almost all were found in literature. Concluding from that, all natural resources, extracted or embedded, are defined as humanity's common goods. They need to be governed and preserved locally in accordance with their global significance. The question humanity now needs to ask itself is: “How do we want to govern our

inherited resources, the common wealth of humanity, so that the next seven generations of children[11] can life?"

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11 Refers to a saying that is to be found in many indigenous cultures, that it is the present generations gift and duty to preserve the inherited wealth of nature for the next seven generations (cf. Grandmotherscouncil.org:for the next seven generations).

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APPENDIX 1. GLOSSARY

Term	Description
Resources and Goods	
Resource	Natural resources are the material and immaterial foundation of human life, including *Water, Air, Soil/Land, Biodiversity and Raw Materials as well as their services.* Existing on multi-level scale with varying intensities of interdependent linkages. Therefore it is rewarding to consider resource systems (UNEP international resource panel 2005; Millennium Assessment 2005)
Raw material	biotic and abiotic materials; fossil fuels, ores, industrial minerals and construction material are abiotic; material use, food/feedstuff and fuel biotic raw material (ProGress 2012)
Classical economics goods	Ownership is the central property of classification, identified by degree of excludabilty and rivalry/subtractability: • private goods • club goods • common pool/open access goods • public goods (cf, Hardin 1968, *de Moor 2012)*
Club goods	subtype of public goods that are excludable but non-rivalrous. These goods exhibit high excludability but low rivalry in consumption, eg. toll roads.
Common pool goods / open access goods	Resemble public goods in that their excludability, the possibility to exclude people from the resource pool is low and thus, if not governed in any way, subject to the free-rider problem and overuse: the tragedy of goods cared for by no-one. Unlike public goods, common resources prohibit rivalry in consumption.
Public goods	Public goods are goods that are neither excludable nor rival in consumption. The free-rider problem is why public goods are often provided by the government.
Private goods	belong into private property such as a family's house and garden, a farmer's fields and forests, a company's buildings. They are characterised by high rivalry, as only one person or family can rightfully drive that car, aquired by buying it (high rivalry), and no one else has a rightful possibility of access – the key - to that good (high exludability).
Terminology of the commons in In Tradition of Elinor (Lin) Ostrom	
„Tragedy of the commons"- Tragedy of open access regime	Arises because individuals, by consuming a good with high rivalry in consumption, are imposing a cost on the overall system without community-based decision-making processes. The result is a situation where more of the good is consumed than is socially optimal. (cf. Garett Hardin 1968)
Commons	Consists of a resource(-system) and a community setting up and

	adjusting aims, rules and institutionalisations for the governance, so that institutions of collective action are the third more or less visible component of a commons. (cf. Elinor Ostrom 1990)
Commoning	the continuous socio-cultural process in a community of setting up and adjusting adequate aims, transparent rules and institutions of collective action for the long-time governance of a certain resource or good *ibid. (Helfrich et al. 2014)*
Common pool resource common good	a resource pool: a fish population a resource unit: a fish
Community of commoners	An identifiable community that is self- governing a good or resource by integrating every voice into the continuous process of setting up and adjusting aims, rules and institutionalisations (*Helfrich et al. 2014)*
Institutions of collective action	Institutions of collective action are those forms of users' interactions that enables them to safeguard the commoned resource over a longer period of time, closer defined as principles of successfull commoning. Principles for successful management of common goods were firstly set up 1990 by Elinor Ostrom and since then object of further developments (Helfrich et al 2014)
Global commons	e.g., air, ocean, climate, land...
Digital commons, new commons knowledge commons	e.g., internet, wikipedia, linux, open source
Properties of resources, goods and commons	
Classification of resources, goods and commons by form of governance	Not applicable for one resource or good in general as to all forests, all waterways, all metals, all crops, all houses. A resource in question is to be considered closer for a) services it provides b) forms of use, government and/or ownership
Forms of use, government and/or ownership	
Ownership of goods, resources and commons: Whom do they belong?	classical economics: ownership is the central property of classification. Commons: Ownership is no essential attribute.
Degree of excludability	Potential to exclude people/person from a certain good, is part of classical economics goods framework, cf. de Moor (2012)
Degree of subtractability/ rivalry	Refers to the degree to which one person consuming a particular unit of a good or service precludes others from consuming that same unit of a good or service. Is part of classical economics goods framework, cf. de Moor (2012)
Form and level of governance	Governance of a resource by governmental institutions, from local to global level (→ top down, (inter-)national politics and policies approach) Self-governance of a resource by a communities institutions, from

	local to global level (→ bottom up, commons definition by Ostrom)
Degree of participation	Participation in the meaning of the term itself implies a top-down government making decisions and inviting citizens concerned by the related topic to take a smaller or larger part in the process. P. can reach from a top-down decision making and providing information on the outcome to the public, over a number of increasingly participative forms, to a bottom-up decision making process in a community under consultation of a government's advisor (Arnstein 1969: "A Ladder of Citizen Participation")
Rules /Regulations on access and resource use	adequate and transparent regulation through commoning (commons definition by Ostrom) instead of more or less transparent top-down regulation (Helfrich et al. 2014)
Inter- and intra-generational justice of resource use: time-perspective and distribution	A resource as common good is permanently used and cared for by all members of the community. The value is distributed amongst everyone instead of being concentrated. (Helfrich et al. 2014)

STATUTORY DECLARATION

I herewith formally declare that I have written the submitted thesis independently. I did not use any outsider support except for quoted literature and other sources mentioned. I clearly marked and separately listed all employed sources. This thesis has not been submitted elsewhere.

Hiermit bestätige ich, Sarah Holzgreve, die vorliegende Arbeit eigenständig und unter Kennzeichnung aller wörtlich oder sinngemäß herangezogenen Quellen verfasst zu haben und hiermit erstmalig einzureichen.

Date: _____ *Signature:* _____