Crossing Sen's capability approach with Critical Natural Capital theory: toward a new perspective to reconcile human development and Nature conservation goals

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"Crossing Sen's capability approach with Critical Natural Capital theory: toward a new perspective to reconcile human development and Nature conservation goals"

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"*We can argue that all people—rich and poor; living in developing or developed countries—depend on ecosystem services for their well-being*" (UNEP, 2005, p10).

"On a very fundamental level, human development is what sustainability proponents want to sustain and without sustainability, human development is not true human development" (Neumayer, 2010, p1)

Abstract: More than 20 years after the Brundtland report, the human development debate is weakly present in Ecological Economics and the environmental debate is weakly present in discussions around Sen's capability approach. In this paper, we try to build a bridge between the two by crossing Sen's capability approach with the Critical Natural Capital (CNC) theory. fisrt we demonstrate How to make Sen capability approach more comprehensive to the environment. In a second part, we start from the side of the EE and CNC theory and try to show how Sen's capability approach could light the issue of the definition of what is critical and for whom . We assume that crossing Sen's capability approach and the CNC theory would provide integrated theoretical foundations to foster Sustainable Human Development Research.

Keywords: Sustainable development, Capability approach, Critical Natural Capital, Ecosystem services, Human development.

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Introduction

The literatures on Human Development (HD) and sustainable development, or sustainability have long been separate, (Neumayer, 2010). However, some scholars from both Ecological Economics (EE) (e.g., Dodds, 1997; Lethonen, 2004; Sneddon, 2005), and HD (Neumayer, 2010) have put forward the opportunities that a marriage between the capability approach and the one based on ecosystem functions and services could provide for analysing the environmental–social interface. On the one hand, there is the Sen's Capability Approach (CA) which, according to Dodds, (1997) provides the most comprehensive and convincing philosophical account of the nature of human well-being yet encountered. But, "*if there is one noticeable gap in Sen's analysis, it is the lack of concern with the environment and ecological changes*" (Sneddon et al., 2005, p 262*).* On the other hand the Critical Natural Capital theory, stemmed from EE[2], provides the most consistent theoretical foundations of sustainability through the "strong" perspective. If EE is defined as the approach treating the human economy both as a social system and as one imbedded in the biophysical limits (Martinez-allier, 2001), is still largely using limited tools inherited from neo classical economics (Gowdy and Erickson, 2005), notably for well being concerns (Dodds, 1997). Therefore, there are some reciprocities to establish by crossing Sen's CA with CNC theory. We first demonstrate how to make Sen's CA more comprehensive to the environment. In a second part, we start from the side of EE and the CNC theory and try to show how Sen's CA could light the issue of the definition of "what" is critical an for "whom". We conclude that crossing Sen's capability approach and the CNC theory provides integrated theoretical foundations to foster Sustainable Human Development Research.

I. How to make Sen's capability approach more comprehensive to the ecological dimension

a) The Sen's capability approach (CA) and Human Development (HD)

"Usually, the progress of societies is measured mainly by the Gross Domestic Product (GDP) per capita and the growth of the economy– not by improvements in people's well-being" (Alkire, 2010, p38). In order to shift from the reductionist neoclassical assessment frame of well-being, Sen has proposed the "capability approach" which is based on freedom. From this point of view, development can be seen as "*a process of expending the real freedom that people enjoy*" (Sen, 1999, p3). Sen can be considered as the godfather (Neumayer, 2010) of human development which is defined as "the expansion of people's freedoms to live their lives as they choose (UNDP, 2009, p 14)[3]. In the Sen's capability approach the expansion of freedom is viewed both as the principal "end" and the principal "means" of development (Sen, 1999a preface XII). Sen's approach is based on positive freedom i.e. freedom of choice. On the contrary negative freedom might lead to consider a person free whereas his/her range of choice is restricted. Positive freedom enables to make the difference between a man who has chosen to do not eat (e.g. starvation by choice for political claims) and a man who does not eat because he has no food and hence does not have the choice to eat (e.g. man suffering from famine). Thus, the capability concept is operated through a notion of freedom which enables to encompass both of potential and achieved choices (Reboud, 2008). So, capabilities reflect a person's real opportunities or positive freedom of choice between possible life-styles

[2] see N° 44 of ecological economics, 2003,
[3] In Alkire, 2010

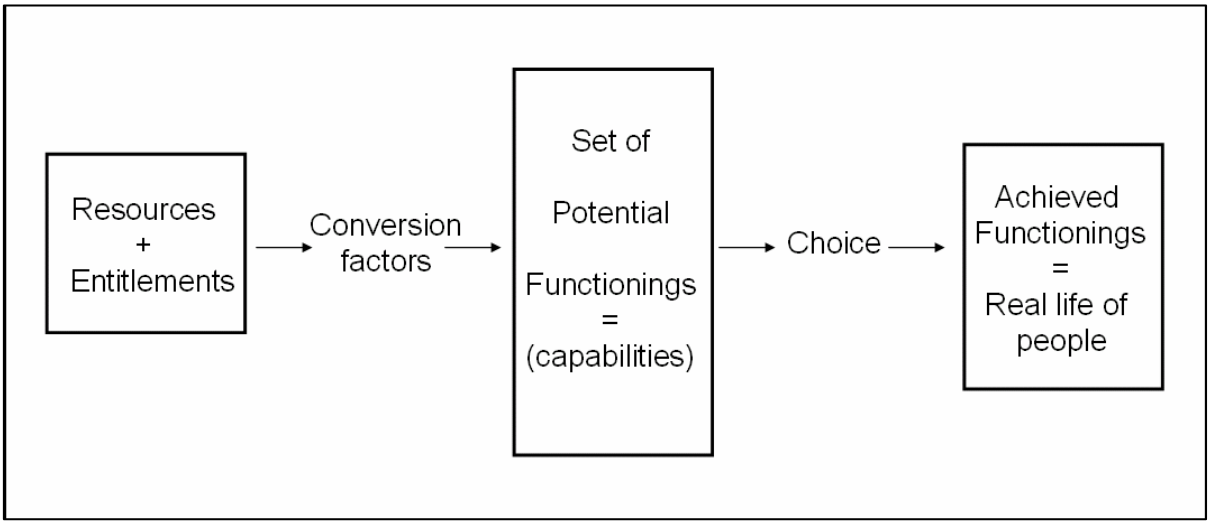
(Sen, 1992, 1999). Capabilities are the various functionings bundles a person can choose from to achieve the life that she/he has reason to value (Sen, 1992). Functionings are the actual achievements of a person, i.e. "*what a person is succeeding in doing or being*" (Sen, 1987, p19). They can be either potential or achieved.
Functionings have three characteristics:

- Functionings are **being and doing**: They can be elementary, such as nutrition, health, life expectancy, or more complex such as "taking part in the life of the community and having self-respect" (Sen, 1999, p75).
- Capabilities and functionings are beings and doings **that people value.** Functionings must be valued by those who achieve them. This means that development cannot be imposed without regard to people's values and preferences. Ultimately, if people do not value an outcome, then human development has not occurred (Alkire, 2010).
- **Capabilities and functionings are beings and doings people have reason to value.** HD does not advance everything that people value, it does not specify who decides what people 'have reason to value' in each context. But it does create the space to discuss this issue, to question and dialogue (Alkire, 2010).

However, Sen observes that different people and societies typically differ in their capacity to convert capabilities into functionings. People capacity to convert (conversion rate) is relying on personal (physical characteristics…), social (institutions, customs, public goods, entitlements…) and environmental (climate…) factors (see Development as freedom p71 for more details)

The capabilities set give information about the vectors of functionings reachable by a given person and this information is important whatever the definition of the social well-being. Functionings are related to well-being achievement and capability is related to the freedom of choice to achieve well-being. In this view acting freely and being able to choose are directly conductive to well-being (Sen, 1992).

Figure 1: Scheme of Sen's Capability Approach (adapted from Robeyns 2005; Bouvin and Farvaque, 2008)



For Sen, well being is not only a matter of goods but of what a person is free to do or be. Figure 1 illustrates the logical reasoning chain of Sen's CA. People have some resources (variety of goods: shoes, clothes, bicycle…) and they are entitled to these resources

("entitlements" they have rights to these resources, the right to use them). But, for Sen it is not sufficient to have functionings (e.g. riding bicycle, be well nourished…). He observes that to translate resources into capabilities it is important to take into account the person both internal and external characteristics. For example, a person who values mobility needs: some resources (a bike), the right to ride it (entitlement), to know how to ride the bike and to be in good physical condition (internal conversion factors). She also needs a road or usable pathways (external conversion factors). Only if the functioning could be achievable (potential functionning) it will be considered as a capability. All the potential functionings a person could achieve, constitutes his/her set of capabilities. Among this set, the person will choose some of them and achieve the ones he/she values. Thus poverty is defined as a lack of choice, when achieved functionings are equal to potential functionings. The set of achieved functionings represents the real life of a person.

b) The lack of ecological sustainability concerns in Sen's approach and in the Human Development

"*If there is one noticeable gap in Sen's analysis, it is a lack of concern with the environment and ecological changes*" (Sneddon et al*., 2005, p262).*
According to Flippo (2005), in his approach, Sen conceives the nature in the same way as neoclassical economics does i.e. passive, inert, stable, guaranteed. Hence, in the Sen's perspective, Human beings are the only means of freedom expansion or restriction. Therefore, freedom expansion is only blocked by a lack of ingeniousness or cooperation of Human beings. The absence of an ecological concern in the Sen's approach does not enable to assess well-being in a fully sustainable way. Neumayer (2010) in a recent research report of UNDP confirms that Sen is somewhat ambiguous about sustainability in his writings. It is just very recently (Alkire and Neumayer june of 2010) that scholars of HD are interesting in sustainability and for the first time a definition of the aim of HD includes "very lightly" the ecological dimension defining it as "the *expansion of people's freedoms – the worthwhile capabilities people value – and to empower people to engage actively in development processes, **on a shared planet***" (Alkire 2010, p40). It is precised, under the above cited definition, that "*People are both the beneficiaries and the agents of long term, equitable human development, both as individuals and as groups. Hence Human Development is development by the people of the people and for the people*." The first phrase could be very useful, as we will see in part II, for Critical Natural Capital theory improvement, but the second sentence corroborate Flipo's above statement (in thought of HD scholars people are the only means of capabilities). To our mind it would be necessary in order to make HD sustainable to precise "HD is development by the people of the people and for the people with and within Nature which, as the next paragraph will show, provides ecological foundations for many capabilities.

c) Introducing strong sustainability and CNC related concepts to make Sen's approach more consistent with the idea of sustainability

"It is interesting to note the resemblance of Sen's approach with the function-based approach used by some ecological economists to define what is often called critical natural capital. A marriage between the capability approach and the one based on environmental functions might hence provide ideas for analysing the environmental–social interface". (Lethonen, 2004, p204)

In a neo-classical economic approach, the sustainability debate is reduced to a mere question of substitutability between natural and man-made capitals; there is no concern for the complex interplay between economic, socio-cultural and ecological systems (Chiesura and De Groot, 2003). On the contrary EE defends strong sustainability approach, which derives from a different perception that substitutability of manufactured for natural capital is seriously limited by such environmental characteristics as irreversibility, uncertainty and the existence of 'critical' components of natural capital, which make a unique contribution to welfare (EKINS et al, 2003). In this view, Natural Capital (NC) is s more as complementary to man made capital rather than substitutable (EKINS et al, 2003).

This assumption lead to the concept of Critical Natural Capital (CNC) but, first it is necessary to remind and precise what EE understand by NC.

Natural capital is a metaphor to indicate the importance of elements of nature (e.g. minerals, ecosystems and ecosystem processes) to human society. CN has to be understood not as a simple stock of natural resources but as a set of complex systems compounded of biotic and abiotic evolving elements of which interactions determine the ecosystems' capacity to provide directly or/and indirectly a wide array[4] of services to human society (from raw materials to amenities etc.) (adapted from Faucheux and O'Connor, 2000 ; Ekins et al 2003 ; Chiesura and De Groot, 2003 ; De Groot et al, 2003 ; Brand, 2009)

Critical Natural Capital is in fact considered as a subset of Natural Capital which, at a prescribed geographical scale performs essential ecosystem services to present and future well being, for which no substitute in terms of other type of capital currently exist and the loss of which would be irreversible (entailing very large costs)[5] provoking socio-ecological crisis. (adapted from Dodds, 1997; Noel and O'Connor, 1998; Ekins, 2003; Ekins et al 2003; Chiesura and De Groot, 2003 ; De Groot et al, 2003 ; Levrel, 2006; Brand 2009). According to Ekins (2003), it is not possible to identify CNC as particular elements of natural capital due to the complexity of the former. CNC has to be identified through critical ES it provides.

Such critical services (or functions depends on author)[6]range from the very sustenance of basic biophysical conditions (supporting, regulation, provisioning services or source, production functions) to the provision of opportunities to recreate, learn and experience 'higher' feelings (Cultural services or information and scenery functions) (see for more details eg. Noel and O'Connor, 1998; De Groot, 1992; De Groot et al 2002 and 2006; Douguet and O'Connor, 2003; Chiesura and De Groot, 2003 ; MEA, 2003 and 2005;Ekins et al 2003). If the first provide the basic requirements for the very existence of human life, the second contribute to making it worthy to be lived (Chiesura and De Groot, 2003). From the above it is clear that Ecosystem Services (ES) fulfil not only the basic physiological needs (clean air, water, food etc.), but also economic and social functions, through their critical contribution to human well-being both at the personal (freedom, self-development, recreation, psycho_/physical health, etc.) and at the collective (social contacts, norms and values, ideals, cultural identity, etc.) levels (Chiesura and De Groot, 2003). Hence, it appears clearly that ES provide ecological foundations for many functionings. All these different services might be

[4] incommensurable because what is a an ecosystem service or goods is context specific (Haines-young and Potschin, 2010)

[5]Some substitution of these essential elements by manufactured and human capital can be envisaged, but their wholesale substitutability, as assumed by weak sustainability, appears improbable, certainly with current knowledge and technologies. criticality of natural capital is dependent on the level of technology and values put forward by the society (Ekins et al, 2003 ; Chiesura and De Groot, 2003)

[6] The difference between services and function will not be discussed here, some authors use the word function (eg. De Groot 1992, 2002, 2006; Noel and O'Connor, 1998; Ekins et al 2003) and others (eg. Costanza, 1997; Daily, 1999; MEA, 2005; Fischer, 2008) the world services. Here we to choose use the term of MEA "ecosystem services". For further information on this topic see Haines-Young and Potschin, (2010).The distinction between function "for" et "of" "direct" and "undirect" services will also not be discussed.

considered as critical that is important and irreplaceable (see De groot et al 2003 for more details), but it is also important to note that criticality is to some degree context-specific and dynamic, as it is related to certain standards of living and human values that may change over time (De Groot, 2003; Brand 2009; Douguet and Schembri, 2000)
We can improve the previous scheme of Sen's CA adding ES in the first compartment.

Figure 2: Inclusion of ecosystem service in the capability approach

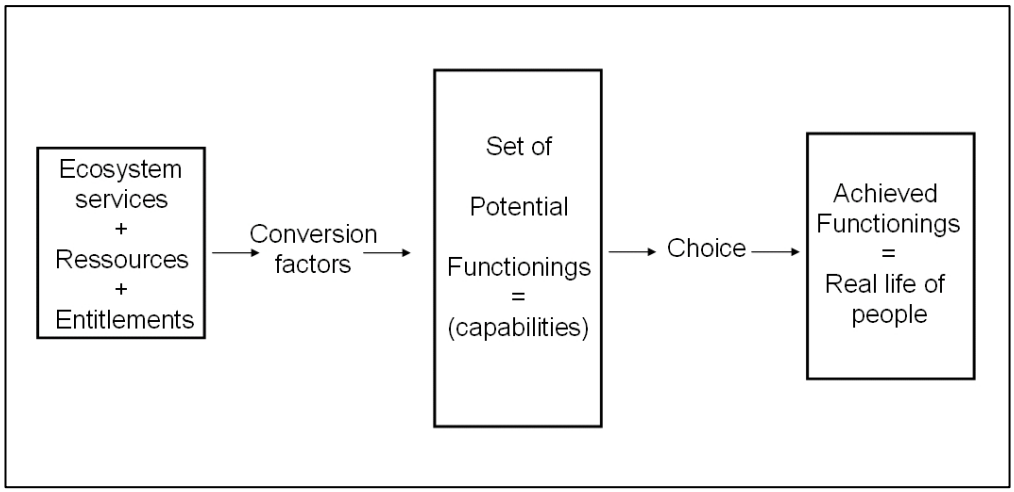
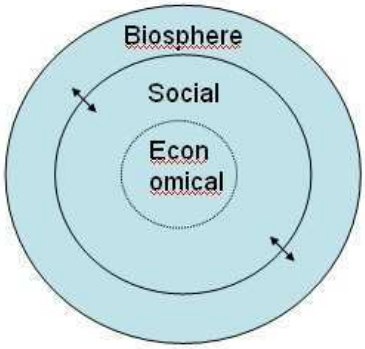


Figure 2 shows that ES represent essential inputs for many capabilities which will be translated in achieved functionings i.e. constitutive determinants of well being. The figure illustrates Flipo (2005, p73) statement that "*Human being and human society take part in Nature from which they draw a part of their being and their effective capacities of action. That is precisely the definition of a "capability"*. But the existence of capability requires the existence and the maintenance of natural activity about which, in order to avoid provoking harmful consequences on people's freedom, human must pay attention (Flipo, 2005). The CNC identified through the ES it provides thus constitutes the ecological foundations of capabilities. The size and quality of CNC is hence directly related to the real freedom that people enjoy. That is why capability achievement or improvement can not be done, to some extent (defining CNC through an open and participatory process), without taking into account this ecological dimension. In this respect, we establish the link with the CNC theory. Capability could therefore be considered as a hybrid product of Nature and Society. Considering ES as a source of capabilities involves that conservation and enhancement of the availability and quality of ES should also be regarded as a goal for a "development as freedom". Conversion of ES into determinants of well being becomes a major issue for HD. We state that applying Sen's CA to ES could light the debate concerning where the difference between ES and well being occurs. There are some elements of response in the next part but a later paper will be dedicated to this particular issue.

Figure 3 : Hierarchical imbrication of the three dimensions of SD (adapted from



Thanks to this demonstration we switch from the independent[7] three pillars scheme of SD to an adapted view of the three concentric circles of Passet (1996). In this model, the environment is circumscribing the social dimension, and the economic sphere constituting the innermost circle. This reflects the idea that economic activities should be in the service of all human beings while at the same time safeguarding the biophysical systems necessary for human existence. The social would thus be in the command of the economic, but at the same time evolving within environmental dynamic constraints, and as we will see in the next part, social dimension participates to define them trough the election of Critical Natural Capital.

II. How Sen's capability approach could help the CNC theory to be more consistent with social and individual concerns

"The criticality refers not only to the existence of environmental thresholds (or 'norms') but also to socio-economic contingencies and to social acceptability." (Douguet and Schembri, 2000, p4)

a) Limits of EE and complementarities with HD

In ecological economics the economy is see as embedded in the ecosystem (or, more accurately, in the historically changing social perception of the ecosystem). The economy is also embedded in a structure of property rights on environmental resources and services, in a social distribution of power and income, in social structures of gender, social class or caste (Martinez-Allier, 2001). However, Some EE scholars have noted that EE largely continues to operate within the limited and often misleading conception of well-being (Dodds, 1997) and with some others tools[8] (Homo economicus model of behaviour, marginal cost and benefit framework etc.) inherited from mainstream neoclassical economics (Gowdy and erikson 2005). As claim by Neumayer (2010), HD serves to remind sustainability proponents that people are real people with freedoms and choices, not social welfare state clients who are allocated a certain amount of utility by the omnipotent social welfare planner. According to Sneddon et al (2005) "*In Sen we can begin to see a way to radically alter the general orientation of development, away from its obsession with an aggregate, ill-defined wealth towards a rigorously defined notion of freedom that builds on ideals of social justice and human dignity*". Lethonen (2004) is going further stating that "*A marriage between the capability approach and the one based on environmental functions might hence provide ideas for analysing the environmental–social interface*". Regarding Martinez-Allier's definition, the critiques of Dodds, Gowdy and Erickson on one side, and on the other side, the

[7] By continuing to distinguish the 'social' from the 'economic', the three-pillar model contributes to strengthening the idea that the economy can be treated as a separate sphere, detached from the social context within which all human activities are embedded. See Lethonen (2004) for more details.

[8] Gowdy and Erickson, 2005 and Gowdy, J,M., and Mayumi, K., 2001. Reformulating the foundations of consumer choice theory and environmental valuation. Ecological Economics, Volume 39, p 223-237

recommendations of Sneddon, and Lethonen we state that crossing Sen's CA and CNC could improve in a real integrated way concepts, methods and tools for sustainability research, and policy analysis.

b) Limitations in the realisation of the CNC theory and how the CA reasoning applied to ecosystem services could help to overcome them

Although strong sustainability recognizes nature as a distinct, even critical, sort of capital (which makes it already more consistent with sustainability requirements) it remains somehow abstract and difficult to operationalize. Concepts such as 'non-substitutable' or 'irreplaceable' raise fundamental questions like: irreplaceable for what? and for whom? (Chiesura and De Groot CNC, 2003). Questions which so far have only been partially addressed, because among others:

-many environmental problems are characterized by fluid and incomplete state of scientific knowledge, accompanied by the inherent unpredictabilities of complex systems (O'Connor and Noel, 1998, Ekins et al 2003)[9]

-of the inherent complexity of sustainability distribution problem (question of social distribution of risks, benefits, costs and opportunities)[10].

That does imply two things:

-Maintenance of ecosystem functions or services cannot be set through use of conventional economic valuation methods (O'connor and Noel, 1998, Ekins et al 2003)

-Determination of criticality depends on ecological, as well as economic, political and social criteria and critical levels depend not only on ecological standards, but are also related to standards of living and relative affluence of a particular group, region or nation (De Groot et al 2003; Douguet and Schembri, 2000). What constitutes an intolerable loss hence, what is critical, is to be decided by social or political consensus (De Groot et al, 2003).

Concerning the last statement Daily et al (2009) recommendations, among others, to integrate ecosystem services in everyday decision; and to build the credibility of ecosystem service approaches, are to develop:

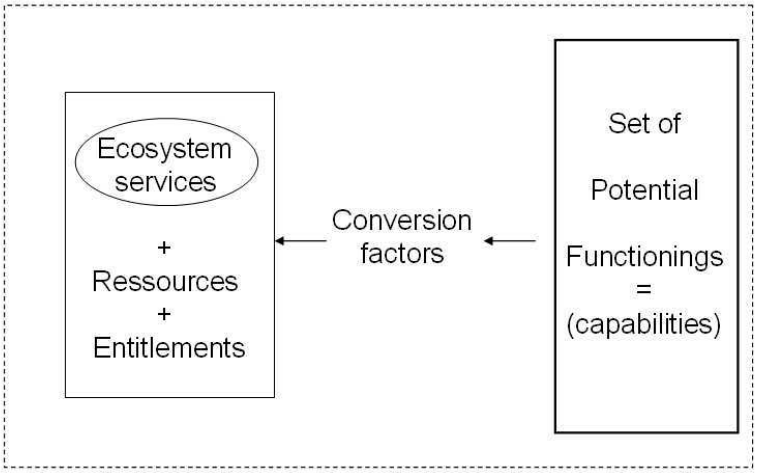
- A grasp of the decision-making processes of individual stakeholders
- Methods for identifying who benefits from ecosystem services, and where and when those who benefit live relative to the lands and waters in question. Without this information, we risk creating or exacerbating existing social inequities with policy incentives

We state that applying the CA reasoning to ecosystem services could provide some concrete elements to Daily's recommendations and help defining for what and whom CN could be critical.

[9] See for more details, Boisvert, V., Holec, N., Vivien, F. D., 1998. Economic and Environmental Information for Sustainability in Faucheux, S., O'Connor, M., (Eds.), Valuation for Sustainable Development. Methods and Policy Indicators., Cheltenham: Edward Elgar Publisher, pp. 75-98.

[10] See for more details, O'Connor, M., 1998. Ecological-Economic Sustainability, in: Faucheux, S., O'Connor, M., (Eds.), Valuation for Sustainable Development. Methods and Policy Indicators., Cheltenham: Edward Elgar Publisher, pp. 75-98.

Figure 4: Illustration of the CA reasoning applied to ES



As we saw before, if a person values mobility she needs a bike (resource), to be entitled to use it (entitlement), to be in good physical condition, to know how to ride it (internal conversion factors) and the existence of tracks or roads suitable for cycling (external conversion factors). By analogy, a person who values walking in the forest needs: an healthy forest ecosystem which could deliver the recreation ecosystem service, means of transportation (or the income to take public transportation) appropriate clothes, free entrance into the forest (resources), to be entitled to use the ecosystem services (to have the right to walk in the forest, entitlement), to be educated or informed about the well being she could derive from a walk in the forest, health condition (internal factor), existence of public transport (or roads tracks for private transportation). Now we illustrate a case of capability inequalities drawn from an apparent free ES e.g. "the air quality". To breath, people do not need resources neither to be entitled, but depending on one's internal factors, an asthmatic person will not be able to draw the same capabilities from low air quality that a non asthmatic person could. To escape (for few hours, day or permanently) low air quality problems (to seek good quality of regulation ES) people will depend their resources (cars, bike, income level…), entitlements (property rights..) and external factors (existence of cities green parks, second house in rural area, natural areas close to cities, public means of transportation to get there etc.). According to this demonstration comparisons, measures, indicators or public policies based on ratio of CN *per capita* is not sufficient to assess the interactions between people's well being and the environment because not everyone can draw the same opportunities from the same quantity and quality of CN.

Therefore applying CA reasoning to ecosystem services could allow a better understanding for "what" and for "whom" CN could be critical.
-for whom: CA and HD put the light on the person[11] (or groups)[12],his characteristics and the environment in it broader sense (including Natural, social, political, cultural and economical dimension) within she evolves (Sen, 1999; Alkire, 2010) and his/her values.

[11] Alkire, In human development, the 'focal space' is people's lives. Resources, income, institutions and political or social guarantees are all vitally important means and policy goals; yet ultimately success is evaluated in terms of the lives people are able to lead, the capabilities they enjoy

-for what: Defining what constitutes an 'ecosystem service', an understanding of spatial context (geographical location), societal choices and values (both monetary and non-monetary) is as important, as knowledge about the structure and dynamics of ecological systems themselves (Haines-young and Potschin, 2010). As long as capabilities and functionings are beings and doings that people have reason to value development cannot be imposed without regard to people's values and preferences. Therefore, Human development can help improve CNC definition because it does not specify who decides what people 'have reason to value' in each context. But it does create the space to discuss this issue, to question and dialogue (Alkire, 2010). Applying AC to ecosystem services could help revealing "why" people "have reason" to value a particular set of functionings drawn from a particular ES (e.g. organic farming or intensive farming, buying a four wheel drive car or hybrid one etc.). That could help highlighting levers to get better information in order to build the deliberation process which should lead to CNC definition.

As a preliminary conclusion we can say that applying CA to ecosystem services puts the light on people's inequalities (individuals, households or groups) to draw opportunities from ecosystems in terms of conversion factors, entitlements and resources.

c) Access inequalities to ecosystem services

As we saw CN provides to people critical ES which enable them to have essential functionings (food, health, recreation, inspiration etc.)
Considering ecosystem services as elements of people's real freedom (thought capabilities) means that individuals or communities should have a granted access to the service they value. However, the access to ecosystem services if often a source of well being inequalities:

-Entitlements: Poor's or marginalised social groups are always suffering of entitlement problems that do not enable them to draw functionings (even less sustainable) from ES (e.g. farmer communities are excluded from many protected area without negotiations etc.)
-Many scholars have shown that economic inequalities and environmental ones are often cumulated (e.g. Laigle and Oehler, 2004; Laigle L, Tual M, 2007). Poor people are often living in or nearby low quality environment which does not provide them the ES needed to have all the functionings required by HD.
- Competition between ES for situations where the use of one ES is at the expense of some other services valued by other stakeholder (e.g. provisioning VS recreation trough intensive agriculture). Since ES are in competition to ensure well-being of different social groups, the choice of the ES to be maintained or the way of maintaining it, will depend to some extent on the political capacities of these groups.

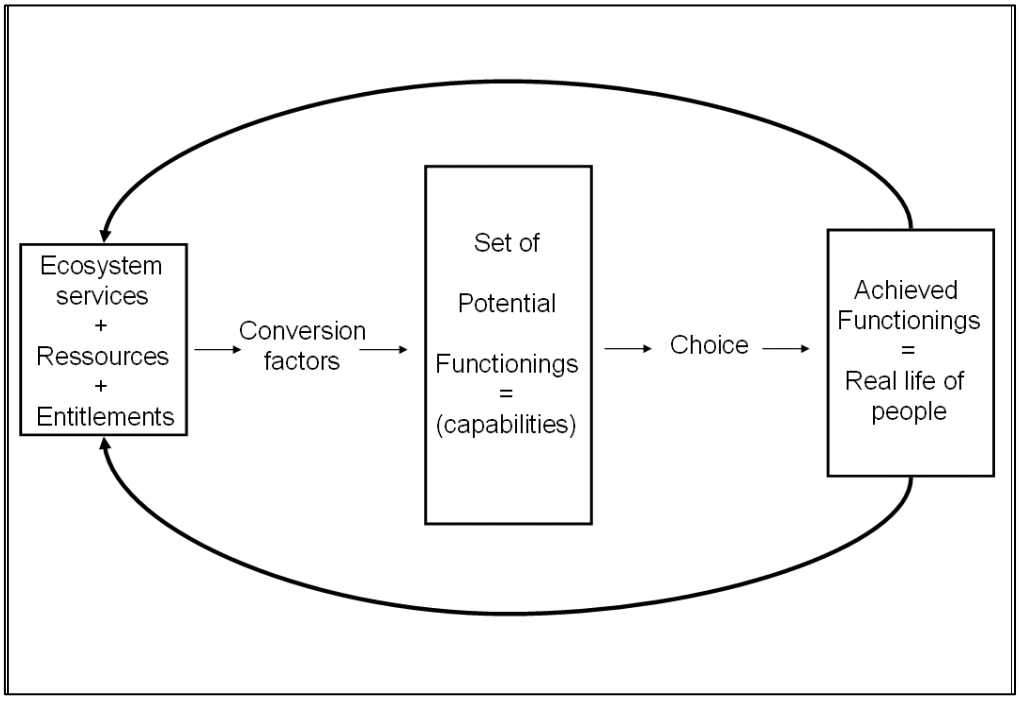
d) People as 'agents' who can make the world more sustainable : the posibility of sustainable functioning

"*If we are to achieve sustainable use of our (critical) natural capital, it is therefore essential to address not only the ecological, but also the sociocultural and the economic dimensions*" (De Groot *et al* 2003). CA was developed expressively for that. If we look at the scheme in the previous part we see that capabilities drawn from ES depend on people's conversion factors, entitlements, resources and ultimately on "the values" which guide the choice

[12] IMPACT, 2008, REPENSER L'ACTION COLLECTIVE : Une approche par les capabilités, Sous la direction de Bakhshi Parul, Brouillet Anne-Sophie, Duray-Soundron Chantal, Dubois Jean-Luc, Réseau Impact, Ethique Economique

between potential functionings. Therefore the sustainability of a chosen functioning will depend on these parameters. As long as poverty is defined as a lack of choice (and not in monetary terms) many people can not have the possibility (regarding their conversion factors, entitlements and resources) to obtain a sustainable functioning from an ES[13]. Some other people could have the required resources, entitlement and conversion factors to achieve sustainable functionings from ES but they do not because of lack of information or opportunity. In turn, they unintentionally have a negative feedback on the CN, but they often do not have the choice! Others do not, because of their values. By converting resources and ES into unsustainable achievements they gradually nibble the CN which provides ecological foundations for capabilities.

Figure 5: CA dynamic scheme



This scheme shows the positive or negative feedback an achieved functioning could have on ES or resources and entitlements. Degradation of ES by its unsustainable use or through the only promotion of resources (at the expense of ES) could lead to a net loss of capabilities for present generations and to some extent to future generations. If the set of options decreases, there are some irreversible effects. In economics, irreversibility occurs when the current choices are constrained by the previous ones (Levrel et al, 2009). According to the nature of the functioning the set of potential functionings will increase or decrease. The first corresponds to sustainability and the second one to the exact opposite. Back to the example of the forest walk, the functioning obtained from the ES, for example, could be sustainable if there were trash bins along the walk to throw the wastes, if the pathways were signalised in order to avoid overuse which cause erosion (altering regulation services). People have the right to choose between sustainable and unsustainable functioning!

[13] According to Levrel (2003) poor do not have the opportunity to choose a valued use of their resources (they don't have capabilities). For Weber (2002) the poor use intensively as possible ecosystem services which they might not reach anymore "tomorrow". For him that can partially explain why poor have very short term strategies.

Making the difference between achieved functionings and capabilities enable the assessment of a person true range of choice. That's very interesting to assess interaction between societies and Nature notably, in the developed countries where the income of a major part of the population is not depending directly on natural resources. Indeed, making the difference between achieved and potential functionings could reveal the constraints (time allocation, information lack, conversion factors etc.) that people endure. It could also reveal the adequacy between people's values, behaviour regarding use of ES and the opportunities they really have to function sustainably. According to Neumayer (2010) HD serves to remind proponents of sustainability that the debate about *what* should be sustained is as important as *how* to sustain it. Human beings are not only the beneficiaries of development; they are also agents (Alkire, 2010). In the thought of SEN, if individuals evolve in a democratic environment, they use their capabilities to take part in decision-making process, in order to increase their opportunities (Sen, 2000). Thus the 'patient' whose well-being commands attention becomes the 'agent' who can transform the society (Dreze and Sen, 1989). So the agent could be the core unit for SD construction. Therefore, HD goal should be that each person could participate, through his functionings, to CNC definition and maintenance through time. We assume that promoting an equitable distribution of resource entitlements and a strong attention to the person's characteristic (conversion factors) could allow each individual to construct a sustainable pathway for human development. The research goal hence becomes: to bring to light the gap that exists between potential functionings and achieved functionings in order to highlight the capability space and the characteristics of conversion factors on which public policies must act in order to improve people's opportunities of sustainable functionings.

Conclusion

"Criticality can be considered as an 'emergent property' arising out of the interaction of ecological and human value systems" (Chiesura and De Groot, 2003, p224). As it is demonstrated in this part crossing Sen's CA and the CNC theory could help to address this statement. Indeed, on the one hand, CNC provides a flow of ES which take part in building people's capability. Exceeding critical thresholds[14] of natural capital involves that people will loose the possibility of achieving essential functioning (breathing good air, having a walk in forest etc), therefore the conservation of the CNC size and quality becomes an important goal for HD. On the other hand, applying CA reasoning to ES highlights that on its own ES are not sufficient to provide people capability. Therefore a special focus should be put on people's conversion factors, resources and entitlements to address inequalities of capabilities drawn from ES. The next step will be to introduce some definitions which integrate the outcomes of this crossing and which could constitute real integrated theoretical basis to foster Sustainable Human Development Research. This theoretical work gives more weight and operationalization possibilities to Sen's definition of SD[15] and sets up a theoretical corpus representative of Passet's (1996) hierarchical conception of SD[16], not as three independent pillars anymore.

[14] Defined through deliberation process guided by science involving stakeholders concerned by a particular environmental problem

[15] "Development that promotes the capabilities of present people without compromising capabilities of future generations" (p5 of Sen's speech "Ends and means of sustainability" in Kyoto, 2000)

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