SUSTAINABLE DEVELOPMENT & DIVERSITY: REFLECTIONS ON KNOWLEDGE, CULTURAL DIVERSITY AND ENVIRONMENTAL SUSTAINABILITY FROM A *TRANS*DISCIPLINARY PERSPECTIVE

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This research is part of a Bilateral Joint Doctoral Project between Vrije Universiteit Brussel and Université Libre de Bruxelles. Research supervised by co-authors b, c, d, e and f.

Abstract: In our rapidly globalizing world, continuous readjustment of the scientific basis of sustainable developmennt (SD) is a prerequisite for sustainability. We shed light on the shift in international discourse concerning cultural diversity and SD. We analyse worldviews as a constitutive element of SD, proposing to re-interpret SD as a joint worldview-construct in progress, embracing a multiplicity of visions and knowledges. Through critical literature review, we identified *trans*disciplinarity, co-creation of knowledge and inra-/inter-cultural dialogue as a necessity for SD to retain its ‚universal' appeal. *Transversal* thinking, biocultural diversity and trends within SD research act as a guide throughout our reflection on knowledge-creation for and interpretation of SD, starting from a worldviews perspective and interdisciplinarity.

Keywords: sustainable development, sustainability, diversity, worldviews, knowledge, interdisciplinarity, transdisciplinarity, science for sustainable development

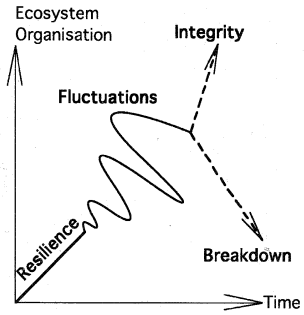
1 Introduction

Sustainable development (SD) is a hard to define concept. Attempts towards *exact* definitions of SD fail repeatedly because of invocation of normativity, contextual values and priorities. The enormous complexity of interwoven socio-ecological (sub)systems does not ease the job. Attempts to interpret SD and to translate it into decisions and actions are hampered by these complexities. *'plus c'est la même chose, plus ça change'* This converse of the French aphorism (Bateson 1972: 440) seems to be the more exact definition of biological, ecological and social *cybernetic* and *homeostatic* systems.[1] We interpret this phenomenon of *spread of change* as a learning process and a guide throughout our argumentation. A static interpretation of SD and purely mono-disciplinary attempts to address sustainability related issues are not compatible anymore with the growing complexity of the socio-cultural dynamics through which SD is being shaped and the resilience of transforming ecosystems that has to be optimalised. Transitions towards sustainability aim at the same kind of dynamics, a world that is constantly transforming and evolving.[2]

The growing knowledge of socio-ecological systems, their mutual interactions and interconnections, *feedback loops* and circuits demands as well a continous readjustment of the scientific basis of SD. In interpreting SD we can not opt for a purely scientific study of 'matter' any longer. We have to integrate other forms of knowledge (e.g. local knowledge) and keep in mind the discursive political-ecology that eventually interprets data and that constructs solutions, priorities and perceived risks in the scope of SD. (Dove & Carpenter 2008: 321-422) In a world confronted with growing uncertainty and complexity - fed by rising globalisation and (super-) diversification – stakes are high and decisions become more then urgent. (Ravetz 1999) (See also Figure 1 on ecosystem unpredictability[3]) Synergies have to take place and multiple legitimate viewpoints – from a wide variety of disciplines – have to collaborate in order to make accurate decisions and action possible to address the problems of our world today. The inherent normative character does not ease the future of SD in a context of complexity and uncertainty. Further on in this paper, this *normativity* will lead us to scrutinize the 'pretentious' ambition of SD as a *universally* desirable goal or pursued ‚state-of-being'. Interdisciplinarity – or as we argue later on in this paper *trans*disciplinarity – might give an interesting outcome and important component for the scientific challenge of *coupling* the cybernetic systems of the individual human organism, the human society and the larger ecosystem. As Bateson (1972) argues, also *consciousness* will play a major part in enabling us to do so. Guattari (1989) – in his theory of *three ecologies* (societal, natural and psychological) - points out the need to bridge disciplines and systems to address the environmental and sustainability related crises (confronting us in an ever more urgent way today) by learning to think *transversally* (see § 2.3).

In this paper – based on critical literature review - we shed light on three major topics related to SD, its diversities and its knowledge needs. First, we reflect on sustainability and diversity from a cultural perspective by addressing three focal points: cultural diversity (CD), worldviews and the eco-sophical concept of *transversality.* (Guattari 1989) Second, we elaborate on both cultural and biological diversity (BD) as constitutive elements of SD, linked by the concept of *knowledge*. This *biocultural diversity* (Haverkort & Rist 2007) will serve as a shifting point towards the core of this paper, being interdisciplinarity, knowledge and SD. Third, we continue our argumentation on SD as a knowledge-based concept by having a look at recent trends and evolutions within sustainability research - as *science for SD* - and what insights have been gained in these academic fields regarding interdisciplinarity. By interpreting SD through these perspectives, we identify challenges for and recommendations on interdisciplinary sustainability research and SD as a knowledge-based concept.

Figure 1. Ecosystem unpredictability



Source: After Weyns 1998 and Prigogine and Stengers 1984

2 Sustainable Development and its Diversity of Visions

During the 1980's there was a shift in thinking about the economics of development. The earlier centrality of economic growth (increases in real GDP per head) was replaced by broader notions. Development was approached more as a human-centered rather than a commodity-centered process. Important contributors to this paradigm shift are the UNDP's *Human Development Reports* – starting in 1991 – and the writings of economist Amartya Sen, characterizing development as 'human capability expansion', including access to cultural resources and

[1] A constancy of some variable is maintained by changing other variables. (Bateson 1972: 441)
[2] We refer to the *dynamism principle* of SD: the idea of SD as process of directed change or an ongoing evolutionary process, and not as a defined end-state. (Lafferty & Meadowcroft 2000)
[3] The non-linearity of complex dissipative systems, which occurs when they are far from equilibrium, makes the potential fluctuations unpredictable. (Prigogine and Stengers 1984 in Weyns 1998)

cultural participation. The importance of culture in the development scenario was brought forward by the World Commission on Culture and Development ('the Perez de Cuellar Commission'), resulting in the report *Our Creative diversity* in 1995. (WCCD 1995) The Commission suggested taking culture out of the periphery of development studies, by pointing out the substantial cultural dimensions of a human-centered development paradigm. UNESCO elaborated these ideas in its *World Culture Report* (2000).

On September 3rd 2002 the UNESCO and UNEP organized a round-table conference in Johannesburg, during the WSSD. This debate put forward the problem of CD and BD on a higher level. Before, the 'official' concept of SD particularly embraced economic, ecological and social parameters, but largely ignored important cultural bottlenecks. According to UNESCO a change of strategy was an absolute need. CD had to gain a central role within all SD negotiations. Therefore UNESCO created its 'Universal Declaration on Cultural Diversity'. (UNESCO 2002)[4] It clarified the importance of CD: *'As a source of exchange, innovation and creativity, cultural diversity is as necessary for humankind as biodiversity is for nature. In this sense, it is the common heritage of humanity and should be recognized and affirmed for the benefit of present and future generations. (art. 1)'* Putting CD forward as a crucial factor for development because it widens the range of options open to everyone: *'it is one of the roots of development, understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence. (art. 3)'* It raised the defense of CD as an *'ethical imperative, inseparable from respect for human dignity (art. 4)'*. UNESCO looks at CD as the key to sustainable human development, emphasizing that *'Market forces alone cannot guarantee the preservation and promotion of cultural diversity, … (art. 11)'*. The Declaration does not put CD above human rights guaranteed by international law, for not ending up in a situation of 'absolute relativism'. But it sees CD as an adaptive, survival-related process, as a *'living, and thus renewable treasure'* and therefore it should not be perceived as unchanging heritage but as *'a process guaranteeing the survival of humanity'*. (UNESCO 2002: preface) By seeing diversity as a living process, it tackles static, essentialist and reductionist approaches of the cultural concept. The 2002 declaration views 'indigenous knowledge' also as such an adaptive and survival-related process, involving intra-community examination of knowledge. (McKee 2008) TheUNESCO reports on CD expressed the need to promote awareness among policy- and decision-makers about the benefits of intercultural and interfaith dialogue, while bearing in mind its potential instrumentalization.[5]

Arjun Appadurai stated that CD guarantees sustainability, because it connects universal development goals with attainable and specific moral perceptions. (UNESCO – UNEP 2002) Long-term biodiversity always depends on maximum diversity of this kind of moral visions. If 'human diversity' decreases, as a consequence also the archive of visions – that connects moral management of nature with 'material' well-being – declines. Both these diversities constitute the best available resistance to ideological and technological uniformity. CD means more than pure differences in culture. It is a value that recognizes differences in people as a part of systems and relations. It unites values like creativity, dignity and community. Without these 'cultural' values no single sustainable perspective on development is possible, because it will not be based on the moral dedication of the executers. (Appadurai 2003)

One of the main concerns and criticisms on SD today is the dominance of economic conceptions, identifying them as particularly problematic for sustainability. (Gottlieb 1996, Bell & Morse 2010) The dimension of culture and its definition is often narrowed down (e.g. heritage, arts, …) and by doing so made irrelevant for the wider development discourse. Nurse (2006) calls to reflect on the impact on sustainability by the mode of development thinking that puts emphasis on 'growth-oriented industrialization' or 'profit-driven production' and he points at the growing diffusion of consumerism.[6] These critiques call for an alternative framework for SD, of particular importance for developing countries. By giving culture a more central role in the SD paradigm, as an alternative framework, it allows for much greater diversity in policy choices. *'… what is proposed is a non-deterministic approach that breaks out of progressivist, universalistic and dependency-creating development thinking and promotes self-reliance, social justice and ecological balance. (Nurse 2006: 38)'* (See chapter 3 and Haverkort & Rist 2007, Haverkort & Reijntjes 2007 on biocultural diversity and endogenous development)
In the next subchapter we will elaborate on one particular aspect of CD in the scope of SD, being *worldviews*. We propose a re-interpretation of SD as a joint *worldview-construction* in progress, embracing a plurality of visions (and knowledges). Interdisciplinarity will play a significant role for SD's potential as a worldviews-construct through inter- and intra-cultural collaboration and identification of shared goals, focusing on inherent heterogeneity (see §2.3).

2.1 Worldviews and SD

Worldviews – as one particular aspect of CD - are defined as a combination of a person's value orientation and his or her view on how to understand the world and the capabilities it offers. They are the *lens* through which the world is seen. (van Egmond & de Vries 2011: 855) The kind of (often unconscious) mental habits, frames and assumptions of which worldviews are composed, might not immediately seem to be relevant to contributors of the SD debate, but exactly these kind of cultural mechanisms or 'filters' are the basis on which humans decide how to act, according to their perception of the environment and reality. (Weyns 1998) It shapes their beliefs in nature and in the world-as-a-whole. (Schlitz, Vieten and Miller 2010) Worldviews are perceived as cognitive, perceptual, and affective maps that people continuously use to orient and explain the world, and from which they evaluate, act and put forward prognosis and visions on the future – and as a consequence on sustainability related issues.[7] (van Egmond & de Vries 2011) Our answers on 'ethical' questions concerning humanity as a whole (e.g. sustainability) depend on our worldview. Indeed our personal worldviews truly matter and influence our suggested political solutions. (Apostel 2002) Worldviews are complex, heterogeneous and unequally developed, as people are unequally informed. The possibility of completely describing perfectly balanced worldviews is excluded by this diversity in their construction. Scientists should be utterly aware of the underlying heterogeneity of worldviews. Following worldviews theories, SD will not be interpreted everywhere in the same way or might even not be workable in some places at all. Therefore the actual interest for the sustainability researcher lies in what people working towards SD *think* SD is – what *they call* SD. (Lafferty & Meadowcroft 2000)

As worldviews are *unfinished*, this dynamic incorporates the possibility of change and amelioration of our personal view on the world. (van Egmond and de Vries 2011: 862) Therefore we suggest the re-interpretation of SD as a joint worldview-construction in progress. (Van Opstal & Hugé 2013) Worldview construction is collective work that is not identifiable with only one individual person, but tries to connect shared goals - or in the scope of SD a sustainable worldview - with acceptable and

[4] elaborated in the 2005 *Convention on the Protection and Promotion of the Diversity of Cultural Expressions* and 2009 *UNESCO World Report. Investing in Cultural Diversity and Intercultural Dialogue.*
[5] The insight that culture can never be reduced to the inferior position of an instrument for economic growth was one of the key issues of the 1998 conference *The Power of Culture* organized in Amsterdam, The Netherlands.
[6] See also Igoe & Brockington 2007 and Igoe, Sullivan & Brockington 2009 on green capitalism, market environmentalism and neoliberal conservation.
[7] Haverkort and Reijntjes (2007: 431) apply worldviews to environmental issues: *'Worldview: (or cosmovision) the way a certain population perceives the world (or cosmos). It includes assumed relationships between the human world, the natural world and the spiritual world. It describes the perceived role of supernatural powers, the relationship between humans and nature, and the way natural processes take place. It embodies the premises on which people organise themselves, and determines the moral and scientific basis for intervention in nature.'*

specific views of these individuals or the social groups they are living in. The definition of SD proposed by the Brundlandt Commission (WCED 1987) as *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* is the most widely excepted and frequently cited one. As such, it will continue to serve as the guide toward future 'sustainability'. Jepson Jr. (2004) raises the potentially problematic character of this definition, because of the use of many 'underdefined' terms (neither interpretation of these terms is inherently inconsistent with the definition itself). *'This definition raises as many questions as it answers. (Jepson Jr. 2004: 6)'* On the other hand, it is left as a concept that is open to interpretation and to the integration of different perspectives / worldviews. *Interpretative flexibility* (Van Opstal & Hugé 2013) can be of special interest for SD, as it has to be applied and implemented according to specific problems and in particular (locally) varying contexts. Variation in the interpretation of the sustainability concept '*allows for a multitude of actors, possibly the whole of society, to be involved, encouraging local solutions'*. (Kemp & Martens 2007) In other words it allows different worldviews to identify shared goals and co-evolve - through joint worldviews construction – towards co-produced interpretations of SD that can generate sustainable *transformations* of all worldviews. As a person's worldview transforms, awareness can expand leading to enhanced 'prosocial' experiences and behaviour. Increased social consciousness can in turn stimulate further transformations in worldview towards sustainability. (Schlitz, Vieten & Miller 2010)

2.2 Interdisciplinarity from a Worldviews & *Transversal* Perspective

Apostel (2002) stated 4 major motivations for interdisciplinarity starting from a worldviews perspective. Science is subdivided into disciplines, but reality itself is not. Secondly, almost everyone has a psychological need to integrate their experience and perception of nature and culture into a *worldview* or a *total view*. This counts for laymen as well as scientists. Thirdly, environmental (cf. sustainability) issues are extremely complex and constitutively transboundary. A fourth motivation is an evolving relationship between science and society - resulting in a trend towards applied, action-oriented science in synergy with society at large.

To establish the link between science and society and to enhance this synergy (between e.g. local, indigenous & - global?- scientific forms of knowledge) we put forward the concept of *interculturality* as highly significant for the implementation of CD - from a worldviews perspective - in SD. Rist and Dahdouh-Guebas created a typology that reveals an intercultural perspective as the most adequate to relate different knowledges. '*… it encompasses the highest potentials for cooperation based on mutual respect maintaining the autonomy of the different processes of knowledge production. (Rist and dahdouh-Guebas 2006: 473)'* Both authors raise three main issues that need to be addressed for an intercultural approach of knowledge. The typology reveals that no relationship between local knowledge and science can be value-free. It depends on specific ethical positions. Secondly, it implies '*the establishment of the broadest possible field of interaction between different types of knowledge. (Rist and dahdouh-Guebas 2006: 473)'* and a process of deliberation. An agreement on fundamental ethical principles is necessary before going into an intercultural dialogue. The will to accept the possibility that 'the other may be right' is a necessity. Thirdly, intercultural dialogue is better possible when all parties '*have shared questions on fundamental aspects related to the form of knowledge they represent. (Rist and dahdouh-Guebas 2006: 474)'*

Bateson and Guattari drive the link between the social and the natural, man and environment or nature and culture even further by introducing the human psyche, the mind. '*There is an ecology of bad ideas, just as their is an ecology of weeds (Bateson 1972: 484)'* In Bateson's attempt to outline some of the 'epistemological fallacies' of Western civilization, he argues that – scrutinizing Charles Darwin's theory of natural selection – '*the unit of survival is organism plus environment. We are learning by bitter experience that the organism which destroys its environment destroys itself. (Bateson 1972: 484)'* He arrives at the conclusion that the unit of natural selection turns out these days to be identical with the unit of mind. Resulting in a different hierarchy of units: gene-in-organism, organism-in-environment, ecosystem, etc. Ecology in this broadened sense turns out to be the study of the interaction and survival of ideas and programs (e.g. differences, complexes of differences) in *circuits*. Felix Guattari based his *ecosophy*[8] of the three ecologies (Guattari 1989) on this idea that nature cannot be seperated from culture. Based on his theory, he states that in order to comprehend the interactions between eco-systems, the mecanosphere and the social and individual 'Universes', we must learn to think *transversally*. (Guattari 1989: 29) As opposed to traditional environmentalist perspectives – according to Guattari obscuring the complexity between humans and their environment through a dualistic separation of culture and nature – we agree to resist pure holism, in the sense of emphasizing heterogeneity and diversity[9] rather than creating unified and holistic structures.

3 Bridging Cultural and Biological Diversity

Within the perspective of this chapter, we emphasize the mutual dependence, interactions and links between both CD and biological diversity. Many cultural practices depend on specific aspects of biodiversity for their staying into existence. Their expressions - on the other hand - are meaningful constructions of biodiversity, developed, conserved and managed by cultural communities (with language and knowledge as the media of this management). UNESCO summarizes the importance of a combined sustainable approach towards CD and BD by using the word 'knowledge'. (UNESCO 2002) Through this local cultural knowledge an immediate connection between CD and BD is handed. Koïchiro Matsuura declared in 2002 that a step forward has to be made by acknowledging diverse (cultural) views on the well-being of humanity, as essential to fully understand the environment, to protect it and to be able to fulfill the needs of present and future generations: *'Indigenous and traditional communities all over the world developed an extra-ordinary sophisticated insight in biodiversity, the fruit of a rich basis of knowledge and a pattern of values that respects this knowledge. We can no longer ignore the knowledge that connects cultural and biological diversity.'* (WSSD 2002)

3.1 Knowledge as Bridging Factor between Diversities: Biocultural Diversity

Respect for CD and a multiplicity of visions broadens the possibilities for everyone. In combination with BD it is essential for our survival. Loss of diversity brings along an enormous loss in the quality of life. Thereby we restrict and cut down our potential knowledge of the environment and the advantages of our biosystem. Nowadays there is more consensus that the deterioration of BD as well as CD is a threat for global stability. It puts the earth and humanity in an extremely vulnerable position. The Johannesburg Declaration emphasizes that CD and BD are equally significant conditions for SD. (WSSD 2002) In the Millennium Declaration (2000), the U.N. called for respect for nature, as one of the fundamental values for humanity. Contemporary patterns of consumption and production (in developed societies) have to be changed in the interest of our future well-being and that of our relatives. Respect for BD implies respect for human diversity. CD is a source of innovation, creativity and exchange. CD does not offer an unchangeable object that has to be 'conserved', but it offers a framework for a continuous dialogue between all possible expressions of identity. Culture connects individual, community and humanity. CD ensures SD because it connects universal development goals with acceptable and specific moral visions.

[8] For a wider discussion see *The Ecosophic Object* in *Chaosmose*. (Guattari 1992)
[9] Synthesizing assemblages and multiplicities in order to trace rhizomatic structures.

Globalization (especially fast neo-liberal globalization) create new questions and challenges. (Igoe & Brockington 2007, Igoe, Sullivan & Brockington 2009) More than a purely economic phenomenon, globalization is also a cultural, technical and ecological phenomenon. Political and legal measures have to be taken in order to help promotion of CD and BD. Based on the insight that cultural and biological phenomena can not be dissociated, actions are needed.

3.2 Knowledge for SD & Interdisciplinarity

SD should embrace a multiplicity of knowledges (scientific knowledge, local knowledge, etc.), evolving towards an active pluralization of the knowledge-concept for SD. Rist and Dahdouh-Guebas (2006: 471) argue that each form of knowledge can be scientific in nature. Indigenous knowledge is often holistic, functional and adaptive to changes in the environment. Therefore it has high potential for resilience-based ecosystem management. They state that '*it is not the mere fact of this integration of knowledge which is challenged; the critical aspects are related to the questions on who is setting the issues for a particular disciplinary research agenda and how the findings should be re-integrated in function of a societal process oriented in the principles of SD. The roles of conventional scientific knowledge production in the context of societal processes are put under public scrutiny.'* A first key issue within the discourse of 'scientific' knowledge production for SD is interdisciplinarity, in order to achieve a less fragmented view on SD topics. Although it allows the integration of different scientific disciplines, the choice of issues addressed and its ontological foundations will remain exclusively 'academic', encompassing a lack of true participation of the involved society and communities. Thereby creating the same problems as disciplinary-based knowledge production. 'Abuse' of the term interdisciplinarity, as a combination of different sciences *within* a science field or as a compilation of different disciplines without true interaction or integration, has led to the development of newer concepts like *trans*disciplinarity. Rist and Dahdouh-Guebas (2006) emphasize the need for true interdisciplinarity between basic and applied sciences on the one hand, and social and human sciences on the other. They term it as 'interscientific interdisciplinarity'[10], sometimes referred to as '(scientific) transdisciplinarity'. They also plead for a 'transdisciplinary approach' that seeks to go beyond '*the boundaries of western scientific actors'* and aims for a more societal mode of knowledge production. It therefore includes 'interscientific interdisciplinarity' and different forms of traditional / local knowledge. (Hirsch Hadorn 2002) Transdiciplinarity recognizes the plurality of knowledge, worldviews and values. Major challenge is to stimulate dialogue and cooperation between heterogeneous groups, instead of imposing one worldview as a 'universalism'. Thereby we recall the idea of *transversality* (see §2.2) and Guattari's emphasis on heterogeneity rather than the creation of unified and holistic structures. In chapter 4 we will discuss some recent trends in the academic fields of sustainability research, primarily focusing on current recommendations and challenges for SD as a knowledge-based concept and the need for inter- and transdisciplinarity.

4 Knowledge, Science for SD and Interdisciplinarity

The legitimacy of knowledge – for SD - depends on the process by which that knowledge is generated. Knowledge needs to be co-produced and provisional, thereby challenging 'normal' academic science. It demands a 'systems' approach, which emphasizes the primacy of the whole. Bell and Morse (2008) state that '*a system is a perceived whole whose elements hang together because they continually affect each other over time and operate toward a common purpose'*. Any system is an intellectual construct, imposed by some humans on a set of phenomena and their explanations. The boundaries of that system do not always coincide with the actual interactions relevant to a societal problem. (Funtowicz *et al.* 1998) A systems approach is often compared to the contrasting reductionist approach where the well-defined problem is in the mind of the scientist and a part of a complex whole is analysed. In a systems approach, the problem is shared by legitimate stakeholders, has flexible boundaries and is reviewed as a whole. It aims to structure different sources of knowledge around a common topic. It is an evolving process of knowledge construction (through sharing approaches) requiring deep co-operation between disciplines to arrive at a shared understanding of issues. (Blanchard & Vanderlinden 2010) Individuals within teams seek to integrate concepts and methodologies and the individual researchers are based primarily in one discipline but will have familiarity with at least a second discipline. (Sumner & Tribe, 2008) Hulme and Toye (2006) say 'knowledge communities' instead of disciplines.

4.1 Science for SD

Today conditions like uncertainty, growing complexity, diversity and synergy are gaining importance rapidly. For better understanding the type of knowledge generation needed to implement SD, one has to keep in mind these defining features of the context in which sustainability is realized. By recognizing these contextual factors that shape SD in reality, new approaches emerged in the sustainability arena: *sustainability science*, *Mode-2 science* and *post-normal science*. Proponents of these 'sciences for SD' have opened promising avenues for addressing the shortcomings of conventional science. (Kemp & Martens 2007) Funtowicz et al. (1998) mention two key properties of complex systems: the presence of multiple sorts of uncertainty and the multiplicity of legitimate viewpoints on an issue. Convinced that conventional *normal* scientific methodologies are no longer effective for finding solutions of such complexity, Ravetz proposes a *second-order science* or *post-normal science*, '*... where facts are uncertain, values in dispute, stakes high and decisions urgent (Ravetz 1999).'* Kemp & Martens (2007) speak of normal science as *mode 1 science* being academic, mono-disciplinary, technocratic, certain and predictive; versus *sustainability science* or *mode 2 science* being academic ánd social, interdisciplinary, participative, uncertain and exploratory. Sustainability science is then defined as an integrative science, which aims at the integration of different disciplines, viewpoints and knowledges. Its central elements have recently been clarified in literature: '*Inter- and intradisciplinary research; coproduction of knowledge, a systems perspective with attention to the co-evolution of complex systems and their environments; learning-by-doing (and learning-by-using) as an important basis of acquiring experience, besides learning-by-learning (learning through detached analysis); attention to system innovation and transitions. (Kemp and Martens 2007)'* Knowledge for SD needs to analyse a system's deeper-lying structures, needs to project into the future, needs to assess the impact of decisions and has to lead to the design of new strategies for solutions. SD's normative character and its long-term horizon result in specific demands. Knowledge for SD has to consist of: 1) diagnostic knowledge, 2) explanatory knowledge, 3) orientation knowledge, 4) knowledge for action. (Laes & Maes 2007)

This demands a particular way of knowledge creation. Grist (2008) states that it *'is far from the rational, cognitive and technical procedures of science as previously understood. Instead, knowledge creation is perceived as a process or practice. Post-modern perspectives embrace an awareness of multiple knowledges, situated specificities, discourse and narrative analysis and complexities of actor-institutional interactions.*' In order to be relevant for SD, the legitimacy of knowledge depends on the process by which that knowledge is generated. Knowledge for SD needs to be: i) co-produced and provisional, ii) it demands a systems approach, iii) a systems approach requires inter-disciplinarity (and other levels of cross- and trans-disciplinary interaction), iv) it needs to be reflexive[11],

[10] Scientific interdisciplinarity that transcends the science field.

[11] Jepson Jr. (2004) elaborates on reflexivity: sustainability science's interdisciplinarity feature implies that disciplines not only differ in subjects and methods, but also have different worldviews. One has to transcend unconscious thinking by reflecting on personal values, interests and representations.

v) alternative problem framings are an essential element[12], vi) a level of subjectivity awareness is key.

5 Conclusion: Transdisciplinarity as *Inter*science for Sustainability and its Diversities

Starting from a short overview of the shift in the international institutional discourse on SD concerning cultural aspects of development and CD, we introduced worldviews as one of the constitutive elements of SD by proposing to re-interpret SD as a joint worldviews construction in progress. Thereby embracing a plurality of visions (and knowledges) on the topic. From a worldviews perspective, interdisciplinarity, collaboration, identification of shared goals and intra- / intercultural dialogue becomes a prerequisite to bring SD into effect in a fastly globalizing world confronted with (super-)diversification and growing complexity and uncertainty. Following Guattari (1989) we agreed to resist pure holism as a sole goal, in the sense of opting for emphasis on heterogeneity and diversity rather than creating unified and holistic structures. New concepts like biocultural diversity and international reports acknowledge inherent links between both BD and CD – as constitutive aspects of SD. The importance of a combined SD approach to CD and BD is summarized in the one word *knowledge*. Knowledge for SD requires interdisciplinarity as transdisciplinarity, embracing a multiplicity of ‚knowledges' and knowledge systems. We propose an active pluralisation of *knowledge for SD*. Recent trends and insights on knowledge production for SD within academic fields of sustainability reserach confirm this urgent need.

As pointed out, SD's normative character and its long-term horizon result in specific demands for science and a specific way of knowledge creation. The legitimacy of this knowledge depends on the process by which it is generated. It needs to be co-produced and provisional, by aiming at bridging epistemologies, worldviews and viewpoints that are relevant for the context in which SD has to be applied in order to generate '*best available' knowledge* and *know-how* to address the sustainability issues involved. Science for SD is then defined as an *integrative* science, aiming at transcending and reconciling different disciplines, worldviews, viewpoints and their knowledges towards generating shared and co-produced knowledge in the scope of an *integral* and balanced view on sustainability. Elaborated by concepts like e.g. sustainability science, this demands for a *systems* approach, emphasizing the primacy of the whole and respecting heterogeneity. This requires thorough *trans*disciplinarity, that is not limited to the combination of different sciences *within* a science field or to the compilation of different disciplines without true interaction or integration. (Rist & Dahdouh-Guebas 2006: 471, Blanchard & Vanderlinden 2010)[13] Transdisciplinarity acknowledges that science is part of the processes it describes and is therefore focusing on a systemic view of social and natural dynamics that are shaping the world. It also recognizes the plurality of forms of knowing, worldviews and the values connected to them within different social and cultural groups. (Scholz et al. 2000) A certain amount of subjectivity awareness and recognition of *contextuality* is a key element in achieving transdisciplinary knowledge for SD. In this context we suggest *broadening the definition of expertise* and *articulating the global and the local*.

Literature:

1. Apostel, L.: *Wereldbeelden en ethische stelsels.* Brussels: Vubpress, 2002. 208 p. ISBN 9789054873174.
2. Appadurai, A: *Modernity at large: Cultural dimensions of globalization.* Public Worlds Vol. 1. Minneapolis: Minneapolis University Press, 2003. 229 p. ISBN 9780816627936.
3. Bateson, G.: *Steps to an Ecology of Mind.* New York: Ballantine, 1972. 517 p. ISBN 0345273702.
4. Bell, S., Morse, S.: *Sustainability Indicators – Measuring the Immeasurable. Second Edition.* London: Earthscan, 2008. 228 p. ISBN 9781844072996.
5. Bell, S., Morse, S.: *The role of Sustainability Indicators within evidence-based policy for sustainable development in the European Union.* Proceedings of the Conference of the International SD Research Society Hong Kong, 2010.
6. Blanchard, A., Vanderlinden, J.P.: *Dissipating the fuzziness around interdisciplinarity: the case of climate change research.* Sapiens, 3, 2010: 65-70.
7. Dove, M.R., Carpenter, C.: *Environmental Anthropology. A Historical Reader.* Oxford: Blackwell Publishing, 2008. 480p. ISBN 9781405111379.
8. Funtowicz, S.O., Ravetz, J.R.: *Three Types of Risk Assessment and the Emergence of Post-Normal Science.* In Krimsky, S., Golden, D. (Eds.) *Social Theories of Risk.* Westport, CT: Greenwood, 1993. Pp. 251-273. ISBN 9780275943172.
9. Funtowicz, S., Ravetz, J., O'Connor, M.: *Challenges in the use of science for sustainable development.* International Journal for Sustainable Development, 1, 1998: 99-107.
10. Gottlieb, R.S.: *Religion and Ecology.* Oxford: Oxford University Press, 2006. 662 p. ISBN 9780195178722.
11. Grist, N.: *Positioning climate change in sustainable development discourse.* Journal of International Development, 20 (6), 2008: 783-803.
12. Guattari, F. : *Les trois écologies*. Paris: Editions Galilée, 1989. 72 p. ISBN 9782718603513.
13. Guattari, F. : *Chaosmose.* Paris: Editions Galilée, 1992. 186 p. ISBN 2718604018.
14. Haverkort, B., Reijntjes, C.: *Moving Worldviews. Reshaping sciences, policies and practices for endogenous sustainable development.* Leusden: ETC/Compas, Compas series on Worlviews and sciences 4, 2007. 432 p. ISBN 9077347100.
15. Haverkort, B., Rist, S.: *Endogenous Development and Bio-cultural Diversity. The interplay of worldviews, globalization and locality*. Leusden: ETC/Compas, Compas series on Worlviews and sciences , 2007. 447 p. ISBN 9789077347140.
16. Hirsch Hadorn, G.: *Unity of knowledge in transdisciplinary research for sustainability. Encyclopedia of Life Support Systems (EOLSS).* Oxford: Eolss Publishers, 2002. ISBN 9781848269828.
17. Hulme, D., Toye, J.: *The Case for Cross-Disciplinary Social Science Research on Poverty, Inequality and Well-Being.* Journal of Development Studies, 42, 2006: 1085-1107.
18. Igoe, J., Brockington, D.: *Neoliberal Conservation: A Brief Introduction*. Conservation and Society, 5 (4), 2007: 432-449.
19. Igoe, J., Sullivan, S., Brockington, D.: Problematising *Neoliberal Biodiversity Conservation: Displaced and Disobedient Knowledge.* Current Conservation, 3 (3), 2009: 4-7.
20. Jepson Jr., E.J.: *Human Nature and Sustainable Development: A Strategic Challenge for Planners*. Journal of Planning Literature, 19 (1), 2004. DOI 10.1177/ 0885412204264529.
21. Kemp, R., Martens, P.: *Sustainable development: how to manage something that is subjective and never can be achieved?* Sustainability: Science, Practice & Policy, 3, 2007: 5-14.
22. Laes, E., Maes, F.: *Sustainability assessment: concepts and methodology*. SEPIA Deliverable 1. 1a. Research Programme 'Science for a Sustainable Development'. Brussels: Belgian Science Policy, 2008.
23. Lafferty, W.M., Meadowcroft, J. *Implementing sustainable development. Strategies and initiatives in high consumption societies.* Oxford: Oxford University Press, 2000. 523 p. ISBN 9780199242016.
24. McKee, R.G.: *Storytelling for Peace*-Building*: Towards sustainable Cultural Diversity*. In GIALens: 3. http://www.gial.edu/GIALens/issues.htm, 2008.
25. Nurse, K.: *Culture as the Fourth Pillar of sustainable Development.* London: Commonwealth Secretariat, 2006.

[12] It will lead to 'outside the box' thinking and to innovative solutions for complex societal challenges.

[13] It is an evolving process of knowledge construction (through the sharing of approaches) requiring deep co-operation between disciplines to arrive at a shared understanding of issues. (Blanchard & Vanderlinden 2010)

http://www.fao.org/sard/common/ecg/2785/en/cultureas4thpillarsd.pdf
26. Prigogine, I., Stengers, I.: *Order Out of Chaos*. London: Bantam Books, 1984. 349 p. ISBN 9780553340822
27. Ravetz, J.: *Post-normal science – an insight now maturing.* Futures, 31, 1999: 641-646.
28. Rist, S., Dahdouh-Guebas, F.: *Ethnosciences – A step towards the integration of scientific and indigenous forms of knowledge in the management of natural resources for the future.* Environment, Development and Sustainability, 8, 2006: 467-493.
29. Schlitz, M.M., Vieten, C., Miller, E.M.: *Worldview Transformation and the Development of Social Consciousness.* Journal of Consciousness Studies, 17 (7-8), 2010: 18-36.
30. Scholz, R.W., Häberli, R., Bill, A., Welti, M.: *Transdisciplinarity: Joint problem-solving among science, technology and society.* Zürich: Haffmanns Verlag, 2000. 667 p. ISBN 9783251400188.
31. Sumner, A., Tribe, M.: *Development Studies and Cross-Disciplinarity: Research at the Social Science-Physical Science Interface.* Journal of International Development, 20 (6), 2008: 751-767.
32. UNESCO: *Universal Declaration on Cultural Diversity*. Paris: UNESCO, 2002.
33. UNESCO-UNEP: *Round-table discussion*. Johannesburg: World Summit on Sustainable Development (WSSD), September 3rd 2002.
34. van Egmond, N.D., de Vries, H.J.M.: *Sustainability: The search for the integral worldview.* Futures, 43, 2011: 853-867.
35. Van Opstal, M., Hugé, J.: *Knowledge for sustainable development: a worldviews perspective.* Environment, Development and Sustainability, 15 (3), 2013: 687–709. DOI 10.1007/s10668-012-9401-5.
36. WCED: *Our Common Future. Report of the World Commission on Environment and Development.* Published as Annex to the General Assembly Document A/42/427. United Nations, 1987.
37. Weyns, W.: *The Cultural Filter*. In Nath, B. et al. *Environmental Management in Practice. Volume 1. Instruments for Environmental Management.* London and New york: Routledge, 1998. Pp. 44-61. ISBN 9780415149068.
38. World Commission on Culture and Development (WCCD): *Our Creative Diversity*. Paris: UNESCO, 1995.
39. WSSD: *World Commission on Sustainable Development.* Johannesburg, South-Africa, 2002.

Primary Paper Section: A

Secondary Paper Section: AA, AC, AL, EH