

Sustainability in Higher Education

Benefits and career prospects with an interdisciplinary higher education degree

Aikaterini Boutou

Master Thesis Series in Environmental Studies and Sustainability Science,
No 2013:014

A thesis submitted in partial fulfillment of the requirements of Lund University
International Master's Programme in Environmental Studies and Sustainability Science
(30hp/credits)



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Sustainability Studies



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Submitted May 18, 2013

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ABSTRACT

This is a study about sustainability in higher education, its benefits and employment potentials for sustainability graduates, as well as, contributions to sustainability through professions. The aim was to identify sustainability in higher education and the importance of interdisciplinarity on it through theory and a study sample of five master programs and find out benefits of such programs, career opportunities and potential contributions to sustainability via professions based on Lund University's International Master Program in Environment and Sustainability (LUMES) alumni opinions. The last one was carried out through in depth interviews of 15 graduates of the LUMES program and the conducted data analysis was theoretic for sustainability in higher education, descriptive and comparative for the master programs and thematic for the graduates' perspectives. The results indicated that sustainability in higher education is a vague but feasible concept and interdisciplinarity plays an important role on it. Universities have a wide range of different sustainability master programs that can be either more practical or more theoretical and the first ones offer more career opportunities to sustainability graduates. Moreover, master graduates gain valuable knowledge, develop their skills during their sustainability studies and they will possibly become project managers or sustainability – environmental consultants. The contributions to sustainability through related job positions vary from informing colleagues and co- employees on sustainability to obliging companies on adopting sustainability patterns. The principal conclusion was that interdisciplinarity is a matter of vital importance both on promoting sustainability in higher education and linking the differences between isolated specialization of the job market and the required holistic approach for sustainability.

Keywords: sustainability, sustainability science, interdisciplinarity, sustainability in higher education, career opportunities

Word count: 13.907

ACKNOWLEDGEMENTS

First and foremost I would like to thank my wonderful supervisor, Vasna Ramasar for her overall support, patience and valuable help throughout the thesis preparation process. Moreover, I want to thank to professors Barry Ness and Kim Nicholas, as well as, Chad Boda and David O' Byrne for enlightening me with useful information and material. Special thanks to all the LUMES alumni participants of my research, my mother Stella Maggina, my father Yiannis Boutos, my brother Nassos Boutos and my friend Ana-Maria Vizireanu.

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1. INTRODUCTION

1.1 Background

Sustainable development has become a priority in the last decades and an increasing number of universities are concerned about sustainability. There are various university programs around the world that provide sustainability education in a scientific context, like the LUMES one (Lund University International Master's Program in Environmental Studies and Sustainability Science) where the most important admission criteria are internationality and interdisciplinarity (LUMES presentation, 2013, p.2). Nevertheless, few current students of the LUMES program are not aware of what career path they are willing to choose after their graduation which can be attributed to the complexity of sustainable development (MCH Report-Jobs after LUMES, 2013). At this point, it is important to link sustainability knowledge within higher institutions and practice by giving emphasis to what is sustainability in higher education, what do students gain from that field of study, what are the prospects and how is possible to contribute to sustainability.

1.2 Research Questions

The purpose of this study was to investigate the status of sustainability in higher education, especially in interdisciplinary master programs, the career opportunities for such graduates and their contribution to sustainability as professionals. Three research questions were designed for this investigation.

What is sustainability in higher education and why interdisciplinarity is important for it?

What does sustainability in higher education look like?

What area)the benefits from interdisciplinary master programs in sustainability education, b)the career prospects and the potential contributions of the graduates to sustainability through their career?

1.3 Structure of the thesis

In the first chapter, it is provided background information on the problem, purpose of the study and the research questions while the second chapter presents the methodological process of the research about the data sources, collection and analysis along with the limitations. The third chapter is the research question one and the theoretical framework of sustainability in higher education which stresses the importance of interdisciplinarity on it. Chapter four is the analysis and

comparison of five interdisciplinary master programs as successful paradigms of sustainability education in practice. The fifth chapter is about the benefits of such programs, career prospects and contributions to sustainability according to the LUMES alumni perspectives; the sixth is the overall discussion part and the seventh the conclusion one.

2. METHODOLOGY

2.1 Data resources and collection

Theories, definitions and frameworks were used for the first research question regarding sustainability, sustainable development and sustainability science in higher education and the role of interdisciplinarity in it by distinguishing the concepts of sustainability, sustainability science, sustainable development, education for sustainability, sustainability in higher education and interdisciplinarity. The sources were found on journal articles and official documents of United Nations.

The second research question is about 5 leading sustainability master programs from 5 prestigious universities - Arizona State University, Columbia University, Maastricht University, the University of Tokyo and Lund University - through internet-based and journal article research. The selection criteria for these programs were their international status, their leadership in sustainability education and research, as well as, the entry requirements for future students and university curricula.

In question three, 15 in depth interviews were conducted on LUMES alumni people concerning their perceptions on the LUMES program, their current career status and their contribution to sustainability as professionals. The focus group are 15 LUMES graduates, an absolute and relative sample (Bryman, 2008, p. 179) of 6 men and 9 women from various batches and countries where the vast majority of them were interviewed via Skype and only one respondent in person. A combination of two sampling methods was used; convenience sampling because it was relatively easy to access LUMES alumni people as interview candidates (Bryman, 2008, p. 183) and purposive sampling because the respondents must have been practitioners that were currently employed (Bryman, 2008, p. 414) so as to indicate a variety of career prospects in the domain of sustainability. This means that sampling bias was taken into account as it was intended to limit the responses from doctoral students and exclude unemployed graduates as a group (Bryman, 2008, p. 168). The academic background of the sample is quite diverse and this is an important finding for the study as it demonstrates and verifies the interdisciplinary nature of LUMES. All of them completed different

programs before LUMES as they have bachelors in management, physics, law and politics, projectmanagement, international and European studies, development studies, media and journalism, international business and management, biology, general psychology, environmental science, software engineering, international relations, aero – space engineering and technology policy and finally geology. Consequently, there are 6 graduates from sciences and social sciences in each group, as well as, 3 from business or management schools (Figure 1).

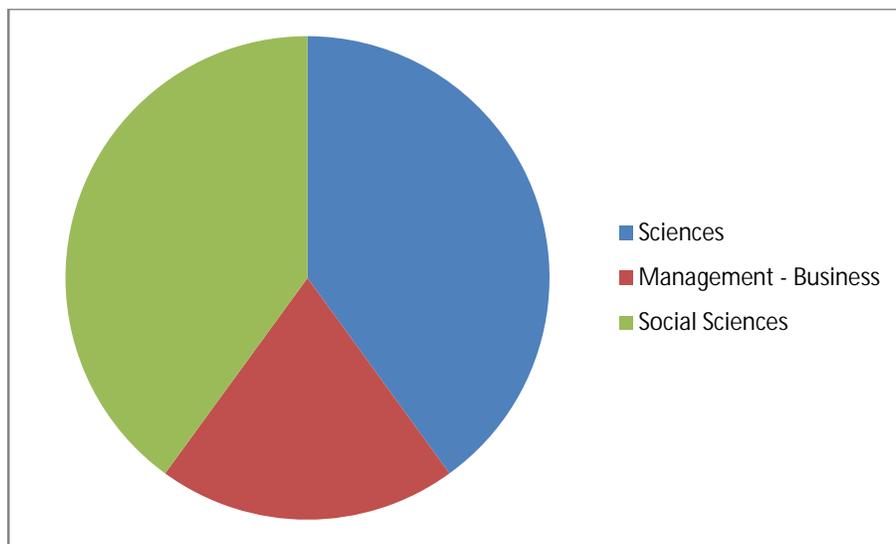


Figure1: Academic background before LUMES

In terms of their current employment status, the plurality works either as project manager – officer or as sustainability consultant (3 in each) and only two people as PhDs. Others are employed as project developers, health, safety and environment advisors, program managers, project coordinators, energy analysts, geologists, and facilitators. It is observed that 6 people are involved with projects (managers, developers, coordinators) and the vast majority works for the private sector – 10 out of 15 people – while there is only one in the private sector, 2 in nonprofit organizations and 2 PhDs as mentioned above (Figures 2 and 3).

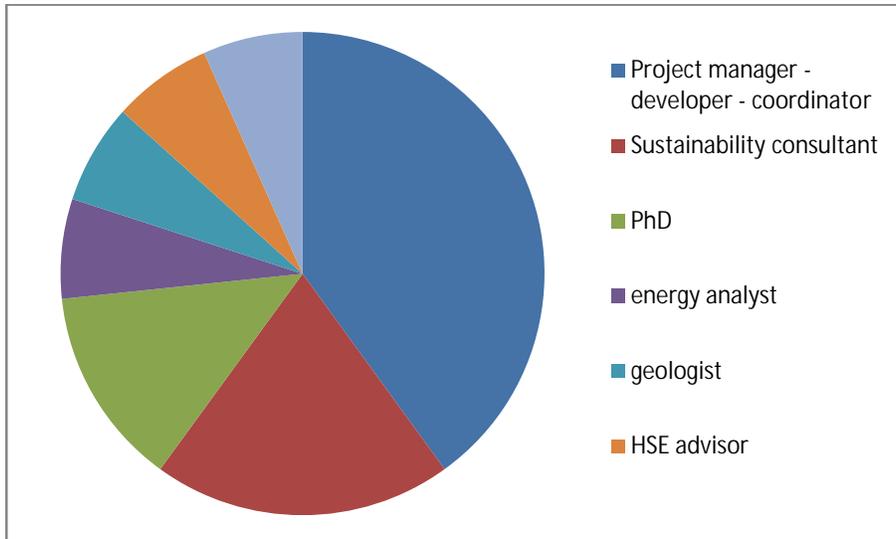


Figure2: Current professions

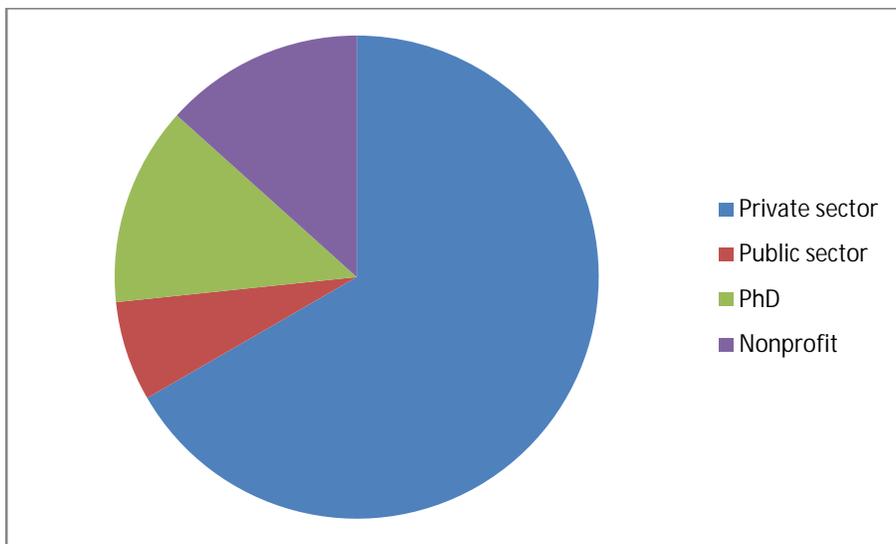


Figure3: Sectors of employment

The approach process of the interview candidates was electronic via the e-mail addresses that were found on an alumni database provided by LUMES professor Kim Nicholas and via social networks like Facebook and LinkedIn. There are two core research questions where the structure of interview is based on; a) what do LUMES graduates have gained from an interdisciplinary sustainability master program and b) what jobs do these graduates go into and how do they contribute to sustainability as professionals. The reasons for selecting these questions were to investigate the general impressions

on the program, where do LUMES graduates work, how and if they use LUMES knowledge on their current jobs, the potential career prospects for sustainability master graduates and how do these graduates contribute to sustainability through their chosen careers.

2.2 Data analysis

For research question one, there is theoretic analysis of the three concepts of sustainability, sustainable development and sustainability science, as well as, the ones of education for sustainability, sustainability in higher education and interdisciplinarity. In question two, there is descriptive and comparative analysis of the five master programs in terms of university curricula, practical experience for students through the programs, leadership in research and admission criteria for future master candidates.

Qualitative methods approach was used for research question three (thematic analysis) for the in-depth interviews. It is a case study where a single community, the LUMES graduates, is analyzed in details (Bryman, 2008, p.52) regarding their perceptions on LUMES, their career choices and contribution to sustainability. The thematic analysis is divided in two main sections; 1) benefits of LUMES and 2) career prospects and contribution to sustainability. The section of benefits includes three themes: a) LUMES education on providing sustainability knowledge and enhancing capacities, b) LUMES's interdisciplinary and transdisciplinary character and c) LUMES's contribution to sustainability via its graduates. The career prospects part has two themes: a) career prospects for sustainability graduates and selection criteria and b) contribution to sustainability via jobs.

2.3 Limitations

As for the limitations, the time to investigate candidate respondents to the interviews was quite limited, as well as, the availability of time for those who participated in the research. The qualitative method also entails errors both in understanding and answering exactly to the questions from the part of the interviewees and interpretation from the part of the interviewer.

The 15 respondents are 9 women and 6 men from various countries and LUMES batches who are all currently employed with average age of 30 years. Almost all of them are practitioners as they were only 2 PhDs who participated. Concerning the countries of origin (Graph 4), most of the interviewees come from Europe (7 in total: 2 respondents from Greece and each one from France, UK, Sweden,

Italy and Germany) and the rest were from North America (3 in total: 2 from USA, 1 from Canada), South America (1 from Brazil), Asia (3 in total: each one from Japan, India and Azerbaijan) and Africa (1 from Zimbabwe). As for the countries where they currently live and work (Figure 5), it seems that Europe is still dominant with 7 people in total (2 in Greece, 2 in Sweden, 1 in UK, 1 in Belgium and 1 in France) while others are in North America (1 in Canada), in South America (1 in French Guiana and 1 in Brazil), in Asia (3 in total: each one in Japan, India and Azerbaijan), in Africa (1 in South Africa) and one in Australia.

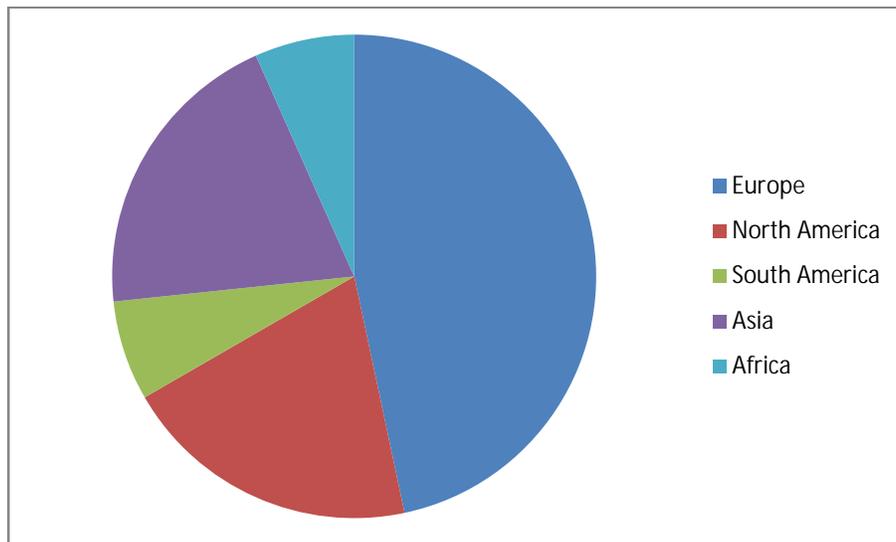


Figure4: Continent origin profile of LUMES alumni participants

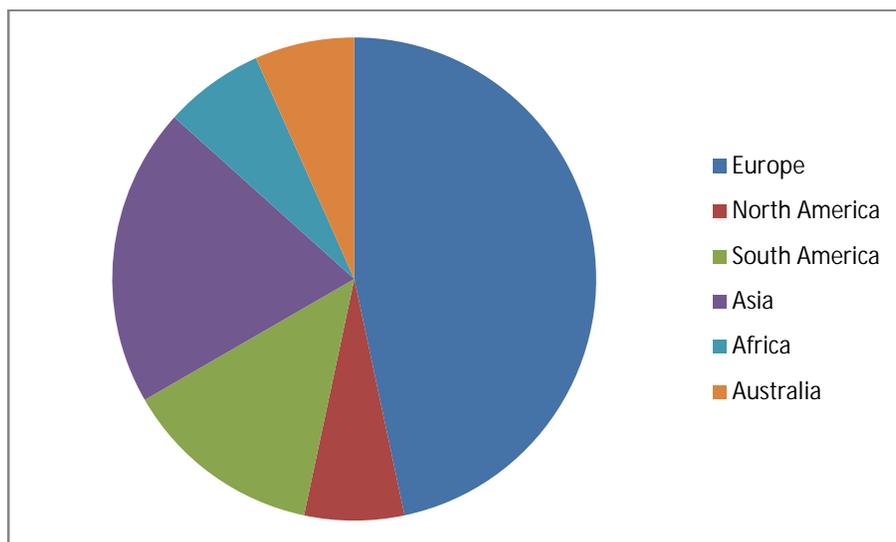


Figure5: Continents where LUMES graduates are currently based

The batches with the higher response rate (Figure 6) were the 12th and the 13th with 4 respondents from each and the following ones were the 10th (2 participants), the 14th (2 participants), as well as, the 5th, 9th and 11th with one from each.

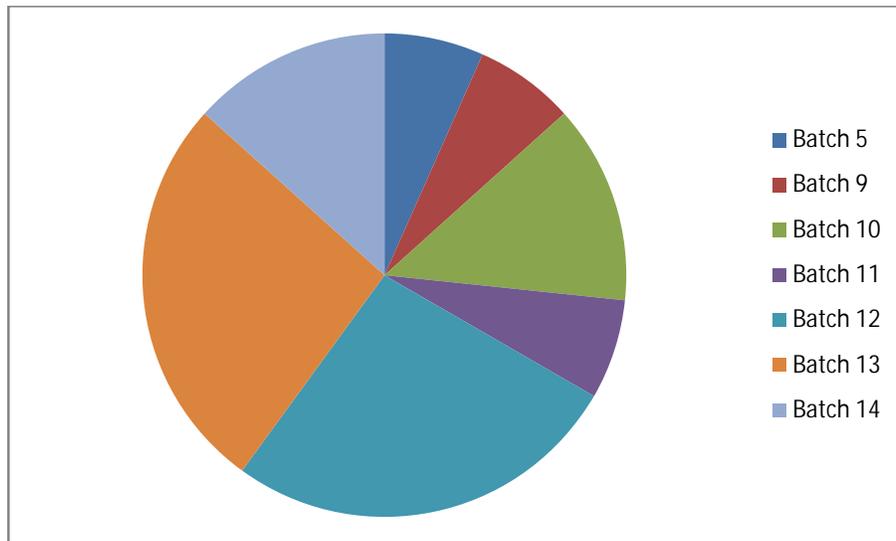


Figure6: Batch profile of LUMES respondents

3. SUSTAINABILITY IN HIGHER EDUCATION AND THE IMPORTANCE OF INTERDISCIPLINARITY

3.1 Introduction

This research question covers the theory part of the study by investigating the nature of sustainability, sustainability education, sustainability in higher education and interdisciplinarity. It begins with the distinctions and clarifications among sustainability, sustainable development and sustainability science by mentioning the most common definitions on these and continues with the concept of Education for Sustainable Development and that one of sustainability in higher education. Afterwards, there is a description about the declarations that have framed sustainability in higher education (Figure 1) and a useful framework on integrating sustainable development on higher education, especially in university curricula (Figure 2). Furthermore, it clarifies derivatives of discipline like interdisciplinarity, multidisciplinary, transdisciplinarity and it gives emphasis on the

interconnection between sustainability, especially in higher education institutions and interdisciplinarity, as well as, the importance of the last one.

3.2 The context of Sustainability, Sustainable Development and Sustainability Science

Living at the dawn of the globalized 21st century, humanity is still facing a whole series of planetary challenges like illiteracy, environmental degradation and unequal wealth distribution which deteriorate the quality of human, animal and plant life to a great extent. This situation has raised people's concern, as our current lifestyle and development trends are not compatible with a sustainable future. However, before moving further, it is important to clarify that there are three different terms about this concept; sustainability, sustainable development and sustainability science.

To begin with, according to the Oxford dictionary (1995, p. 1205) sustainable is something that can be maintained and consequently sustainability is the ability of maintenance or endurance. The word sustainability was originally used in the 18th century for "German forestry management practices" and it appeared in dictionaries on 1972 (Le Grange, 2011, p. 742). The primary mainstream sustainability concern was observed around the 70s as the international community recognized that the environmental degradation would sooner or later affect the economic stability and social development to a great extent (McFarlane and Ogazon, 2011, p. 82; Clugston and Calder, 1999). The Stockholm Declaration on the Human Environment was influence on the above fact, as it was the first official statement about sustainability with focus on environmental law and the interconnection between the environment and humanity (Wright, 2002, p.2).

A crucial attempt to define sustainability and underline the essential connection between sustainability and development dates back to 1987, as the term Sustainable Development was initially used in the Brundtland Report of United Nations of that year titled as "our common future". In the Brundtland Report, the definition of sustainable development was framed as "the ability to make development sustainable" when we "ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p.8). After that, the concept of Sustainable Development (SD) was internationally acknowledged and as a result, people had a deeper concern on such issues and challenges; since then there have been numerous interpretations, approaches and definitions for it and despite the above specific one, there is no a generally accepted one (Lozano, 2006, p. 787). Throughout the years, the meaning and goals of SD became more and more specific with highlight the United Nations World Summit on Social Development which introduced the three pillars of sustainable development – economic

development, social development and environmental protection – and the promotion of their integration (WSSD 2005, pp.11 – 12).

As for the term of sustainability science, it appeared for the first time on the World Congress “Challenges of a changing earth 2001” in Amsterdam and it has its roots on sustainability and sustainable development (MEXT official website, 2013). In the last years, sustainability science has been developed as a new academic discipline (Kajikawa et al., 2007, p. 221; Kates et al., 2001; Mihelcic et al., 2003; Clark and Dickson, 2003; Reitan, 2005 and Komiyama and Takeuchi, 2006) with an increasing number of academic articles but yet no commonly accepted definition – like sustainable development – (Kajikawa et al., 2007, p. 222; Komiyama and Takeuchi, 2006). For Clark and Dickson (2003, p. 8060) “sustainability science focuses on the dynamic interactions between nature and society”, as well as, it is “not an autonomous field but vibrant arena that brings together scholarship and practice, global and local perspectives from north and south and disciplines across the natural and social sciences, engineering and medicine”. The citation network of the sustainability science academic articles - in total 29.391 papers until 2007 - includes key clusters that vary from agriculture to ecological economics, from business to health and from water to urban planning (Kajikawa et al., 2007, p.223 – 225).

3.3 Education for Sustainable Development

In terms of education, it is a key tool towards sustainable development as the learning process can provide deeper information to the people about sustainability challenges by influencing their current mentality (McFarlane and Ogazon, 2011, p. 83). Both sustainability and environmental education are different but they share some common topics for analysis such as renewable energy, agriculture and ecosystems, therefore, various scientific debates take place regarding their differences as well as their definitions (Le Grange, 2011, p.743). Stockholm’s declaration on human environment and Agenda 21 (chapter 36) from the 1992 UN conference on environment and development are amongst the documents that highlighted education’s importance for sustainability (Khalifa and Sandholz, 2012, p.346).

It is worth mentioning that the Agenda 21 of 1992 was the basis for framing the Education for Sustainable Development (ESD) – the most common approach of sustainability teaching practices – along with the report of the UN Commission of Sustainable Development in 2002. The concept of ESD involves objectives related to the respect of human life, the development of critical thinking and responsibility, as well as, the comprehension of “environmental values” and “interdisciplinary relations” (Petrovic et al., 2012, p.34; DESD, 2009). The Decade of Education for Sustainable

Development (DESD) of United Nations was an important step towards “the integration of the principles, values and practices of sustainable development into all aspects of education and learning” (Fadeeva and Mochizuki, 2010, p. 254). The above goals are valuable for achieving the transition to a more sustainable living for the present and the upcoming generations within the three pillars of sustainability.

However, sustainability and its education still remain ill-defined (McFarlane and Ogazon, 2011, p. 81) and this has led to several attempts in order to identify the exact meaning of them. For instance, the Higher Education Sustainability Act (HESA) was introduced in 2008 by the U.S. Congress (Fadeeva and Mochizuki, 2010, p. 251) with the aim of hosting a summit on Sustainability in Higher Education by bringing together sustainability academics and practitioners in order to collaborate on sustainability projects (Miller, 2011, no page found). More specifically, HESA was a University Sustainability Program (USP) approved by the American Department of Education that cost approximately 50 million dollars and there were “increasing calls to define what this means exactly – what sorts of content, pedagogical, education theory revisions are necessary in higher education” (Fadeeva and Mochizuki, 2010, p. 251).

3.4 Sustainability in Higher Education

Higher Education Institutions (HEIs) play a crucial role on sustainability awareness and problem solving of sustainability challenges through “education, research and outreach” (Fadeeva and Mochizuki, 2010, p. 250). According to Tony Cortese, “Higher Institutions have the unique freedom to develop new ideas, comment on society and engage in bold experiments, as well as to contribute to the creation of new knowledge” (Wals and Jickling, 2002, p. 224; President’s Council on Sustainable Development, 1995, p. 5). This is meaningful statement as it justifies a new approach to problems – such a new approach is required to address sustainability challenges which are more complex than other challenges we have faced in the past. New knowledge is therefore required for sustainability and universities are appropriate for using such knowledge in developing, promoting and applying the values and ideas of sustainable development, not only by formulating a clear definition but also by permitting students to contribute in the real-problem solving processes. Furthermore, Higher Education Institutions (HEIs) with expertise in sustainability can provide useful knowledge and competences to budding sustainability scientists who can contribute in SD through their professions and future careers in decision-making or policy making (Barth and Timm, 2010 p. 13; Cortese, 2003, Gough and Scott, 2007; Fien, 2002 and Moore, 2005).

The current challenge of Higher Institutions, in terms of education, research and outreach, is to put the ill-defined Sustainable Development into effect and, simultaneously, move beyond traditional the Newtonian and Cartesian models as educational practices (Lozano et al., 2011, pp. 1-2). It is essential to point out that these models are based on reductionism – analysis of the component parts individually “followed by regeneration through the reassembly of parts” – and mechanistic interpretation (Lozano et al., 2011, p.1; Lovelock, 2007). Consequently, these are inadequate for solving real world complex problems because “reductionism”, “mono – disciplinary education” and “testing by repetition” (Lozano et al., 2011, p. 2; Burke, 2000, Lozano, 2000) provoke behaviors like individualism, self-interest (Lozano et al., 2011, p. 2; Lozano, 2007; Stead and Stead 1994), intense competition (Lozano, 2011, p.2; Cortese, 2003) and overspecialization (Lozano, 2011, p.2; Cortese 2003; Costanza, 1991). As a result, sustainability education, especially in HEIs, requires transition from theory to practice (Khalifa and Sandholz, 2011, p. 347) and holistic approach – a practice that “analyzes a thing from the outside and asks questions about how it works” (Lozano et al., 2011, p.1; Lovelock, 2007).

Sustainability in Higher Education has been mainly framed through important declarations (Figure 7) and institutional policies both in international and national level (Wright, 2002, p. 1). The content of these declarations covered issues of sustainability in the university system like curricula, research, interaction with stakeholders and sustainability practices (Lozano et al., 2011, p. 1). For the last 23 years, eleven declarations, charters and partnerships have been signed in order to implement the context of SD in HEIs; a number of such declarations include the Stockholm of 1972 – mentioned above – the Tbilisi one (1977), Talloires (1990), Halifax (1991), Kyoto (1993), Thessaloniki (1997), Lüneburg (2001) and Abuja (2009)(Lozano et al, 2011, p. 3).

The Declaration of Tbilisi played an important role on the “evolution of international sustainability declarations related to education” by declaring the right for environmental education in all ages and levels of education (Wright, 2002, p.2). Wright (2002, p. 2 -3) has also mentioned that “the Talloires Declaration was the first statement made by university administrators of a commitment to sustainability in higher education”. As for the following ones of the 90s, the Halifax gave emphasis on the influence of universities on governments on approaching environment and development issues, the Kyoto highlighted that specific plans should be followed by universities for the goals of sustainability and the Thessaloniki one declared the importance of implementing environment and sustainable development in all subject disciplines through a holistic perspective (Wright, 2002, pp. 4 - 7).

The Lüneburg declaration - supported by the Global Higher Education for Sustainability Partnership (GHESP) – was signed in 2000 but took place between 2003 and 2007 – which introduced eleven fields that universities should develop in order to achieve sustainability in societal level. Areas like assessment and reporting, research and scholarship, curriculum teaching, physical infrastructure, student life, strategies for change, development and training were taken seriously into account for an academic shift towards sustainability (Fadeeva and Mochizuki, 2010, p. 252). Regarding the Abuja one of 2009, it acclaimed the necessity of transdisciplinarity and collaboration between HEIs in terms of curricula, research, operations and outreach (Lozano et al., 2011, p. 8).

All these above declarations emphasize numerous sustainability issues within the academia concerning environmental degradation, the role of universities and transdisciplinarity on promoting sustainability, implementation of sustainability courses in all academic disciplines, as well as, sustainability research development, collaboration amongst universities and stakeholder participation (Lozano et al., 2011, p. 3). There is, also a clear distinction between sustainability in the practices of the university such as waste management and paper use versus sustainability incorporated into the curricula taught to the students. For instance, universities like Waterloo, Buffalo, South Carolina, Toronto, and George Washington have individually contributed to sustainability of higher education by introducing institutional policies with focus on both sustainable physical operations and environmental education (Wright, 2002, p. 8-9).

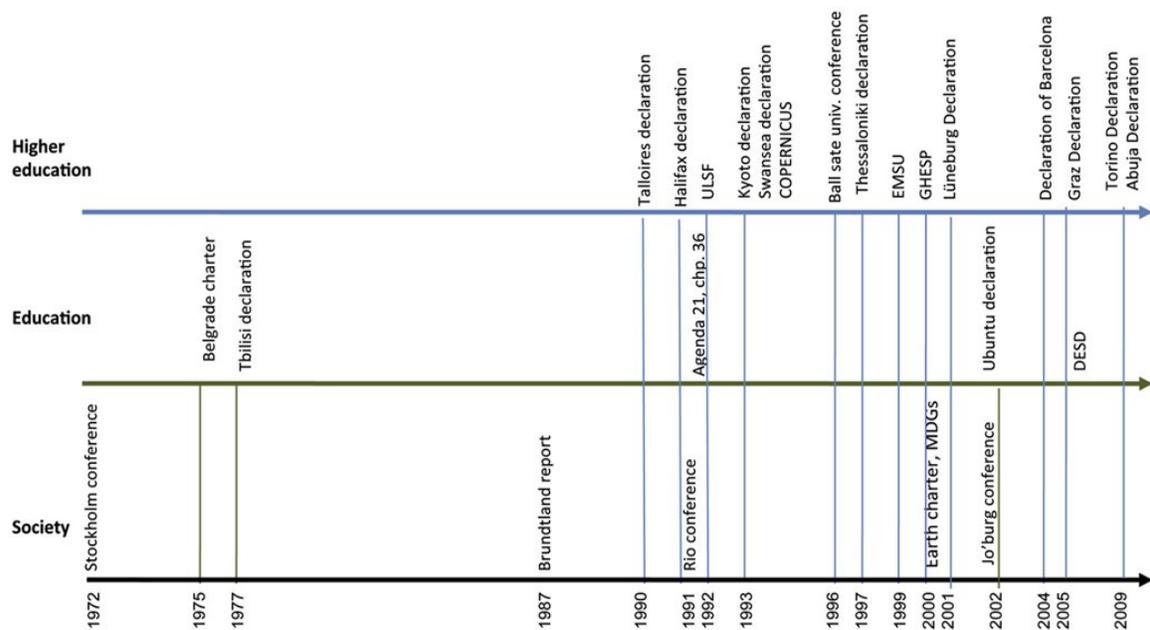


Figure 7: Timeline of declarations, charters and partnerships for sustainability (Source: Lozano et al., 2011, p.4)

In the last years, various sustainability “educational approaches” have been successfully applied in certain HEIs; however, it is still unknown if they are appropriate for other countries and institutions due to the fact that they have not been tested yet in a global scale (Editorial-Journal of Cleaner Production, 2006, p.757). University curricula on sustainability are a valuable indicator to observe such successful educational models. For instance, an intriguing approach by Barth and Timm (2010, pp. 14 - 15) has to do with an innovative model of implementing sustainable development through four steps of integration into university curricula (Figure 8). Inclusion of topic, new learning approaches, development of independent courses and integration in existing curricula are the four steps that can followed either as a whole or partially regarding the integration of SD in universities. More specifically, the inclusion of topic can be achieved with lecture series at universities and it is the simplest way to implement SD both on undergraduate and graduate programs that might not be familiar with sustainability like business or law ones. The new learning approaches that can deal with self – directed or problem – oriented learning is one step further on SD integration where students could be able to develop competences in sustainability (Barth and Timm, 2010, p. 14).

At this point, it should be stressed that “competence in sustainability research and problem solving means having the knowledge, skills and attitudes necessary for successful task performance and problem – solving with respect to real – world sustainability challenges and opportunities” (Wiek et al., 2011, p. 5). The five key competences are systems thinking (analysis from a holistic standpoint), anticipatory (“non – intervention” future scenarios of the problem), normative (assess the problem with sustainability values), strategic (design sustainability scenarios) and interpersonal (managing problem – solving through negotiation and communication). All these interact together by linking knowledge from different disciplines and action for sustainability solutions (Wiek et al., 2011, pp. 5-8). Back to the steps of integrating SD, the development of independent courses via specific study programs is a deeper approach that can be applied in various disciplines either in one theme or multiple oriented ones such as physics or international studies. In the highest place of the hierarchy is the integration of SD in existing curricula where a potential curricula reform with sustainability courses indicates the adaptation of the program to understanding and solving complex issues (Barth and Timm, 2010, p. 14 -15).

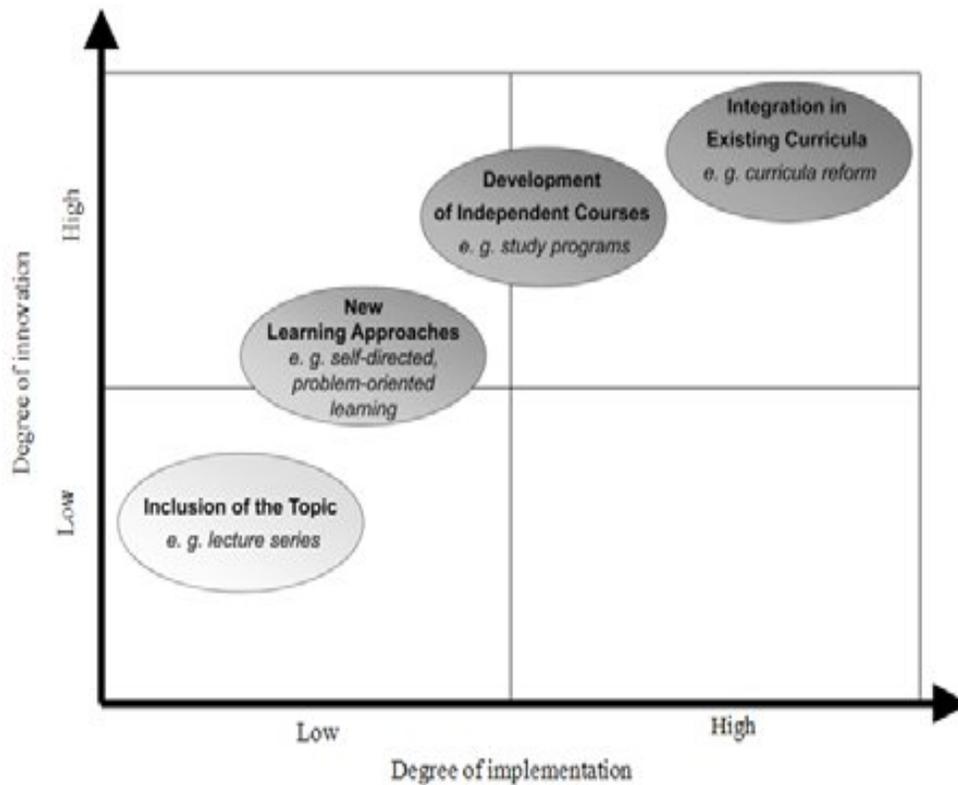


Figure 8: Steps of integration of sustainable development in Higher Education (Barth and Timm, 2010, p. 14)

3.4.1 The role of interdisciplinarity in Sustainability in Higher Education

There are close-knit ties between interdisciplinarity and sustainability, as the concept of the first is frequently found on academic articles, approaches and practices of sustainability. In this part, it is needed to distinguish the terms of disciplinarity, multidisciplinary, pluridisciplinarity, interdisciplinarity and transdisciplinarity in higher education. Disciplines are “subjects of instruction” (Oxford Dictionary, 1995, p. 329) that offer methodologies, language tools, rules, technologies and areas of study (Petts, Owens and Bulkeley, 2008, p. 596) via specialization in isolation (Max-Neef, 2005, p. 7).

Multidisciplinarity is the acquisition of knowledge in more than one different subject areas with lack of connection between them and lack of cooperation between students or researchers (Feng, 2012, p. 32). In pluridisciplinarity, there is cooperation but no coordination (Max-Neef, 2005, p. 7). The opposite of the above is interdisciplinarity which involves “coordination” between different scientific disciplines “of a lower level from a higher one” (Max-Neef, 2005, p.6) and students or learners can

combine knowledge from different disciplines and cooperating with a critical point of view since “a single way of knowing is insufficient for understanding the complexity of the world (Feng, 2012, p. 32; Miller et al., 2008). This occurs because “understandings change in response to the perspectives of others” (Petts, Owens and Bulkeley, 2008, p. 596), hence, students think beyond the box and collaborate efficiently in the problem – solving process. Finally, according to Max-Neef (2005, p. 7) transdisciplinarity is “the result of coordination between all hierarchical levels” that were mentioned before; disciplinarity, multidisciplinarity, pluridisciplinarity and interdisciplinarity. In this context, there is intercommunication and cooperation “between academics and practitioners in order to promote a mutual learning process between them” (Steiner and Posch, 2006, p. 880).

Interdisciplinarity cannot be easily achieved as it is a hard process to work on different disciplines (Petts, Owens and Bulkeley 2008, p. 593; Evans and Marvin, 2004, p. 26). However, interdisciplinarity can be perceived as an important link between multidisciplinarity and transdisciplinarity, instead of a difficult path in education and research (Petts, Owens, Bulkeley, 2008, p. 593). Taking into account the three pillars of sustainable development – environmental protection, economic and social development – and the complexity of sustainability challenges, it is recognized that interdisciplinarity is a vital element of SD as long as sustainability learners connect knowledge from various disciplines in order to contribute to sustainable solutions. Therefore, sustainability in higher education requires interdisciplinary approaches because the second one will provide a holistic perspective on sustainability issues, especially through system thinking (Steiner and Posch, 2006, p. 879). The last one contributes to a deeper comprehension of a sustainability challenge (e.g. water scarcity, poverty) by investigating the causes, the effects and the key players (technology, stakeholders, etc.) that can bring a solution to the problem (Wiek et al., 2011, p. 6). The interdisciplinary learning process enhances, also, personal competences like group work, communication and presentation skills as the sustainability students – either in undergraduate or master programs – need to interact, collaborate and negotiate together (Steiner and Posch, 2006, p. 879 - 880). These facts demonstrate that students can develop their key competences in sustainability through interdisciplinarity in universities which is one of the most essential contributions in problem – solving complex issues.

In terms of university education, it is a matter of importance to mention that all the integration steps of sustainable development in HEIs from the above section (Figure 8) have to include an interdisciplinary approach. For instance, a lecture series on sustainability titled as “sustainability-introduction to the concept, challenges and potential solutions” at a Business School or a Political Sciences Institute cannot be conducted without taking into account the aspect of interdisciplinarity. In this case, a multidisciplinary or pluridisciplinary approach could not be an open space for

exchanging interesting ideas on the concept of sustainability, as interdisciplinarity is, through combination of knowledge in different disciplines and plurality of thinking. Another example might be the application of interdisciplinarity to a master program through curricula reform with the aim of integrating one or more courses about sustainable development in this program. At this point, interdisciplinarity could be easily achieved if these programs are already related to environmental issues or development studies and there is an annexation of a sustainability oriented course. Consequently, linking environmental problems or development challenges with sustainability require cooperation and collaboration between different disciplines, so as to provide solutions from a holistic perspective. Nevertheless, it is more difficult to integrate an interdisciplinarity approach, as well, as sustainability related courses in a mono – discipline master program that focuses on knowledge of one scientific field without including other ones (Max-Neef, 2005, p. 6).

3.5 Discussion

Sustainability, sustainable development and sustainability science are three different but highly linked concepts with various and specific definitions but no generally accepted and objective ones. Taking into account the existing complexity of sustainability and its problems, factors like education, research and outreach are key tools for promoting sustainable development, especially higher education institutions which support the development of innovative ideas and creation of new knowledge. The last one is an important element for sustainability because it is difficult to provide solutions to complex issues through the traditional Newtonian – Cartesian models and isolated specialization, as knowledge on economy, environment and society is mandatory for tackling these challenges. For this reason, an interdisciplinary learning approach is required because when students from different academic backgrounds cooperate all together in a respectful way, it is possible to solve sustainability issues from a holistic perspective.

It should be mentioned that both sustainability education and sustainability in Higher Education remain ill-defined, as sustainability itself, however, the second can be practiced successfully either in administrative level (sustainability life-style within university buildings) or in curricula level (university degrees and programs in sustainability). The above mentioned declarations were some important attempts on framing and applying sustainability including curricula and research in the field of Higher Education such as the Thessaloniki one which emphasized the importance of implementing environmental and sustainability courses in all academic disciplines. University curricula are valuable indicators for successful educational models in sustainability and the framework of Figure 8 is an

intriguing example that demonstrates a potential integration of sustainability on Higher Education degrees from lecture series to a total reshaping of existing programs.

One of main findings in this research question is that sustainability in Higher Education is a vague but manageable concept that has been formulated through international and national declarations and its core part consists of sustainability academic degrees and programs in undergraduate, graduate and doctorate level. The second main finding is the importance of interdisciplinarity in sustainability in Higher Education because it is compatible with the multifarious aspects of sustainability (environment, society and economy). Sustainability curricula in Higher Education Institutions along with interdisciplinarity can be considered as a step forward on educating future sustainability professionals, as they can develop the key competences like system thinking and analysis in order to provide sustainable solutions. This means that both higher education and interdisciplinarity incise the present and the future of sustainable development and sustainability science. As the theoretical framework was provided in this part, in the following section, there will be analysis and comparison amongst 5 different and interdisciplinary master programs in sustainability so as to indicate how sustainability in Higher Education appears to be in practice.

4. SUSTAINABILITY EDUCATION IN PRACTICE

4.1. Introduction

In this research question, five international and interdisciplinary master programs on sustainability are investigated as good and effective cases of sustainability in higher education and they were selected for various reasons. First of all, they belong to the following worldwide prestigious universities of Europe, United States and Asia – Arizona State University, Columbia University, Maastricht University, The University of Tokyo and Lund University – which are all ranked in the top 200 list of Times Higher Education world university rankings (THE official website, 2013). Furthermore, all these master programs are listed as academic programs on sustainability on the “Sustainability: Science, Practice and Policy” (SSPP) peer – reviewed open access journal which is sponsored by the ProQuest information services company (SSPP official website, 2013). Other factors for choosing these programs as strong examples are their significant departmental background, curricula, admission criteria open to interdisciplinarity, the English as the main and only language of instruction, publications, high profile professors and the broad context on sustainability they offer that varies from policy – making to sustainability management and economics. The biggest part of

the research process is internet – based and they are also sources taken from journal articles of these institutions.

4.2 Arizona State University – Master’s in Sustainable Solutions (MSUS)

Arizona School of Sustainability (ASU - SOS) – faculty of the Arizona State University (ASU) and part of the Global Institute of Sustainability at ASU – was established in 2007 (ASU – School of Sustainability official website, 2013) and as stated by Brundiers and her co-authors (2010, p.309), it is “the first school of sustainability in United States”. According to the Board of Directors of sustainability at ASU (2013), sustainability is perceived as a pattern for “promoting human prosperity and well-being for all, while protecting and enhancing the earth’s life support systems” (ASU – SOS official website, 2013). Other scholars of this faculty believe that sustainability is highly associated with justice, equity and solutions regarding environmental protection and complex challenges. The Arizona School of Sustainability educates people from different academic backgrounds about all the aspects of sustainability – economic, environmental and social– through a transdisciplinary and practical perspective with the aim of creating a new generation of problem – solving sustainability professionals, especially for urban environments (ASU – SOS official website, 2013).

ASU – SOS offers educational programs in all academic degrees, including a one-year master program in sustainable solutions (MSUS) that was, also, established in 2007. This program focuses on solving real-world sustainability challenges with specialization in one of these fields: policy and administration, technology and society, international development and Non-Profit Organization (6 – 7 elected courses per field). MSUS’s required curricula deal with the all the aspects of sustainability (environment, economy and society) with entitled courses like resource allocation, human dimensions of sustainability, as well as, sustainability and enterprise (7 courses). The other mandatory curricula provide general sustainability knowledge (2 introductory courses) and emphasize on the methodological part of sustainability, especially on GIS use, statistics and survey research – analysis (6 courses). By the end of the program, MSUS students are given the opportunity to do an applied project, a workshop or an internship – instead of a master thesis – so as to apply their gained knowledge in sustainability to their preferred area of expertise (MSUS official website, 2013).

Applicants who are willing to study at MSUS should be interested in sustainability issues, fluent in English and hold any kind of Bachelor degree since the program is interdisciplinary (MSUS official website, 2013) and all the newly-admitted students will have general introductory courses in

sustainability (Brundiers et al., 2010, p.320). During their studies, they will be able to enhance their research and analytical skills, as well as, to build the 3 “key sustainability competences” (Brundiers et al., 2010, p.310). The last ones are “strategic knowledge” via system thinking and methodology (Brundiers et al., 2010, p.310; de Han, 2006; Grunwald, 2007; Wiek, 2007), effective collaboration with colleagues within an interdisciplinary environment (Brundiers et al., 2010, p.310; de Han, 2006; Barth et al., 2007; Sipos et al., 2008) and “practical knowledge” through sustainability internship/other projects (Brundiers et al., 2010, p.310; van Kerkhoff and Lebel, 2006). These competences along with the choice of expertise in one out of four different sectors provide a very good educational basis and real-world sustainability experiences to the MSUS students which are essential tools for becoming a sustainability professional.

It should be pointed out that Arizona School of Sustainability is a widely acknowledged faculty with 71 high profile professors like Arnim Wiek who is specialist in sustainability science, urban development, decision making and participatory research and he has published 34 important peer-reviewed journal articles since 2004. Moreover, Katja Brundiers, who works as community – University liaison at the SOS faculty, has been honored with the President’s Award for Sustainability of Arizona State University in 2009 (ASU – SOS official website, 2013). In terms of the faculty’s Dean, the prestigious professor Sander Van der Leeuw is specialized in archaeology, emerging technologies and innovation and he has been awarded as Champion of Earth of Science and innovation by the United Nations (UNEP official website, 2013).

4.3 Columbia University – Master of Science in Sustainability Management (MSSM)

It might not be wise to distinguish this program of this list but, as a matter of fact, Columbia University is without a doubt one of the most prestigious universities in the world and the oldest university in the state of New York (Hirokawa and Salkin, 2010, pp.639 – 640). The Earth Institute and the School of Continuing Education – both established in 1995 at Columbia University – support the Master of Science in Sustainability Management (MSSM) as part of educating sustainability professionals since 2010 (MSSM official website, 2013; The Earth Institute at CU official website).

The Earth Institute is an interdisciplinary academy that focuses on sustainable development (Sachs, 2005, p. 1) and the basis for almost 30 research centers and 850 scholars (The Earth Institute at CU official website, 2013). In this Institute, there are scientists from various academic disciplines; environmental engineers, earth process scientists, economists, ecologists, policy makers, public health specialists, climatologists and seismologists are all collaborating together with sustainability as

a reference point by investigating the complex nature of sustainable development (Sachs, 2005, pp. 1-2) and providing solutions to issues about energy, urbanization, ecosystems, climate, public health, poverty and natural hazards (The Earth Institute at CU official website, 2013). One of its most important activities is the "Millennium Villages Project" which aims to relinquish poverty in villages of the Sub – Saharan region of Africa by providing facilities such as food production development, access to clean water and proper education (Kanter et al., 2009, p. 802). Concerning the School of Continuing Education, it offers a wide range of 13 master programs from various disciplines - including MSSM – as well as, summer sessions, post baccalaureate study in 50 different subjects and post high –school program curricular options (School of Continuing Education at CU official website, 2013).

For Jeffrey Sachs (2005, p.2), director of the Earth Institute, sustainable development is not just "the environmental sustainability of economic activity" but also a matter of development by "rising material conditions for the planet, and especially [...] for the planet's poor". MSSM is based on this philosophy since the primary concern of the program is to contribute to sustainability in the three-pillar holistic way – environment, economy and society – and therefore to create a generation of sustainability managers that comprehend "the systematic and organizational role of sustainability in every organization" (MSSM official website, 2013). The program can either be attended on full time base as a trimester (3 terms) or on part time base in 9 terms and students have to complete 11 courses in total from 26 required and elective ones (MSSM official website, 2013).

MSSM's curricula are divided in five subject areas: 1) sustainability management (integrative courses), 2) economics and quantitative analysis, 3) physical dimensions of sustainability, 4) public policy environment of sustainability management and 5) general and financial management. The integrative courses include one mandatory course on sustainability management, a workshop about real-world issues and an elective course related to sustainability management science. The area of economics and quantitative analysis offers two mandatory courses; one in general and sustainability economics and another one in statistics while the physical dimensions section provides 3 required courses from at least two different categories of the following; a) earth and environmental engineering, b) environmental planning, design or architecture and ecology or earth and environmental sciences. Finally, regarding the last two subject areas, the public policy of sustainability management has to do with one mandatory course that focuses on educating future policy makers and the general – financial management consists of two required – elective courses either on public, private, nonprofit general or financial management (MSSM official website, 2013).

The admission process is eclectic to a large scale – especially if we consider the global status of Columbia University – and the future master candidates must meet specific criteria to increase the possibility of enrollment to the program. It is essential to hold an internationally recognized bachelor degree in any discipline, to be familiar with mathematics and economics either in academic or practical level and, also, have previous professional experience on sustainability management issues. The majority of the MSSM students attend the part – time version of the program because they are already professionals and work full time on weekdays but there are, also those who are able to attend it on a full-time basis and graduate after 3 academic terms. The fact that many professionals are enrolled to MSSM and work at the same time indicates a transdisciplinary aspect of the program, as active practitioners – students interact with other students and university scholars. MSSM graduates not only they have deepen their knowledge on sustainability management issues but also they can apply theories, tools, frameworks and indicators like cost benefit analysis, CO2 measurements and sustainability financial models on practical level (MSSM official website, 2013).

Jeffrey Sachs, director of the Earth Institute as mentioned above, and Steven Cohen, director of the MSSM and executive director of the Earth Institute, are amongst the distinguished faculty members with various professional and academic achievements. Sachs has been professor at Harvard University for more than twenty years and consultant for numerous international organizations including IMF, World Bank, OECD and the United Nations Development Program. Steven Cohen has worked as policy analyst in the Environmental Protection Agency of United States and he has written a plethora of books and articles about environment, management and sustainability (MSSM official website, 2013). On his latest book entitled as “Sustainability Management. Lessons from and for New York City, America and the planet”, Cohen uses various case studies by connecting “environmental protection to organizational management” and approaching “global sustainability as a problem of public policy and organizational management” (Diaz – Chavez, 2011, pp. 697-698).

4.4 Maastricht University – Master of Science in Sustainability Science and Policy (SSP)

The Maastricht University Graduate School of Sustainability Science (MUST) was founded in 2009 and it is run by the 1998 established International Center for Integrated assessment and Sustainable development (ICIS) which is part of the Faculty of Humanities and Sciences at Maastricht University. The goal of the ICIS institute is to investigate and solve complex sustainability issues through integrated assessment with learning tools like participatory methods, scenarios, transition – management and modeling techniques. The core research topics of ICIS are related to all the aspects of sustainability including human health issues, mobility, biodiversity, tourism and water (ICIS official

website, 2013). ICIS scholars van Zeijl – Rozema, Cörvers, Kemp and Martens (2008, p.411; Martens, 2006) recognize that “sustainable development is a complex concept, dealing with different temporal and spatial scales and with multiple stakeholders” which has unclear objective, needs “a pluralistic approach” and governance is an important element of it. Both ICIS and MUST are scientific learning centers that encourage different generations of researchers to collaborate and exchange knowledge experience on sustainability in an interdisciplinary environment. Part of this process is the one – year international Master Program in Sustainability Science and Policy (MSc SSP) of Maastricht University which has been launched in 2011 by the two above mentioned institutions (ICIS official website, 2013). MSc SSP provides a deeper understanding of the complex sustainability problems and focuses on sustainability assessment practices for policy – making purposes with stakeholder participation in interdisciplinary level (MSc SSP official poster, 2013, p.2). Apart from that, there is a same titled PhD program organized by ICIS with intriguing completed projects such as regional sustainable development, sustainability of applied sciences and prospects for sustainability (ICIS official website, 2013).

Concerning MSc SSP’s academic schedule, each student has to complete 11 compulsory courses plus the thesis in two semesters. The three basic categories “understanding sustainability”, “policy for sustainability” and “assessing sustainability” cover the thematic content of the following 6 core courses; fundamentals of sustainable development, global dynamics of sustainable development, knowledge production of sustainable development, governance for sustainable development, methods and tools for sustainability assessment and sustainability assessment project. The other 5 courses – problem based learning, scientific writing and presenting, participatory methods, basic modeling and seminar series – belong to the skills category and they are taught in parallel with the previous core ones. At this point, it should be underlined that the Problem Based Learning (PBL) is a student – oriented teaching method with small groups of maximum 15 students and it is the leading educational model of Maastricht University. Therefore, SSP students are able to attend courses in “small – scale teaching” style and complete intensive group or individual assignments with continual staff assistance and surveillance in order to face real – world sustainability issues in a “problem – driven” approach. As for the final phase of SSP, there is a thesis research proposal seminar and the thesis research and writing where the future graduates are asked to apply all the acquired knowledge and skills from the program (Maastricht University official website, 2013).

For the admission part, every applicant needs to hold a bachelor degree in science, social sciences or humanities, a specific certificate of proficiency in English (for non – native speakers), to have minimum 15 ECTS on attended courses affiliated in sustainable development, sustainability science, development studies, globalization or governance and other 15 ECTS on scientific methods courses

(Maastricht University official website, 2013). MSc SSP graduates can become professionals of sustainable development with strong analytical, problem – solving and assessment skills within the context of science, policy and society as they have gained useful knowledge and practical experience throughout their studies on sustainability (MSc SSP official poster, 2013). In addition to this, PBL is an important educational tool for enhancing personal abilities including sense of responsibility, critical thinking, distinguishing facts and values, decision making capabilities and integration problem management (Maastricht University official website, 2013). All the above combined with the integrated assessment approach – on transition, scenarios, modeling and participatory methods – (ICIS official website, 2013) give an interdisciplinary and practical character on this master program which enables students to tackle and assess sustainability challenges through systems thinking perspective (MSc SSP official poster, 2013).

A number of notable academics from the ICIS institute are involved with the MSc SSP program either as professors or organizers (Maastricht University official website, 2013). Pim Martens who has been director of the ICIS institute for 9 years and he has founded the MUST center, the MSc SSP program and the PhD sustainability program of Maastricht University, he recently became director of MUST (ICIS official website, 2013). Martens has published almost 100 or more articles, has contributed to 25 book chapters and he has written 9 books since 1993 until now. Furthermore, he is honorary professor of Stellenbosch University in South Africa and holds chair position of “Global Dynamics and Sustainable Development” at the universities of Maastricht and Leuphana (Pim Martens official website, 2013). Another famous scholar is the associate professor in Governance and Sustainable Development at Maastricht University, Ron Cörvers, who is, also, the educational director of MSc SSP from 2007 and the new ICIS director since spring 2013. Professor Cörvers has been associate professor in environmental policy at the Open University of Netherlands for almost 20 years and his research interests vary from web supported learning opportunities and technology enhanced social learning to governance for sustainable development and policy oriented learning for sustainable – regional development (ICIS official website, 2013).

4.5 The University of Tokyo – Graduate Program in Sustainability Science (GPSS)

The University of Tokyo consists of three core faculty pillars; the Kashiwa that deals with the development of new academic fields, the Komaba which is related to the interdisciplinary academic fields and the Hongo of traditional academic fields (GPSS – GLI presentation, 2013, p.2). The Graduate School of Frontier Sciences is part of the broader pillar, Kashiwa (GPSS – GLI presentation, 2013, p.5) and it has established the Graduate Program in Sustainability Science (GPSS) in 2007 (GPSS

– GLI official website, 2013). GPSS is an “interdepartmental” program (Onuki and Mino, 2009, p. 55) run by the 6 different departments of the Division of Environmental Studies – DES, established in 1999 – (Onuki and Mino, 2009, p.57); the department of environmental systems, the department of human and engineered environmental studies, the department of international studies, the department of ocean technology, the department of policy and environment, the department of socio-cultural environmental studies and the department of natural environmental studies (GPSS – GLI presentation, 2013, p.6).

The interest in sustainability issues at the University of Tokyo has been quite intense, as long as many projects, initiatives and alliances have been established since 1996, such as the Integrated Research System for Sustainability Science (IR3S) in 2004 and the newly launched education program Graduate Program in Sustainability Science – Global Leadership Initiative (GPSS – GLI) in 2012 (GPSS – GLI official website, 2013). At this point, we need to highlight that the vision of sustainability within the GPSS program is as vague as sustainability itself. It is expressed as “an indispensable keyword for the future of humankind” without a clear description of what it really is because they let their students “contribute to the development of this new scientific discipline called sustainability science” (GPSS – GLI official website, 2013). However, in the IR3S, sustainability science is believed to be an academic discipline “that point the way to understanding the diverse issues associated with sustainability in a holistic manner and to propose visions and methods toward the development of a sustainable society” (Onuki and Mino, 2009, p. 55; Komiyama and Takeuchi, 2006). As a matter of fact, GPSS aims to create a generation sustainability professionals on the educational basis and sustainability approach of the IR3S institute (Onuki and Mino, 2009, p.56).

Despite its recent foundation, the GPSS master program has modified its curricula in 2012 and since then, it has been launched as an optional 5 year joint master – doctoral program called “Global Program in Sustainability Science – Global Leadership Initiative” in which you can choose between two different admission schemes (GPSS – GLI official website, 2013). Between 2007 and 2011, the core courses along with the compulsory ones – 17 in total including 5 practical – were quite interdisciplinary covering various topics such as environmental economics and business and finance for environmental technologies, research on sustainability science, environmental politics and policy, strategies for global sustainability and natural environmental studies for sustainability. The 13 elective courses varied from advanced wind engineering, socio – environmental systems and residential environment to marine environment modeling, sustainability education and water and wastewater treatment for material recycling (Onuki and Mino, 2009, p.56).

Since the adjustments of 2012, the program became more focused on sustainability through a social sciences and holistic perspective by removing economic and business oriented courses and adding at the same more exercise – practical courses. The updated course list has 7 mandatory – elective mandatory courses; concepts and methodologies of sustainability science, sustainability and Asian and regional studies, strategies for global sustainability, environmental sustainability, management and policy studies of sustainability, sustainability of resources and planning and design for sustainability. Finally, there are 12 elective courses on the new list that deal with sustainability education, frontier of sustainability science, energy and materials for sustainability, biodiversity, critical thinking (basics and applications in 2 sessions each) and 5 special lectures on sustainability science, as well as, 9 exercise courses – mostly through global field exercises – and a master thesis (GPSS – GLI official website, 2013).

Regarding the admission criteria for this master program, it is not required to have any specific qualifications or certain previous academic background as long as the program is interdisciplinary and every bachelor degree holder is welcome to apply. The most important is to submit a “tailor-made” application by specifying the “academic interests under the big umbrella of sustainability science” (GPSS – GLI presentation, 2013, p.7) in order to indicate the level of interest and future commitment to this domain. Internationality and interdisciplinarity are two important characteristics of the GPSS, as all courses are taught in English, more than 2/3 of the students are foreign ones – 40 students from 20 nations – and they all come from diverse academic backgrounds like environmental engineering, international studies, biology etc. (GPSS – GLI presentation, 2013, pp.14-15).

The entire 5 year GPSS – GLI program has a “threefold approach to sustainability science”; holistic through the master program, as well as, resilient and transboundary through the doctorate one (GPSS – GLI presentation, 2013, p.9). The two year GPSS holistic perspective gives the unique opportunity to the master students to deepen knowledge on human nature systems and its dynamics (GPSS – GLI presentation, 2013, p.9) and develop their skills in communication, systems thinking, social surveys and data analysis via practical exercises and academic discussions in an international environment (GPSS – GLI official website, 2013). The Future Center is a project that consists of several partnership centers like construction and recycling companies, the Kashiwa campus and the city’s citizens and it facilitates the above procedure of learning and practice at master level (GPSS – GLI presentation, 2013, p.10). As for those who have been admitted to the whole GPSS – GLI program and they have completed successfully the master one they will use their acquired knowledge and competences on the doctorate level in which they follow both resilient and transboundary approaches; the resilient focuses on disaster recoveries from earthquakes with the aim of creating resilient societies and the transboundary has to do with international seminars and

partnerships including the United Nations University, the Arizona State University and the International Network of Sustainability Science at Tokyo University (GPSS – GLI presentation, 2013, pp.11-12).

GPSS – GLI is supported by acclaimed scholars like the professor Takashi Mino who has been the program coordinator since 2007 with research activities about sustainability education, future sewage system and microbiology of biological wastewater treatment processes. Another one is the project associate professor Motoharu Onuki from the division of environmental studies who has also contributed to the establishment of the program in 2007 and he is responsible for the Intensive Program on Sustainability (IPoS) – a short term educational course organized by the University of Tokyo and the Asian Institute of Technology. Finally, there is Professor Atsushi Teguchi with 6 peer-reviewed published journal articles since 2004 and various research activities including evaluation methods for sustainable urban systems, GIS application through interdisciplinarity and field surveys on dense populated Asian cities (GPSS – GLI official website, 2013).

4.6 Lund University – International Master’s Program in Environmental Studies and Sustainability Science (LUMES)

Lund University’s Master Program in Environmental Studies and Sustainability Science (LUMES) is the oldest interdisciplinary master program of this list as it was established in 1997, three years before the foundation of Lund University’s Center of Sustainability Studies (LUCSUS) which supports LUMES since 2005 (LUMES official website, 2013). Back then, LUMES was based on the Faculty of Social Sciences (LUMES official website) and LUCSUS was initially a Center for Environmental Studies, abbreviated as MICLU, founded in 2000 and part of the Faculty of Natural Sciences. Since January 2005, MICLU turned its name to LUCSUS by abandoning the Faculty of Natural Sciences and becoming an independent institute at Lund University (SASNET official website, 2013). The LUCSUS center recognizes the importance of interdisciplinarity in sustainability science as the last one “needs new approaches that allow for the integration of knowledge across disciplines and scales” (Ness et al., 2010, p. 479). Apart from the LUMES program, LUCSUS coordinates the Lund University Center of Excellence for Integration of Social and Natural Dimensions of Sustainability (LUCID), a combined research school of various institutes (LUMES presentation, 2013) that offers PhD courses in sustainability and was founded in 2008 (LUCSUS official website, 2013).

The LUMES program has a long history as until 2004 – 2005, it was merely a three - term program on environmental studies with system thinking and governmental studies as reference points and it was

based on the faculty of social sciences. In September 2005, the newly admitted students were enrolled to the 2 year version of LUMES and one year after sustainability science was officially implemented in the program's title and context (LUMES official website, 2013). It's worth mentioning that LUMES is the 16th most popular master program of the entire Lund University (LUMES presentation, 2013) with international character and 500 alumni people from almost 100 different countries (LUMES official website, 2013). As for the program's current curricula, it consists of one pre – course assignment, seven mandatory courses for the 1st year, three elective courses and one compulsory project for the third term and the thesis project for the last semester. The mandatory ones for the first term deal with environmental problem awareness, ideas behind economy, environment and society, sustainability science and environmental governance while in the second one they have to do with methodology, environment and health and development and sustainability. In the second year, students have the opportunity to choose 2 out of 4 elective courses between energy, transport, industry, as well as, 1 out of 2 between urban and rural systems, then to complete an applied group project on sustainability named "Make Change Happen" and finally write the thesis project.

Nevertheless, in August 2013 the LUMES curricula will change and new enrolled students will have the same amount of courses but with transformed and redeveloped context. Therefore, the 1st semester will provide 3 compulsory courses instead of 4 – earth system science, social theory and sustainability and sustainability science – and the 2nd will offer 4 instead of 3 – governance of sustainability, urban & rural systems and sustainability, economy and sustainability and knowledge to action. The rest of the program has a similar structure as there will be provided 2 elective courses out of 4 between energy and sustainability, water and sustainability, transport and sustainability and finally industry and sustainability, as well as, the thesis project (LUMES official website, 2013).

In terms of the admission process, internationality, interdisciplinarity, deep interest in sustainability and full fluency in English language are the key criteria for selecting LUMES students. This means that any person from around the world with internationally recognized bachelor degree of any discipline and passion for sustainability is able to apply for the program. Throughout their studies, LUMES students have to complete a plethora of individual and group assignments on environmental issues, environmental governance and sustainability challenges through system thinking approach. Consequently, they will use their gained knowledge and experience on the "Making Change Happen" group project and their thesis by applying sustainability theories and frameworks on practical level (LUMES official website, 2013).

Most of the professors and researchers who are actively involved with this program come from the LUCSUS department (LUMES official website, 2013); few of them have also graduated from LUMES, like the assistant professor Barry Ness who is currently Director of Studies at LUMES, he has published 20 journal articles in the last 12 years and became the first PhD in Sustainability Science at Lund University in 2008. The list of acclaimed academics at LUMES and LUCSUS include also Lennart Olsson who is Professor in Physical Geography and director of LUMES and LUCSUS and the co-Director of LUMES and Professor in Social and Economic Geography Stefan Anderberg with 24 published journals since 1989 and 27 books since 1990. Finally, there is Ann Jerneck who is associate Professor in Sustainability Science with PhD in economic history and 30 total publications in peer – reviewed journals, conference papers, books and book chapters and Kim Nicholas, assistant professor with 11 peer –reviewed journal articles, 4 conference papers and 8 technical and government reports (LUCSUS official website, 2013).

4.7 Comparison and discussion

Table 1: Comparative overview of the 5 master programs in sustainability

	Coverage of courses	Practical training	Leadership	Admission criteria
Arizona MSUS	Policy and administration, technology and society, international development, non-profit organization	Internship, project instead of thesis	ASU – SOS: 1 st school of sustainability in USA, 71 professors	Interest in sustainability, previous relevant experience
Columbia MSSM	Conservation Science, Environmental Policy, Management and Finance	Distance learning option for professionals	The Earth Institute of Columbia University, Jeffrey Sachs, Steven Cohen	Familiarity with mathematics and economics, previous practice on sustainability
Maastricht SSP	Understanding/assessing sustainability,	Problem Based	ICIS center, Pim Martens,	Interdisciplinary and integrative

	sustainability policy	Learning (PBL)	Ron Cörvers	sustainability approaches
Tokyo GPSS	Holistic sustainability approach, applied skills on development	Future Center project	GPSS –GLI, Takashi Mino, Motoharu Onuki	Internationality, diverse background, interest in sustainability
Lund LUMES	Sustainability Science, methodology, environmental governance	Making Change Happen	LUCSUS, Barry Ness: 1 st PhD in Sustainability Science at Lund University	Internationality and interdisciplinarity

Themaster programs (Table 1) have similarities and differences regarding the coverage of courses (column 1), practical training (column 2), leadership (column 3) and entry requirements (column 4). The MSUS program of Arizona (Table 1, 1st row) is similar to the SSP of Maastricht (Table 1, 3rd row) and LUMES (Table 1, 5th row) ones because the curricula have a holistic approach from a system thinking perspective on sustainability and cover issues like environment, society and economy with more emphasis on the two first ones. However, as seen on Table 1, Arizona MSUS has four different subjects on elective courses (policy and administration, technology and society, international development and Nonprofit Organization – row 1, column 1) by offering the students the opportunity to choose a less broad area of interest on sustainability while the Maastricht SSP has almost no elective courses (row 3, column 1) and the LUMES has few broad ones like energy and water (row 5, column 1). As for the GPSS (row 4, column 1), it became more relevant to the above mentioned programs (LUMES, SSP and maybe MSUS) by modifying its curricula on 2012, while in 2007 it included some practical oriented courses on management and business like the MSSM of Columbia University (Table 1, 2nd row) . The last one is the only that has implemented the term “management” on its title and it has the most diverse courses available – from policy making to management.

Apart from this, it is shown on the table that MSSM is a unique program for practical training (row 2, column 2); as long as many students have the ability to attend the distance version of it by staying professionals at the same time. All the other 4 master programs are full time and it is almost impossible for such master students to remain active in the career arena. Nevertheless, the Arizona

MSUS provides internships and projects for the students through the program (row 1, column 2) and the GPSS has also interesting action activities via the Future Center project (row 4, column 2). LUMES and SSP do not offer such facilities for the students as there are no options for doing an internship instead of a thesis as in Arizona MSUS or select a long distance version of the programs and maintain your profession at the same time. In LUMES, there is only a course called Making Change Happen (row 5, column 2) which enables students to put sustainability into practice and in Maastricht SSP, Problem Based Learning (PBL – row 3, column 2).

In the leadership part (Table 1, column 3) seems that all of these master programs have high-profile academics with experience in various disciplines and contributions to sustainability through research. The departmental background and institutions of these programs play, also an important role because some of them have been established a long time before the masters' launch like the International Center of Integrated assessment (ICIS – row 3, column 3) of Maastricht University in 1998 and the environmentally oriented Earth Institute of Columbia University in 1995. LUMES (row 5, column 3) is the only exception because it began as environmental program in 1997 before the foundation of LUCSUS. As for the more recent one, the School of Sustainability of the Arizona State University, it might have a shorter but also remarkable history in sustainability as it is exclusively the 1st established school of sustainability in United States in 2007 (row 1, column 3).

Sustainability in Higher Education can be either experienced on more practical (courses in business, economics – Columbia MSSM, Arizona MSUS and old Tokyo GPSS program) or on more theoretical level (emphasis on sustainability dialogue, theories and frameworks – Maastricht SSP, Lund LUMES and new Tokyo GPSS program). This occurs because sustainability is not a narrow field of studies and it can be approached from various perspectives since environment, economy and society are the three basic pillars of sustainable development. Interdisciplinarity is a prominent reference point on all these cases – master programs, as bachelor graduates with a high interest in sustainability are eligible to study in almost any of these programs. In fact, this encourages people with different academic backgrounds to get involved with sustainability issues and make valuable contributions on sustainability through enhancing competences like system thinking and collaboration with such colleagues. The only program that requires familiarity with mathematics and economics is the Columbia MSSM, however, it is not compulsory to have a degree on these disciplines.

The sustainability master programs with integrated practical courses, internships and applied projects (Columbia MSSM, Arizona MSUS and old Tokyo GPSS) offer more job opportunities to the students for a career kick start. For instance, an Arizona graduate will already have professional experience and broadened network through his accomplished MSUS – supported internship and it

might be less difficult to get his second internship or traineeship. The other ones (Lund LUMES, Maastricht SSP and maybe the new Tokyo GPSS) offer interesting projects and develop critical thinkers for sustainability dialogue, nevertheless, there is limited career assistance for students and graduates. This is, actually, one of the reasons for conducting this whole research; the LUMES program has a weak alumni network and apart from e-mailed job announcements, there is no particular facilitation within the program for job kick starts in sustainability via job fairs and networking outside the academia. This means that the LUMES students and graduates who are not willing to pursue a PhD degree, they should search for sustainability-related jobs exclusively on their own so as to contribute to sustainability as professionals. Despite the previous statement, the departmental background and high-profile scholars in all these master programs are key factors for promoting sustainability in higher education and improving the level of contribution to sustainability either in practical way (e.g. environmental measurements, sustainability in the business field etc.) or in theoretical way (e.g. calling people for sustainability dialogue, promoting sustainability projects etc.). However, if we take into account this study sample such programs are mostly located in the developed countries of Global North (United States, Sweden, Netherlands and Japan). Consequently, sustainability education does not seem to be a priority within the developing countries, only a great privilege for the developed ones which certainly include sustainable projects for the developing world.

To conclude, the research results of this question indicate that sustainability education in practice, especially in master level, offers a wide range of degrees and programs that cover all the aspects of sustainability – environment, economy and society – and interdisciplinarity is a very important admission criterion for these programs along with the interest in sustainability itself. Job opportunities in sustainability are mostly integrated in “practical” university curricula – Arizona, Columbia and Tokyo – and this practice is the best kick start for future professionals in sustainable development because graduates from the other programs have more difficulties in finding their first internship on their own. Finally, the study sample demonstrates that university departments and distinguished academics are major indicators of sustainability leadership through education and research, however, the vast majority of them is still located in the developed world. In the upcoming chapter, we move from the analysis and comparison of five sustainability master programs to LUMES alumni perspectives regarding the advantages and career opportunities of sustainability in higher education with an interdisciplinary character.

5. BENEFITS FROM INTERDISCIPLINARY MASTER PROGRAMS ON SUSTAINABILITY, CAREER PROSPECTS AND CONTRIBUTIONS TO SUSTAINABILITY

5.1 Introduction

This section covers a case study on Lund University's Master Program on Environment and Sustainability Science (LUMES) graduates regarding what they have gained from an interdisciplinary master program on sustainability like LUMES, on their current career status and on their contribution to sustainability as professionals. LUMES graduates were selected for this research because every individual experience of a sustainability master graduate is different and unique either in LUMES or in other relevant programs that were mentioned above. It was, also, a matter of practicality and accessibility to approach interview candidates with the same academic background and experience on the program. The purpose of this study is to provide a clear picture about the benefits of such programs, the career prospects and the future contribution to sustainability after graduation from the LUMES alumni perspective as a single community. Leading motivation for such a research was the weak connection between the alumni network and the current students of the LUMES program, the personal experienced difficulty on finding an internship relevant to sustainability on your own and the positive response from current LUMES students on the Making Change Happen project "Jobs after LUMES".

This study is quite intriguing because career opportunities and employment are issues of public concern and the broad nature of interdisciplinarity and sustainability can be both benefits and disadvantages for such master graduates on pursuing a career relevant to their academic background. Apart from that, it is interesting to examine and analyze the viewpoint of few people who have fully experienced an interdisciplinary master program on sustainability, the expectations on finding a job in the field of sustainability and the outside reality after graduation through the job hunting process or the current job position. At this point, this could be useful either as a study or job guide from any current or future aspiring student on sustainability or relevant job – seeking graduate and as evaluation to the LUMES program from a graduate standpoint.

5.2 Qualitative results - what have LUMES graduates gained from an interdisciplinary masters program in sustainability?

5.2.1 LUMES education on providing sustainability knowledge and enhancing capacities

The respondents were quite satisfied regarding the knowledge they gained on sustainability issues throughout the LUMES program. They have broadened their horizons in the field of environment and sustainability by learning the philosophy behind the concept, understanding the problems to a large scale and trying to find solutions. For the vast majority of them, LUMES is perceived as an international theoretical program with a good social science background and this is very important in order to understand the complexity of the sustainability challenges from a holistic perspective. An essential tool is system analysis and systems thinking (e.g. causal loop diagrams). There are many problems on sustainability itself as the unsustainable economy, as well as, the broad and many definitions. However, many agreed that practicality is missing at some points and especially the opportunity to associate theory with practical issues in real-world situations. As students they all had the opportunity to enhance scientific and personal skills such as problem – solving through system thinking, as well as, communication, presentation and writing via individual and group assignments. Internationality was a big asset and played an important role on enhancing the above skills.

“LUMES provides a systemic view of environmental issue – interrelation with governance and economy and society”

“LUMES equips you with a holistic understanding of the issue of sustainable development”

“I Improved presentation skills, I met interdisciplinary-international people with various backgrounds, became aware of global and environmental challenges, had lots of field trips and developed opinion from various perspectives on Environmental and Sustainability topics”

“Yes it is very theoretical - you learn a lot but in the real world more practical things are required”

5.2.2 LUMES's interdisciplinary and transdisciplinary character

For these graduates, LUMES is an interdisciplinary program; the LUMES students come from diverse academic backgrounds and they cooperate and collaborate together in order to find solutions in complex issues by respecting each other's values and opinions. Group assignments, discussions and internationality are some of the key elements that enhance the practice of interdisciplinarity. However, transdisciplinarity is not a reality as the interaction with practitioners and professionals is quite limited in LUMES. For them, it is very important to improve and promote

the aspect of transdisciplinarity because practicality through real –world experiences is a key point to apply gained knowledge on sustainability and therefore find a relevant job.

On LUMES interdisciplinarity: “I learned how you can apply knowledge from one field to another without replicating”

“I often had different resources from his different classmates, different approaches on sustainability and different perspectives”

“You gain a lot when you work with people from different academic backgrounds and this is a big asset of LUMES”

“The greatest gain was the learning from the way that different background people think”

On LUMES transdisciplinarity: “It needs more work to bridge the distance between transdisciplinarity and practice”

“It depends on the people from your class and professors; at this point there is no transdisciplinarity given that the program is much more social science oriented”

“It was only on the energy course – no more chances to interact with other professionals”

“No – we need more sustainability practitioners in LUMES”

5.2.3 LUMES's contribution to sustainability via its graduates

LUMES has helped many of the respondents to contribute to sustainability in many aspects such as influencing their mentality on consumption, informing them on the advantages and side –effects of renewables and providing a definition for sustainability. Some pointed out that LUMES fosters entrepreneurship by offering the ability to identify problems, to find a solution and create your own job. Others were more skeptical because there was lack in providing some technical tools like techniques on environmental impact assessment, carbon footprint calculations, environmental economics and preparing sustainability reports. Hence, they believe that the implementation of more practical courses – more GIS, introduction to environmental economics and environmental impact assessment – would be very beneficial to students on tackling sustainability challenges.

“LUMES has definitely helped me to contribute in sustainability through my job by reframing the way to action and by not losing the objective of sustainability”

“Yes it has – in terms of the things we should focus, selection where to put the effort “

“In case of renewable energy – learned a lot especially from her thesis work and field work, RE can have side effects”

5.3 Qualitative results - what are the career prospects for sustainability graduates and their contribution to sustainability?

5.3.1 Career prospects for sustainability graduates and selection criteria

Job opportunities after LUMES depend on what the graduate is willing to do after the program, its previous academic background and the country. It is possible to find jobs in the environmental field but there is competition from environmental scientists. Becoming PhD or working on governmental organizations or NGOs are also alternative options. It is positive that there is a variety of jobs that you can apply for but the job market needs specialists. For this reason, some of the respondents mentioned that the job market is not compatible with sustainability. However, you can create your own job inspired by a sustainability problem of your area of interest or make a list of companies-potential future employers related to this problem. Some typical jobs are the ones of project manager, sustainability consultant or environmental consultant and others like involvement in the domain of energy and working in NGOs and governments. Most of the interviewees responded that it is not easy to build your career in sustainability because of various barriers like the crisis, the broad concept of sustainability and the job market itself. Some, also, highlighted that it is vague to determine that because it depends on personal preferences and previous academic degrees. Nevertheless, it is not easy to build your career in sustainability, especially an international one in large companies, as it is crucial to identify your area of preference to work in and then to sell your unique competence - skills, abilities and qualifications - via your cover letter and curriculum vitae.

“This is the challenge of LUMES – all sectors and all organizations need sustainability experts but it takes creativity to prove the value of a sustainability science to these organizations since they don't understand how to use sustainability scientists”

“It takes approximately six months of time to prepare for a relevant job on LUMES studies- It is important to have a strong network and do a good web searching”

“Dilemma- how do you build a career by staying true with your LUMES values? How to enhance sustainable development and stay true with LUMES values”

5.3.2 Contribution to sustainability via jobs

The majority of the respondents contribute to sustainability via their current career status, as most of them found a job less or more affiliated with sustainability. This occurs in various ways including informing their colleagues on sustainability and influencing people or companies to become more sustainable. Data collection and analysis in the energy sector, involvement with sustainability projects and collaboration with stakeholders are also part of the contribution and tackling climate change through promoting renewables are also a great part of their contribution. The contribution depends on the country where you apply sustainable development as it is a matter of mentality. The developed world is more into it and developing countries cannot contribute. The graduates that work or used to work in developing countries faced much more difficulties. In Africa for example the governments cannot apply sustainable development in projects either due to lack of financial support or general denial on understanding the importance of sustainability.

“My contribution is the mining field in collecting, compiling and analyzing the data that relates to exploration and its impact on the society and environment”

“Bringing different stakeholders together, help people by designing processes on how to solve sustainability problems (e.g. resilience, complexity studies origin – you design different conversations and then you proceed on problem solving, called change/design labs)”

“I Transfer the sustainability message – tell it to the world – delivering the message by avoiding “green washing”

6. OVERALL DISCUSSION

Sustainability is a vague concept and sustainable development deals with complex issues related to the environment, economy and society. Education is a basic element to determine and comprehend

these problems so as to make a shift towards a sustainable world. Sustainability in Higher Education has been structured via international and national declarations and it has been put into practice through curricula and interdisciplinarity learning approaches in various universities around the world, however, sustainability is hard to be achieved equally on a global scale. Some of the leading master programs in sustainability education exist in developed countries of the Global North (MSUS and MSSM in United States, SSP in Netherlands, GPSS in Japan and LUMES in Sweden) and this fact indicates the level of difficulty in approaching complex issues within developing countries through education. This means that the progress of sustainability education in HEIs is not occurring in the same level on developed and developing countries.

Nevertheless, even such Institutions in developed countries need to have the right mix of subjects to support sustainability and development by including the aspects of environment, economy and sustainability and providing job opportunities to the students so as to contribute to sustainable development. For example, the MSSM program of Columbia University has courses in business and economics related to sustainability and it can be attended on a part-time basis by active sustainability professionals, as well as, the MSUS of Arizona has a variety of elective courses and an internship option instead of a thesis project. The Columbia and Arizona students who have completed their degrees will have more practical experience and experience as well as broadened network for pursuing their upcoming job in sustainability compared to the SSP or LUMES ones who are full-time devoted to their programs without serious interactions with sustainability practitioners. The last programs – and lately the Tokyo one - follow a social sciences sustainability approach by building the necessary theoretical basis to its students but in this case, the graduates get more university assistance in order to pursue a PhD degree than getting an actual job as sustainability professionals.

As for the interviews, they gave very important results about the benefits of an interdisciplinary master program like LUMES as the level of satisfaction from the program was very high; however real career opportunities differ from the high expectations of getting a sustainability-related job after graduation. It is needed to implement more technical or economic –oriented courses on LUMES curricula like environmental economics, management, GIS and environmental impact assessment in order to become more competitive in the job market. Apart from that, the students and graduates are not getting any valuable assistance from staff and professors for job opportunities in sustainability, beside some e-mailed job calls. This verifies the above statement in terms of the need of practical courses and internships within such programs so as to increase career possibilities in sustainability. Although, it is worth mentioning that the LUMES program is a milestone for the interviewed graduates as they gained valuable knowledge on sustainability issues and they

developed critical thinking and personal competences like writing, negotiation and presentation skills in an international environment.

The interdisciplinary and holistic character of LUMES has both many and limited career opportunities at the same time. Such prospects are the ones that intercede on contribution to sustainability like sustainability consultancy, project development etc. On one hand, job market requires specialization, which is not necessarily bad for sustainability as long as there is successful cooperation between colleagues of different disciplines. On the other hand, sustainability problems cannot be solved without holistic approaches and interdisciplinarity – key parts of the LUMES program-;therefore interdisciplinarity is a link between sustainability and the job market. When it comes to job applications, it is essential to identify the area of preference on sustainability and then to sell your unique competence – skills, abilities and qualifications –via your cover letter and curriculum vitae.

Regarding transdisciplinarity, it is process that involves the interaction between academics and practitioners and it might be beneficial for the LUMES program to bring students in touch with active professionals in the domain of sustainability. The problem is that these practitioners should also be willing to adopt first an interdisciplinary way of thinking in order to promote a transdisciplinary approach on sustainable development. This can attributed to the fact that specialization is highly required in the job market and professionals are not able to distinguish the difference between multidisciplinary and interdisciplinarity. These also might ignore the importance of linking specialization with sustainable development through interdisciplinarity by being skeptical on the whole concept of sustainability and interdisciplinarity as well.

7. CONCLUSION

To sum up, no matter how difficult is to address sustainability and achieve sustainable development; there are potential solutions on complex issues like environmental degradation and poverty through key factors like education. Higher Education Institutions and interdisciplinarity are some of the most important tools that direct education for sustainable development. University sustainability programs, especially the master ones provide proper education on sustainability through curricula and practical activities, hence people from different disciplines are encouraged to study sustainability to get involved with it and provide solutions. The problem is that such programs have both benefits and limitations regarding career prospects because of the broad context of sustainability and the need for specialists in the job market. Interdisciplinarity is the key link between sustainable

development and the job market as long as the effective cooperation and collaboration among different disciplines can be successfully achieved either on sustainability or in the job market. However, professionals are not always accepting such approaches either in sustainability or interdisciplinarity and therefore transdisciplinarity is more supported from the academia than the job market.

It is hoped that this study will make a valuable contribution, not only to LUMES but also to other relevant master students and unemployed graduates in the field of sustainability concerning the advantages of sustainability studies and expectations of becoming a practitioner in sustainability. In addition, this thesis will be a useful material for any potential improvements for the LUMES program and also an important guide for future sustainability students, especially in interdisciplinary master degrees. Finally, every person is welcome to read this study, understand sustainability and then reflect on its education and relevant career prospects.

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