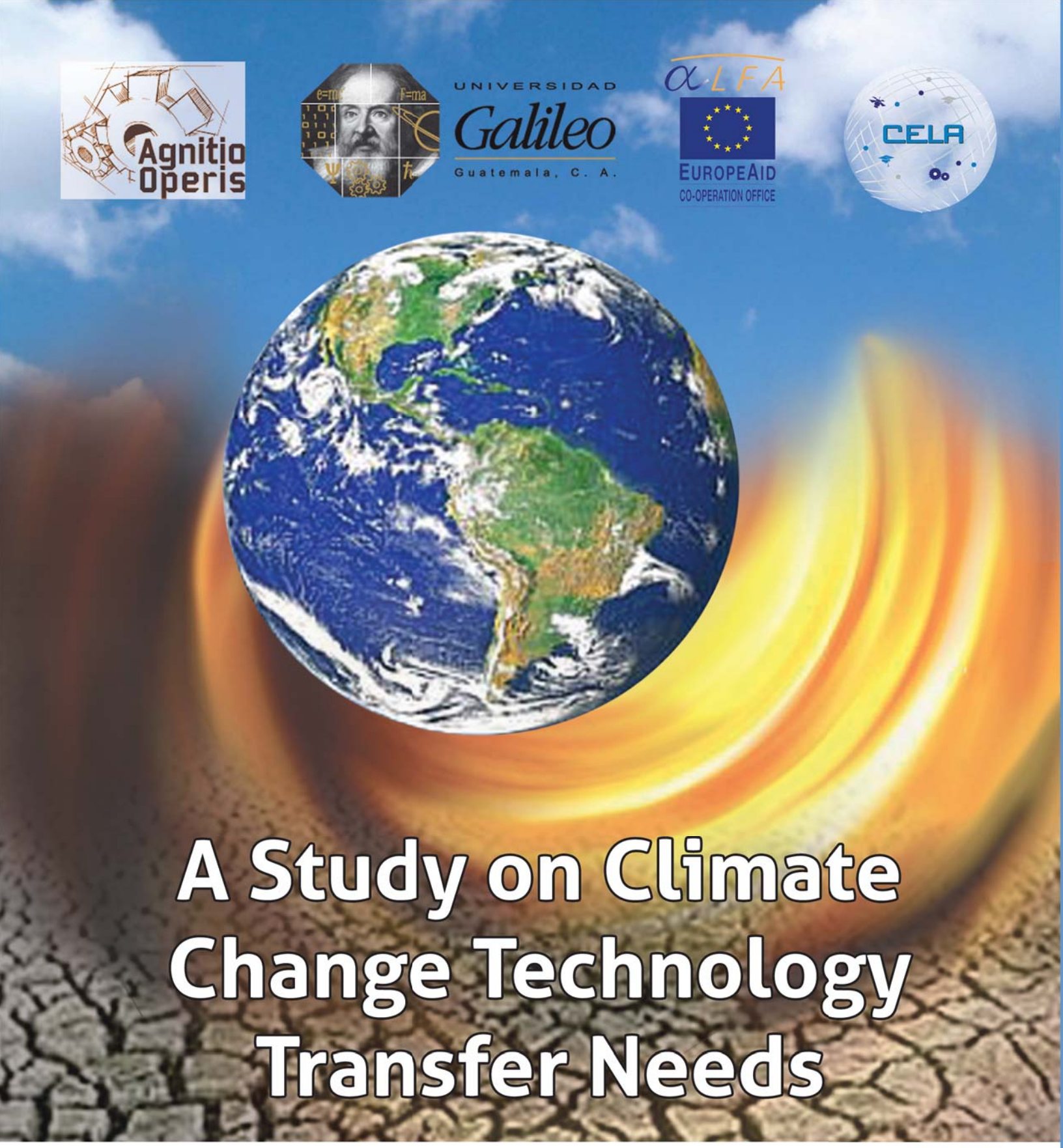

A Study on Climate Change Technology Transfer Needs

This publication has been produced with the assistance of the European Union. The content of this publication is the sole responsibility of the CELA project consortium and can in no way be taken to reflect the views of the European Union.

Network of Climate Change
Technology Transfer Centres in
Europe and Latin America Project
(CELA)

A Study on Climate Change Technology Transfer Needs

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Title:
A Study on Climate Change Technology Transfer Needs
136 pages, 21 x 28 cm.

ISBN: 978-9929-566-07-1
References: p. 133-136
August 2012

Cover design: Editorial Kamar

Printed on acid-free paper

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Acronyms

ANAC	Nicaraguan Alliance on Climate Change by its acronym in Spanish
CCS	Carbon Capture and Storage
CDMs	Clean Development Mechanisms
CELA	Network of Climate Change Technology Transfer Centre in Europe and Latin America Project
CEPAL	Comisión Económica para América Latina, by its acronym in Spanish
CNAE	Código Nacional de Actividad Económica (Nacional Code of Economic Activity)
CNU	Nicaraguan National Council of Universities, by its acronym in Spanish
CO2	Carbon Dioxide
COPs	Conference of Parties
CTTCs	Climate Change Technology Transfer Centres
EAP	Economically Active Population
ECLAC	Economic Comission for Latin America and the Caribbean
EU	European Union
EUR	Euro
EUROCLIMA	Refers to a Program Financed by the European Union
EuropeAid	European Cooperation
FDI	Foreign Direct Investment
FUNDEMPRESA	Foundation for Enterprise Development, by its acronym in Spanish
GCMs	General Circulation Models
GDP	Gross Domestic Product
GHG	Green House Gases
GTZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HAW	University of Applied Sciences of Hamburg
HEIs	Higher Education Institutions
HHRR	Human Resources
ICTs	Information and Communication Technologies
IISEC	Institute of Socioeconomics Studies, by its acronym in Spanish
MMAyA	Ministry of Environment and Water, by its acronym in Spanish
MNGR	National Bureau of Risk Management
NACE	Classification of Economic Activities in the European Community
NGOs	Non-Governmental Organizations
SAB Miller	South African Brewery Miller
SPSS	Statistical Program for Social Sciences
SRES	Special Report on Emission Scenarios
SWOT	Strengths, Opportunities, Weaknesses, and Threats Analysis
TICs	Tecnologías de Información y Comunicación, by its acronym in Spanish
TT	Technology Transfer
UNDP	United Nations Development Programme
UNFCCC	Expert Group on Technology Transfer of the United Nations Framework Convention on Climate Change
USPs	Unique Selling Propositions
WWF-UK	World Wildlife Fund - United Kingdom

Preface

Climate change is a concern for all countries; however, for Latin America, the impact of climate change is especially acute as the population is vulnerable to a decrease in their qualify of life. Due to this fact, the CELA (Network of Climate Change Technology Transfer Centre in Europe and Latin America Project) was initiated in order to look at these issues and foster greater cooperation between countries in Latin America and Europe. CELA is being undertaken as part of the ALFA III Programme of the European Commission and involves countries from both Latin America (Bolivia, Guatemala, Nicaragua and Peru) and Europe (Germany and Estonia).

This report presents the results of a transnational survey, which was coordinated by Galileo University on behalf of the project partnership. Its results show that while there is a great potential for the inclusion and dissemination of matters related to climate change in curriculum as well as in the research and extension activities undertaken by Latin American and European universities, much of this potential remains dormant. It also points out the need for action at the institutional level and the relevance of international cooperation in order to reverse this trend.

The approach and structure of this report will prove useful in the effort to promote climate change at universities, especially those concerned with the problems posed by the lack of expertise and training in this important field.

A special thanks goes to the team at Galileo University for the coordination of the document and to the project partners for their input. I also want to thank the many experts and scientists in Latin America and Europe who have contributed to the survey and who without this effort would not have been successful.

It is our hope that this report will catalyze the further development of educational approaches to climate change at universities and encourage its further implementation throughout Latin America and Europe. We hope you find our study interesting and insightful.

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Summer 2012

EXECUTIVE SUMMARY

CELA (The Network of Climate Change Technology Transfer Centres in Europe and Latin America Project) was created due to the increasing concern of climate change. The purpose of this study is to understand and define the technological needs of CELA countries, so that it may better contribute to minimizing the negative impact of climate change. Using this as the study's theoretical framework, the authors define the variables and methodologies used to obtain the final survey results and then present these results in statistical tables and graphics that are thoroughly analyzed. This summary is a general overview of these findings.

The Theoretical Framework focuses on the technology that is needed in order to minimize the impact of climate change. This framework was created based upon the experiences of universities in Bolivia, Estonia, Germany, Guatemala, Nicaragua, and Peru. The study focuses on the network and technology transfer between Higher Education Institutions (HEIs) in Latin America and Europe and illustrates how HEIs might contribute to the sustainable development of both regions. This study argues that although climate change adaptation is a priority in many Latin American countries, these countries often do not have the technology or the resources needed to adapt to climate change. In addition, the role of HEIs is analyzed, specifically in the field of research, technical assistance, and the impact of qualified human capital. Finally, this study introduces a new scheme in the university-industry network in the light of government policies scenarios. The conclusions offer some enlightening points that may contribute to creating awareness, and ultimately the appropriate response in the Latin American region and part of Europe.

Methodologies, sample design, and fieldwork are a combination of quantitative and qualitative approaches targeted at three groups: companies, university staff, and Decision-makers in key bodies and programs. Three groups steered the sample design: heads of companies; university staff; and Decision-makers at the highest position of university programs or bodies, government entities, and non-governmental organizations (NGOs). All CELA countries prepared surveys addressed to these groups on the basis of a questionnaire elaborated by the Guatemalan Technical Team. While the survey questions were consistent amongst the CELA countries, different methodologies were applied to gather data derived from these structured questionnaires. These methodological differences resulted in minor deviations. Furthermore, the initial selection criteria of the qualifying contact lists used varied slightly from country to country. Lastly, translation efforts, local influences, and specific needs related to each country also created differences amid the CELA countries studies.

These differences limited the ability to generalize the results of this study if just one country's results were reviewed. For example, Germany and Estonia contacted possible interviewees by e-mail and phone. Guatemala, however, relied on judges to select the most important companies, and then chose possible interviewees by their size and influence in the market. Furthermore, the Guatemalan judges then created a ranking of possible interviewees in these companies; of which those with the highest value were selected to match the number of interviews that were planned. Germany and Estonia followed up on the contacts made by phone and e-mail and conducted the surveys through both these media. On the other hand, Guatemala held personal interviews with those identified as the heads of selected companies. Other partners such as Bolivia, Peru, and Nicaragua, conducted both personal and phone interviews.

Another difference, depending on the country, was that some companies and possible interviewees from the sample lists were difficult to reach. This affected the number of actual completed surveys and is reflected in the low response rate in some of the samples, especially in the survey addressed to companies, for the case of Bolivia, Estonia, Germany, Nicaragua, and Peru.

Unfortunately problems of access affect the validity, reliability, and capacity to make general assumptions based on sample or census. For this reason, all technical teams across universities point out the qualitative nature of the data when certain anomalies emerge and acknowledge when generalizations cannot be made. Regardless of the study's restraints, the efforts by CELA resulted in a greater understanding as to how climate change is perceived and confronted by each participant country. Many open questions bring to light how differently climate change has impacted the industrial groups and their response to climate change has run parallel to their experience.

Low participation of women was detected in many sub-samples that were analyzed, often regardless of country and level of development - with an exception. The participation of women in high positions within the hierarchy of surveyed companies, among university staff, and Decision-makers was found lower than anticipated, regardless of where the interviews were held. For example, in Estonia 75% of men versus 25% of women were represented in the companies subsample. Guatemala had similar numbers in all sub-samples. In Peru, it was found in the sub-sample of university staff and Decision-makers that there was a 30% representation of women versus 70% of men. Yet in Estonia, 67% percent of the university staff sub-sample, were women.

One explanation for this deviation is that the kind of careers related to this study, engineering, agronomics and business, might attract more men than women. Furthermore, these fields of study have more recently been opened to women, especially in developing countries. This finding justifies CELA's proposition in its project design that a special approach to gender with respect to climate change is necessary. Furthermore, this approach calls for the greater participation of women as key actors in the process of capacity building and decision-making.

While there is a consensus that climate change should be a priority; neither the will nor the resources are in place in order to manage the possible challenges. In general, those surveyed are open to incorporate the subject of climate change to the process of research and formulation of plans, policies, programs, laws and regulations, investment, execution, follow-up, evaluation, and feed-back. There is an understanding that in order to manage the impact of climate change there must be a fluid system in place that is able to effectuate an appropriate response. A crucial issue, however, is the ability to bring together and coordinate the key actors. Another crucial issue and common concern among those surveyed is determining how best to manage valuable resources in order to mitigate and adapt to the impact of climate change.

There is also a common desire by those surveyed, including companies' interviewees, for government enactment of appropriate laws and regulations capable of improving current standards. Concern revolves mainly around disasters such as excessive rain, inundations, low and high temperatures and hail. While there is support by companies for enactment of appropriate laws and regulations, there too is reservation of potential costs to companies in terms of implementing these government measures.

Capacity building provides further consensus among those surveyed. Professors in general, the majority of those interviewed, express the importance of capacity building and the beneficial role that universities might play. According to them, effective capacity building can prevent, improve, and/or control the impact of climate change.

The degree of awareness within the stakeholders varies according to the perceived threat that each group experiences. The clearest example, in which stakeholder awareness is demonstrated, is Guatemala. Here, those in the agricultural sector have a greater awareness of the threat of extreme climatic events, while the industrial sector has less awareness. This is because the industrial sector has not been as impacted by natural disasters as the agricultural sector. Overall, in countries like Estonia and Germany, which belong to more industrialized countries, there tends to be less awareness of these threats than in Bolivia, Guatemala, Peru, and Nicaragua.

Education level may, however, play a role in the different sector experiences. Low educational levels tend to prevail more in the agriculture sector than in the industrial sector. Furthermore, country development too plays a role in stakeholder awareness. Both lack of education and development makes introduction of new technology, adoption of innovation, and openness to regulation difficult (see for example the Bolivian report). Whereas in the industrial sector there is a sense of social responsibility within companies, as mentioned there is a lack of awareness in all samples interviewed. Furthermore, improvement is necessary in every sector, including higher education, government, and NGOs in both developed and developing countries.

Priorities differ depending on the entity involved. Companies set their priorities around the chain of production and profitability; university staff prioritize research and teaching activities; Decision-makers prioritize national problems. In each group, important gaps are present. The degrees of priority assigned to climate change among different entities vary. Companies with a certain degree of awareness tend to take into account climate change problems when they plan their investment and development of strategy. Meanwhile, University staff participate in programs and teach courses where the subject of climate change could be integral. Nevertheless, this topic is considered irrelevant to other topics. There is a tendency to concentrate those subjects in specialized careers without considering their transversal dimension along all fields of knowledge. In addition, university Decision-makers acknowledge that they hardly have any item in their investment budget for these goals. Decision-makers on the other hand, determine their strategic plans based on decisions defined by the highest echelon of universities, government, and NGOs. However, they face serious problems of adoption and implementation. These documents tend to be forgotten by those responsible of implementing those orientations in the remaining lowest positions of these organizations.

How CELA countries believe climate change will impact them varies according to the nature and experience of each surveyed group to which interviewees belong and their expectations. While few survey samples broke down the industrial sector, those that did it found that some agricultural firms were very specific with regards to the changes they consider that were needed for the development of new technologies. For example, they indicated the importance in the development of new technologies and control methods to combat plagues and disease in sowing and crop programs. Other changes aimed at new calendar designs that could allow to plant and pick up crops during different dates, the move of these crops to different altitudes, and the introduction of new irrigation systems with a better and more efficient use of water.

Furthermore, industries expressed their concern to interruptions in the supply and distribution chains. In order to avoid this outcome, they advise keeping operational the available infrastructure. While the industrial sector fears negative impacts of climate change thus far, there have been few cases with frequent and permanent damage in their operational processes when facing disaster situations. Nevertheless, this sector has suggestions as to how to manage the impact of future climate change. One idea is to construct green buildings. Another is to create clean development mechanisms (CDMs). Furthermore, there is discussion about carbon markets, technology for the reduction of greenhouse emissions, risk management and improvement in energy efficiency.

In addition, every sector in each CELA country is concerned about water management. However, while the agricultural sector is concerned with irrigation problems, industries highlight the importance of an efficient use of water and the preservation of their water sources. The group identified as university staff or Decision-makers, however, have a different perspective that is related to the kinds of activities they pursue. They, of course, are more oriented towards teaching, research, and interdisciplinary programs. In general, these stakeholders' concern is directed at academia rather than what happens outside these walls. However, according to them, interdisciplinary programs should give answers with regard to climate change problems.

University Decision-makers have greater perspective when it comes to climate change, however the HEIs they manage do not actively participate at a microeconomic level like players in the private sector. This fact keeps them from elevating pragmatic solutions to climate change problems that would otherwise come from the private sector, who innovates and mitigates around these issues because its beholden to a profitability model. Instead, these Decision-makers in the public sector and NGOs, are more active at affecting change from a national level and society as a whole. Their interest is focused on the common good.

However, the data is clear that in 2007, when the oil crisis began, activity in all CELA countries intensified. Universities had an advantage due to their association with national and international networks, as well as previous research work. Despite this advantage, research activities in developing countries that participated in this study were generally absent. This is explained by the noticeable lack of patents registered in the field of climate change and all other fields.

This study also proves that universities interactions with the other surveyed groups are weak; highlighting their minimal connection with business and government. However, this is slowly changing, when one observes that society and government are engaging HEIs in more short-term requests; typically as a result of national emergencies. If HEIs continue to minimally engage with society and government, this lack of involvement could make the academic world irrelevant and out of touch with urgent national problems and concerns shared by the rest of society. Furthermore, universities must engage their students, creating programs of study that look at potential climate change problems, as these students will be key actors in their society.

With regard to Decision-makers belonging to the public sector and NGOs, these two groups must interact as both groups face similar problems related to society. This explains the frequent association between state entities that finance programs to be implemented by NGOs. However this close interaction between the two groups runs the risk of bringing forth lack of transparencies.

There is openness to capacity building with specific definitions around contents and appropriate modalities. A crucial relationship among and within the surveyed groups under study is capacity building. According to surveyed business directors, employees have an insufficient awareness of the risks and problems that climate change brings. Furthermore, these Directors desire more effort in capacity building oriented at reducing risks and vulnerabilities. They also mention the need to manage, in a more specialized way, company or business logistics, particularly possible interruptions inflicted by climate change to their supply and distribution chain. In order to accomplish this, the current labor force must be improved. To do this, it is suggested using e-learning devices and informal education methodologies. Of note, the Bolivian survey highlights the importance of the Internet as a way to disseminate knowledge and best practices.

Reforms are suggested to change the HEIs' curricula to make the subject of climate change a priority. Engineering for example should pay greater attention to risk analysis, contingency plans, clean technologies, efficient use and recycling of water, and "green buildings" design. Agronomics should engage in the development of new crops and varieties, with greater resiliency to droughts and diseases. These innovations should be accompanied by contents related to crops adaptation, reforestation, and irrigation technologies. As for Economy and Business Administration, changes should go in the same direction as Engineering. With regard to information technology and communication, suggested subjects include: data protection systems and communications, as well as early alert systems. Finally, Human Sciences should consider the promotion of social organization and risk planning as well as early alert systems linked to trained volunteers. University staff, mainly composed of teachers, also had similar suggestions, although interdisciplinary approaches and risk management is emphasized.

A debate has emerged regarding prioritizing mitigation versus adaptation. This debate appears often at international Conference of Parties (COPs) on climate change. Often developing countries endorse adaptation priorities while some developed countries see mitigation policies as a priority. Behind this debate is the realization that developed countries are the greatest generators of greenhouse gases, passing the need to adapt to the rest of the world. For this reason, financing of these activities should rest on them. This however, is not entirely true as both developed and developing countries use fossil fuels and suffer from adverse effects of their use. The rapid adoption of clean alternatives to substitute oil will benefit all.

With few exceptions, CELA objectives seem to enjoy a great consensus. The creation of Research and Technology Transfer Centres, an outstanding objective suggested by the CELA project, had almost a unanimous consensus among different samples and countries. Only some skepticism was found among university staff and Decision-makers in Guatemala and Estonia. These reservations might be attributed to a tendency to temper enthusiasm around new activities together with the low presence of research projects in Guatemala, as most university staff are temporary and almost exclusively dedicated to the teaching process. In the case of Estonia, Decision-makers expressed their fear that other similar entities have already accomplished these goals in this country.

This study provides suggestions about the role and scope of these Centres. There is almost unanimous agreement among the surveyed groups and countries wanting the centres to prioritize building bridges and creating connections among different groups and organizations represented in the samples surveyed. Their suggestions include:

a) Joint research ventures that might establish a joint collaboration among business, university, public and NGO sector;

b) Multiple agreements and projects to make specific the collaborations agreed;

c) Strategic alliances with common objectives that could build real networks in fields of common interest;

d) Creation of internships that could circulate students into practical jobs capable of giving professional experience in other sectors related to their careers;

e) Stimulus to systems by which students with university staff supervision develop their thesis and course practices, in all interested entities that ask and develop activities related to university workload;

f) Strengthening the role of the university in the offer of technical services through their professors using their specific expertise to help businesses, government, other universities, and NGOs;

g) Concerted efforts to develop patents on the basis of research done by participating organizations active in the network.

The above demonstrates, through the survey findings, that a system should be built that could put all issues raised into a short, medium, and long time framework with responsibilities assigned to all involved stakeholders. This system will seek collaboration of all key sectors: mainly universities, private, public, and NGO sectors. Thereafter it will link local, regional and national goals. This system might constitute the basis for the precise identification of strengths, opportunities, weaknesses, and threats, a SWOT analysis, to share a strategic plan derived from the logical framework of the Project. These outcomes, if accomplished properly, might orient all activities of the system constituted by key actors in specific time periods.

CHAPTER I

THEORETICAL FRAMEWORK AND DEFINITION OF THE PROBLEM

1. Introduction

Climate change is expected to substantially affect both developed as well as developing countries. While developed countries tend to be more resilient to long-term environmental change, developing countries and their people are more vulnerable towards climate variability and change, as these countries have less capacity to cope with the impacts of climate change. For this reason, developing countries need to increase their efforts and activities in order to increase their capacity to adapt to climate change and hedge negative impacts to their economies, natural environments, and people. Agder et al. (2003) remarks that the associated risks of a changing climate are real, yet still highly uncertain; the author remarks that all societies are "fundamentally adaptive" (Agder et al., 2003:179) and refers to past situations where societies successfully managed to adapt to climate change and similar risks.

Latin America represents a less developed region: one that relies heavily on its natural resources in terms of utilization. At the same time, it is expected that this region will be significantly affected by climate change (Baethgen, 1997; IPCC, 2001). Despite the fact that many Latin American states have given climate change adaptation a high priority, these same states often have neither the technology nor the resources needed in order to adapt successfully. Moreover, promoting adaptive capacity in terms of local natural resource management to the scale of international agreements and actions is considered a major challenge in the face of competing sustainable development objectives (Agder et al., 2003).

In the face of these challenges, the role of higher education institutions (HEIs) in terms of research and consultancy of transfer of climate change technology as well as the qualification of human capital within the HEI and beyond will be explored further and a dedicated university-industry networking project will be introduced.

2. Impact of Climate Variability and Change for Latin America

For Latin America, research findings from the last decade have provided concrete evidence of significant changes in precipitation and temperature. Depending on the underlying emission scenario (SRES) and according to multiple models, the projected mean warming for the region towards the end of the century ranges from 1-6 °C. With reference to precipitation, many general circulation models (GCMs) suggest more irregular rainfall for tropical regions and less anomalies for the extra-tropical South America. Furthermore, extreme weather events and climate extremes are expected to become more frequent. Moreover, there is strong belief that sea-level rise, together with weather and climate variability and extremes, will affect Latin America's coasts. Among the most serious impacts associated with the projected changes in climate, which have been documented: extinction of species and habitat loss; changes in vegetation cover; desertification and salinization; and the retreat of glaciers, e.g. in the Andean region. With regard to food security, agricultural yields for selected crops, e.g. rice, are likely to shrink; or increase, e.g. soy beans.

Estimated impacts on other crops are less predictable, depending on the scenario chosen and the consideration of CO2 effects. Concerning societal impacts, future population increase

within the region combined with reduced water availability may lead to serious water stress for up to 150 million people in Latin America. Not considering CO2 effects, the risk of hunger may increase substantially, impacting 26 million people by 2050 and 85 million by 2080, with a declining cattle and dairy productivity worsening the situation (Magrin et al., 2007).

3. Current State of Adaptation in Latin America

While previous climate policy focused on promoting specific adaptation options, current efforts concentrate on strengthening the adaptive capacity which refers to "increasing the ability of individuals, groups, or organizations to adapt to changes, and implementing adaptation decisions, i.e. transforming that capacity into action" (Agder et al., 2005:78) to deal with uncertainty in today's climate projections (Smithers and Smit, 1997; Yohe and Tol, 2001). Eakin and Lemos (2006) refer to the growing scientific consensus on a range of generic factors which are viewed as building adaptive capacity: free flow of ideas, knowledge and technology, more flexible and efficient government and governance schemes, policies fostering social and political capital as well as building human capacities, and a fairer distribution of resources (Eakin and Lemos, 2006; Yohe and Tol, 2001; Brooks and Adger, 2004).

Eakin and Lemos (2006) also emphasize the importance of interaction between Decision-makers, stakeholders, and institutions from various governmental levels for raising the adaptive capacity of a system, or in this case a nation.

Magrin et al. (2007) reports that some Latin American countries are starting to adapt to the changing environment, focusing, for example, on setting up risk reduction measures such as early warning systems, designing flood/drought/coastal management strategies or ensuring better protection of their ecosystems. Yet these actions seem to be outpaced by reality. The reality in these countries is there and refers to a lack of financial and human resources, a limited awareness regarding climate change particularly at the political level, missing data and information, lack of capacity and adequate regulatory frameworks, low income levels, people living in vulnerable areas etc. (Magrin et al, 2007; EuropeAid, 2009). Drawing from the EUROCLIMA assessment of climate change in Latin America, an overview of the current state of adaptation in selected Latin American countries might be described (EuropeAid, 2009:50-81). Mainstreaming climate change legislation in the Latin American region is rather new: most countries mentioned introduced their national strategies during the last decade.

4. The International Technology Transfer Of Climate Change Technology

4.1 Defining International Technology Transfer

According to literature, the term 'technology transfer' (TT) has, over time, evolved from a rather narrow definition referring to tangible items, e.g. computer hardware, to a broader terminology which includes intangible elements of organizations, so-called tacit knowledge, i.e. knowledge that is embedded in people and processes (Cantwell, 2009:420). Moreover, technology transfer mechanisms can be distinguished according to their formal or informal nature:

- Formal: licenses, research joint ventures, and university-based start-ups, technology transfer offices etc. (see for example (Cantwell, 2009; Mowery and Ziedonis, 1999; Siegel et al., 1999; Feldman et al., 2002; Thursby and Kemp, 2002);

- Informal: knowledge transfer, joint publications with stakeholders from industry, consulting, etc. (see for example Bozeman, 2000; Siegel and Phan, 2005).

Concerning an existing lack of research, Bercowitz and Feldman (2006) critically remark that most research on technology transfer still takes a limited view and analyzes only formal mechanisms, whereas the importance of informal mechanisms in university-company relations as well as further economic, social, and political influencing factors are not factored in. In line with this, even if formal mechanisms have been implemented, these may be circumvented due to various reasons (Link et al., 2006).

4.2 Technology Transfer Paradigms

The prevailing TT paradigm, i.e. North-South technology and financial flows, is criticized (Brewer, 2008) for falling short. It falls short as it is said to lack consideration of the importance of trade and foreign direct investment (FDI) as main mechanisms for international technology transfer; which would possibly allow countries to better seize the potential of international TT for climate change mitigation and adaptation. Brewer (2008) proposed a complementary paradigm that takes into account that technology transfer may not only work in a North-South direction, but also among groups of countries from developing to developed nations as well as from developing to developing countries. In this respect, several developing countries are regarded as world leaders in a range of climate-friendly technologies, e.g. South Africa in coal-to-synthetic-fuels, Mexico in solar hot water heaters, China in coal gasification and photovoltaic, and India in biofuels and wind energy (Socolow, 2006; Worldbank, 2008).

4.3 Characterizing the University-Industry Transfer of Technology

Link et al. (2006) suggest that socially constructed networks, which allow TT between all parties, may represent an important mechanism for university-industry technology transfer processes. Such networks may comprise of academic and industry scientists, university administrators, technology transfer officers as well as entrepreneurs (Liebeskind et al. 1996; Powell 1990). At the heart of university-industry-relationships there are transactions that may occur; in the frame of sponsored research, licensing agreements, hiring research students, start-ups, or simply by chance (Bercowitz and Feldman, 2006). Providing technological know-how for industry has been one of the classic roles of universities; lately, (Bercowitz and Feldman 2006: 175) been an increase in university-industry collaboration has been observed due to the following interrelated developments:

- Increase in sharing scientific and technological content with reference to industrial production;
- The development of new technological platforms, such as computer science, molecular biology, material science;
- The need for new sources of academic funding due to university budget constraints;
- New government policies stimulating university technology transfer to generate positive returns on investment in public research.

Regardless of these developments, successful technology transfer is viewed as a challenging task for all actors involved; even though a prerequisite, the sheer presence of an academic institution does not automatically result in the technology flows to foster economic development if motivations and incentives to act are missing (Bercowitz and Feldman, 2006; Slaughter and Leslie, 1997). Several "points of influence and specific factors" (Bercowitz and Feldman, 2006:176) may foster the generation and transmission of know-how, e.g. labor mobility, social interaction, local networks, and personal communication, all of which need to be considered in the context of the respective institutional environment.

Adding a motivational perspective, Link et al.'s (2006) empirical findings on selected informal TT mechanisms among 766 university staff members suggest that the gender, tenure of staff, and the active involvement in research grants determines the motivation to engage in informal knowledge transfer. In this case, knowledge transfer, writing joint publications, and consulting. Moreover, a 2004 study on TT through disclosing inventions suggests that the following influences the motivation of university staff: training, leadership, and cohorts. (Bercowitz and Feldman, 2006).

4.4 Introducing Climate Change Technology

With regard to actual technology, a variety of lists on goods and services relating to climate change have been published. For example, and reflecting the prevailing carbon reduction perspective of many Latin American countries, the Expert Group on Technology Transfer of the United Nations Framework Convention on Climate Change (UNFCCC) provided a comprehensive list of greenhouse gas (GHG) mitigation technologies which may lead to enhancing the implementation of the global framework for climate change (Socolow and Pacala, 2006; Pacala and Socolow, 2004; UNFCCC, 2002). According to the previously mentioned UNFCCC list, mitigation technologies can be distinguished with reference to the following categories and disciplines:

- Reducing emissions from energy supply and infrastructure reducing emissions from energy use (transportation, buildings, and industry);
- Enhancing capabilities to measure and monitor emissions;
- Reducing the climate effect of non-carbon-dioxide greenhouse

In contrast to this list of mitigation technologies, Brewer (2008) finds that adaptation technologies appeared to be less systematically researched and promoted. The recent UNDP Technology Needs Assessment Report (2010) provides very vague definitions of climate change mitigation and adaptation technologies by simply stating that these resemble "all technologies that can be applied in the process of minimizing greenhouse gas emissions and adapting to climatic variability and climate change, respectively" (UNDP, 2004:ix). Accordingly, the UNFCCC expert recommendations on technology transfer provide the by no means exhausting list (UNFCCC, 2006) of technologies associated with adaptation to climate change:

- **Coastal Zones:**
  - o Hard structures-dykes, sea walls, tidal barriers, detached breakwaters
  - o Soft structures-dune or wetland restoration or creation, beach nourishment
  - o Indigenous options- walls of wood, stone or coconut leaf, afforestation

- **Water Supplies:**
  - o Increase reservoir capacity
  - o Desalinate
  - o Improve soil conservation

- **Agriculture:**
  - o Change tilling practices
  - o Build windbreaks
  - o Line canals with plastic films

- **Health:**
  - o Early warning systems for heat waves
  - o Improved public transport

This preliminary suggestion of adaptation technologies is far from being complete and in the future will become amended as global adaptation efforts progress.

5. The CELA Project - A Network Approach for Fostering Climate Change Technology Transfer between Europe and Latin America

Linking theory with practice, the CELA project may serve as an illustrative practice example on the international transfer of climate change technology and knowledge supported through a collaborative scheme with distinctive organisational structures, processes, and activities:

The EU-funded project "CELA – Network of Climate Change Technology Transfer Centres between the EU and Latin America" (www.cela-project.net) addresses the need for better exchange and multilateral interaction from the years 2011 to 2013. Its overall objectives are threefold:

- Fostering sustainable research and technology transfer cooperation between higher education institutions (HEI) in Latin America and the European Union;

- Improving the quality of research and technology transfer of Latin American HEI;

- Strengthening the role of Latin American HEI in the sustainable socioeconomic development.

In this respect, the CELA project focuses on the thematic sector of climate change as both mitigation and adaption to climate change are contributing to supporting sustainable socio-economic development in Latin America. It does so by means of three key areas of activity:

- Setting up a dedicated networking infrastructure at partner institutions;

- Linking academia with industry and politics through effective networking and brokering of information and cooperation in the field of climate change technology;

- Capacity-building among research staff in support of transnational technology transfer in the field of climate change technologies.

Setting up a dedicated networking infrastructure which is replicated at all project partner institutions is the backbone of the CELA project: These Climate Change Technology Transfer Centres (CTTCs) will make better use of scientific and technological knowledge that exists in the participating regions; setting-up local networks and establishing transnational contacts to intensify joint applied research in the field and between Latin America and Europe, all while supporting socio-economic development.

The CTTCs are also designed to fulfil another important function: As 'knowledge hubs' within the CELA network, they strengthen the link between European and Latin American research communities, not only in the academic sense, but also beyond, i.e. with regional markets, business and legislation (policy) in the field of climate change. By closely linking the economic actors to the respective CTTCs, these structures may support the development of a wider market-oriented European-Latin American network of Climate Change Technology Transfer Centres.

As lack of expertise and limited access to climate knowledge is still a major impediment to tackle the challenges of climate change, the project further entails capacity-building actions for the partnering of research institutes and in particular their qualified research staff. The ultimate goal is to create an enabling environment for the occurrence of technology transfer by means of training staff and providing expert advice to stakeholders from academia, industry, and politics. CELA targets three distinctive groups to enable the exchange of expertise and knowledge transfer not only within the sub-groups but also among them:

- Researchers, teaching staff, administrative and management staff at participating research institutes;

- Enterprises, private and public institutions in the field of climate change in participating countries;

- Decision and policymakers in participant countries in the field science and technology.

Its implementation method bears reference to achieving both long-term (e.g. market-oriented science and technology transfer, networking) and short-term (e.g. pilot projects, staff capacity building) impacts by providing replicable structures and procedures for spin-off projects.

Moreover, CELA's objective is close involvement and participation of the local stakeholders and target groups (enterprises, ministries, NGOs etc.). Thus, the partners may create reliable and trustful contacts to future clients and cooperating partners for applied research and technology transfer activities. Ultimately, it is anticipated that the CELA project may assist efforts in Latin America to provide a market-oriented research and technology transfer approach, complemented by establishing specific recommendations for the different countries on how to excel within their region and beyond.

CHAPTER II

MAIN VARIABLES

Variables Definition. Next, we will specify the variables that were part of the questionnaire and the interviews to carry out during fieldwork.

Questionnaire for Companies

Section I: Company Profile
Objective: Establish the characteristics of the company and the interviewed Director:

1. Economic sector of the organization's activity (Code of National Classification of Economic Activities, CNAE for its initials in Spanish);
2. Size of the organization in terms of sales volume;
3. Size of the organization in terms of the number of employees;
4. Work geographical range of the organization;
5. Gender of the interviewee;
6. Educational level of the interviewee;
7. Age of the interviewee.

Section II: AttitudeTowards Climate Change
Objective: Determine attitude and perception of companies towards climate change and its associated problems.

1. Importance of climate change in the agenda of the company's top management team;
2. Perception of risks and threats of climate change in the medium and long terms;
3. Frequency of appearance of climate change in the company's agenda;
4. Top management awareness of the mitigation subject;
5. Awareness of the functional areas of the company on vulnerability;
6. Degree of implementation of carbon footprint measurement;
7. Importance of water as a strategic resource;
8. Long-term strategies to assure water supply;
9. Importance of energy as a strategic resource;
10. Long-term strategies to optimize the use of energy (mitigation).

Section III: Situation and Development of Human Resources and the Role of Universities.
Objective: Determine the company's demand for higher education services in regards to climate change.

1. Educational training of the company's personnel;
2. Occupation of employees with knowledge on climate change;
3. Find out the opinion of the company on university programs that should include climate change;
4. Demand of the company for employees with knowledge on climate change;
5. Opinion on the future demand of human resources with knowledge on climate change;
6. Attitude or tendency of companies to work jointly with universities;
7. Potential demand of training services in the company.

Section IV: Climate Change Regulation
Objective: Determine company perception and attitude towards climate change regulation.

1. Opinion on the importance of climate change in the national agenda;
2. Company's opinion on the degree of preparation of the country's ability to control problems associated with climate change;
3. Opinion on society's attitude towards the problems of climate change;
4. Company's knowledge on the carbon credit market and its benefits to the company;
5. Knowledge and use of the reforestation law and its benefits to the company;
6. Attitude and perception of the company towards the need to regulate climate change.

Section V: Climate Change Technology Transfer Centres
Objective: Gauge the extent that Centres of Research and Technology Transfers on Climatic Change.

1. Company's perception and attitude towards a Research and Technology Transfer Centre.

Section VI: Negative Effects, Opportunities, and Strategies Developed in Agriculture
Objective: Establish the company's accumulated experience on the problems derived from climate change.

1. Effects of environmental phenomena caused by climate change on crops;
2. Type of environmental phenomena that threaten the crops;
3. Strategies to develop to face the effects of climate change;
4. Ability of the company to protect itself from the effects of climate change.

Questionnaire For University Staff

Section I: Interviewee Profile
Objective: Establish personal and educational characteristics of interviewees and HEIs where they work.

1. Type of institution;
2. Degree of centralization;
3. Age;
4. Gender;
5. Education degree and specialization;
6. Importance of climate change on university's agenda;
7. Inclusion of climate change in all university's careers;
8. Competencies in climate change to be included in university's curricula;
9. Teaching priorities regarding climate change;
10. Professor's opinion about the HEIs mission toward climate change;
11. Teaching experience of climate change;
12. Climate change technical assistance experience to businesses or governmental institutions;
13. Climate change research experience;
14. Climate change collaboration schemas between university–industry.

Section II: Training Needs
Objective: Training needs regarding climate change.

1. Training needs on adaptation to climate change;
2. Training needs on mitigation;
3. Training needs on curricular development and teaching modules;
4. Training needs in research direction.

Section III: Training Requirements in Climate Change Issues
Objective: Find out training requirements in climate change.

1. Development of teaching skills and research;
2. Update needs regarding climate change technologies;
3. Climate change skills to be included in curricula;
4. Access to data bases regarding climate change;
5. Participation needs.

Section IV: Fostering on Climate Change Issues
Objective: Determine subjects to be promoted for training and curriculum.

1. Fostering on climate change issues in HEIs;
2. Climate change issues included in curriculum design;
3. University, businesses, and public institutions collaboration schemes;
4. Research on mitigation;
5. Research on adaptation;
6. Occupational plan design on climate change.

Section V: Centres for Research and Technology Transfer on Climate Change in Universities:
Objective: Extent that centres has favorable demand.

1. Organization feasibility of Climate Change Research and Technology Transfer Centres;
2. Potential climate change products to be developed in such a centres.

Section VI: Open Opinion:
Objective: Receive general suggestions in case anything was left out before.

Questionnaire for Decision-makers: University, Public Institutions and NGOs.

Section I: Institutional and Interviewees Profile
Objective: Establish the background of institutions and interviewees.

1. Institution's type: either HEIs, government or NGOs;
2. Interviewees age;
3. Academic degree and specialization;
4. Organizational mission;
5. Organization's geographical coverage;

6. Perception of issues regarding climate change and Institution's priorities;
7. Climate change knowledge;
8. Staff awareness about climate change issues;
9. Importance of water as a strategic resource;
10. Importance of energy as a strategic resource.

Section II: Behavior, Strategies, and Opportunities Regarding Climate Change
Objective: Information on organization's experience toward climate change.

NGOs and Government's section
1. Policy development to foster mitigation;
2. Policy development to foster adaptation.

Sub-section for HEIs:
1. Teaching and research experience on climate change issues;
a. Teaching programs;
b. Laboratories oriented to climate change;
c. Patents developed;
2. Multidisciplinary programs in climate change;
3. Access to knowledge bases;
4. Working frequency;
5. Availability and usage of a strategic plan;
6. Other practices regarding climate change not included in the questionnaire.

Section III: Notable Contributions
Objective: Attitudes toward the institution the interviewee belong.

1. What are your three main contributions?

Section IV: Climate Change Investments
Objective: Extent that attitudes are translated into allotment of resources.

1. Determination of resources spent on climate change issues;
2. Relative importance of resources spent on climate change in the general budget.

Section V: Technology and Research Centres.
Objective: Degree of demand for CRTTCC.

1. Review of interest in creating a Technology Transfer Centre;
2. Comments about the contribution of a CRTCC.

Section VI: Open Opinion
Objective: Suggestions that may be left out.

1. Open section for opinion toward questionnaire.

CHAPTER III

SAMPLE DESIGN AND METHODS, RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

BOLIVIA

3.1 Methodology

According to the methodology agreed by CELA partners, the collection of relevant information on market technology transfer needs arises from exchanges among Higher Education Institutions (HEIs), the public sector (mainly Government), and Non-Governmental Organizations. This network leads researchers to three well-defined groups capable of generating three types of surveys to be performed. Details on the logistics and methodology of each one of these surveys are described below:

Survey results addressed to companies. This survey's objective was to understand companies' needs of the subject matter. The contact list for this survey was taken with the same methodology for the survey of Decision-makers, starting with contact information given by the Institute of Socio-Economics Studies (IISEC by its acronym in Spanish). This list was reinforced thanks to the Foundation for Enterprise Development (FUNDEMPRESA by its acronym in Spanish) and the Ministry of Environment and Water (MMAyA by its acronym in Spanish). Pollsters conducted interviews at 12 companies that were willing to participate in the survey.

Survey results addressed to staff at the universities. The target for the survey was programs and areas that have a close relationship with climate change and energy. The final list of contacts included professors and researchers from different universities. This list was obtained through information provided by the office of the Faculty Dean. A high percentage, 80%, of this list showed a high willingness to participate in the survey. We finally applied 24 interviews to a similar number of cases that were drawn from this list.

Survey results addressed to Decision-makers in entities within universities, government institutions, and NGOs. The initial list of surveyed institutions was taken from the contact database at the Catholic University of Bolivia. A long list of actors who operate and/or work in areas related to environment, sustainability, energy, and climate change was collected from these organizations. A considerable percentage, over 70%, of the contacted organizations and representatives showed a willingness to participate in the survey and a total of 48 interviews were conducted with public and private institutions, universities, and NGOs. In order to reach better conclusions it was decided to separate the results of non-governmental and supranational bodies having similar characteristics. The selection of interviewees was made at random. Experienced interviewers were chosen and in addition, a workshop was held to train interviewers on how to conduct the interviews. This was done to reduce strategic bias during their application. All interviews were personally conducted through visits at agreed meeting points with the respondents.

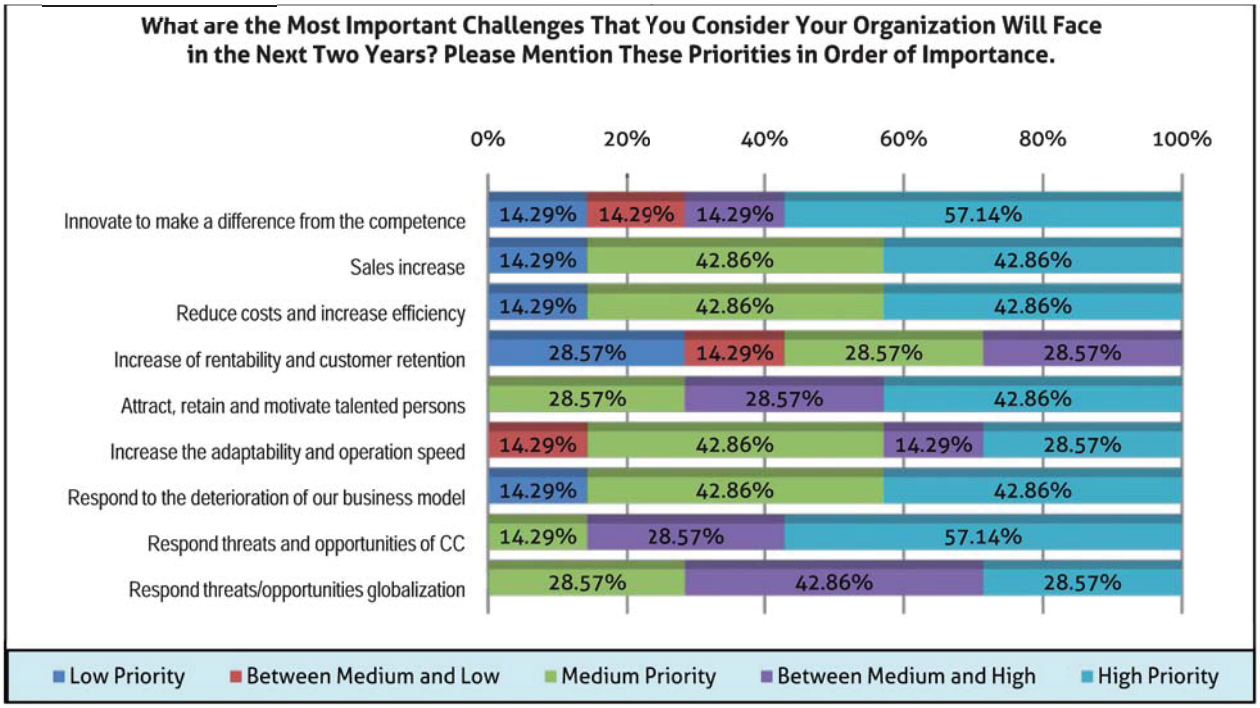
Survey results addressed to student. Another survey was conducted and its methodology was designed by IISEC but within the framework of the CELA project. This survey targeted university students from different programs. This survey's objective was to question students about their needs and perceptions on climate change and the way they perceive their universities role. To carry this survey out, a group of young people, trained in the subject, was prepared. They directly conducted the surveys with students on campus through visits or during class periods. A total of 148 surveys were collected. Subsequently, the contribution of students was tabulated and analyzed in this study.

3.2 Survey Results Addressed to Companies.

Profile of interviewed enterprises. We interviewed a total of 12 managers and/or representatives of companies within the national area that are working on environmental and/or energy issues. Out of the 12 companies, only two of them are considered large companies because of its high number of employees (over 121), the remaining 83% corresponds to small-midsize companies. On the other hand, 33% of the latter belongs to companies with 5 employees or less, 17% are companies with 6 to 10 employees and 33% are firms with 11 to 20 employees. For those interviewed, 50% indicated to have a master's degree and 50% only had an undergraduate's degree. Thirty-three percent of respondents are aged between 30 and 34, and another 33% were over the age of 50. The rest of the respondents were between 35 and 49 years. These last traits confirm heterogeneity in the selected group.

Attitudes toward climate change. The first question in this segment asked the following: "What are the most important challenges you consider that your organization will face in the next two years? Please mention these priorities in order of importance." Graph 3.2.1 shows the answers gathered.

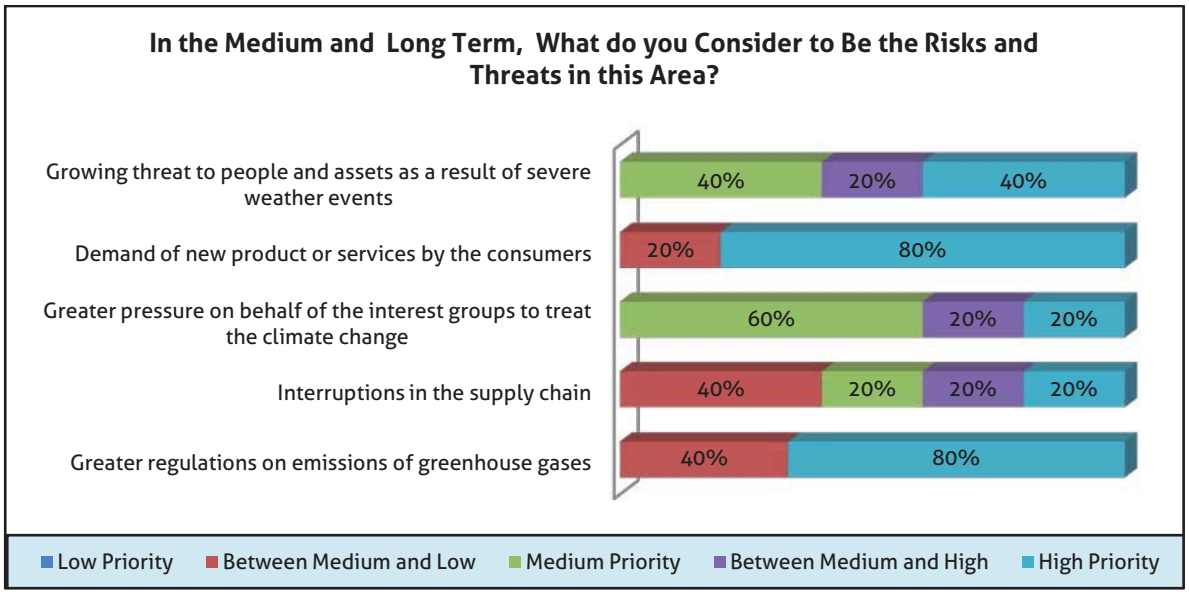
Graph 3.2.1



According to Graph 3.2.1, it is found that 57.14% of companies consider innovation the highest priority in order to keep themselves competitive. However, 42.86% considered sales increase, cost reductions, greater efficiency, retention of talented persons, and deterioration of their business model their second highest priority, on responding effectively to threats and opportunities of climate change. These high priorities reflect the need and interest of companies to strengthen the capabilities related to climate change. Furthermore, as can be seen in Graph 3.2.2, among the risks and threats mentioned, it is highlighted that 80% selected as a high

priority to have greater regulation on emissions of greenhouse gases. Also, 80% considered as a high priority the demand for new products or services by consumers. On the other hand, the growing threat to people and assets as a result of severe weather events is also considered a high priority by 40% of respondents and an additional 20% considered it as medium-high priority, demonstrating the conscious concern of physical and economic damage done by climate change and its effects beyond the well-being of their firms.

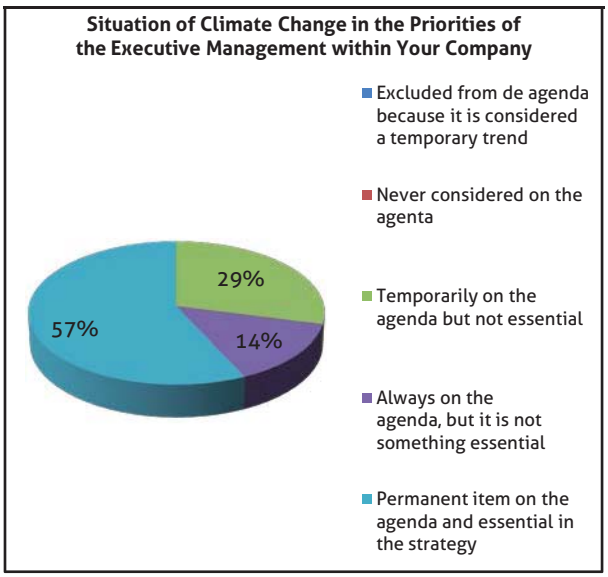
Graph 3.2.2



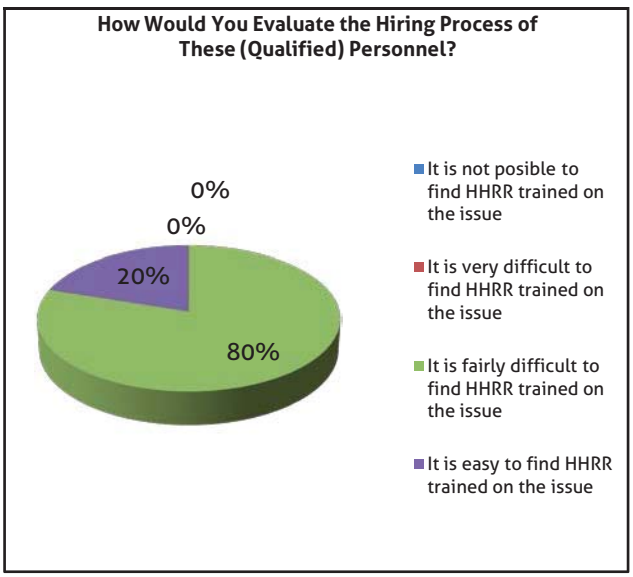
Graph 3.2.3 shows the high percentage of companies, 57%, indicated that climate change is a standing item on the agenda and fundamental in their company strategy. An additional 14% consider it an element that is always on the agenda, although it is not considered essential.

This is confirmed by the perception of the participants regarding the level of awareness of their employees. Data not shown here demonstrates that only 29% of those interviewed considered that their collaborators fully understand the issue and strategy applied. Another 29% indicate that they have a vague understanding, but they are aware of the key issues. Therefore, it is found that the climate change is a priority and a current topic in companies. Regarding the importance of water and energy for the companies, in both cases 72% indicated that water and energy were very important and therefore the capacity regarding the optimization of these resources is a clear need for companies.

Graph 3.2.3



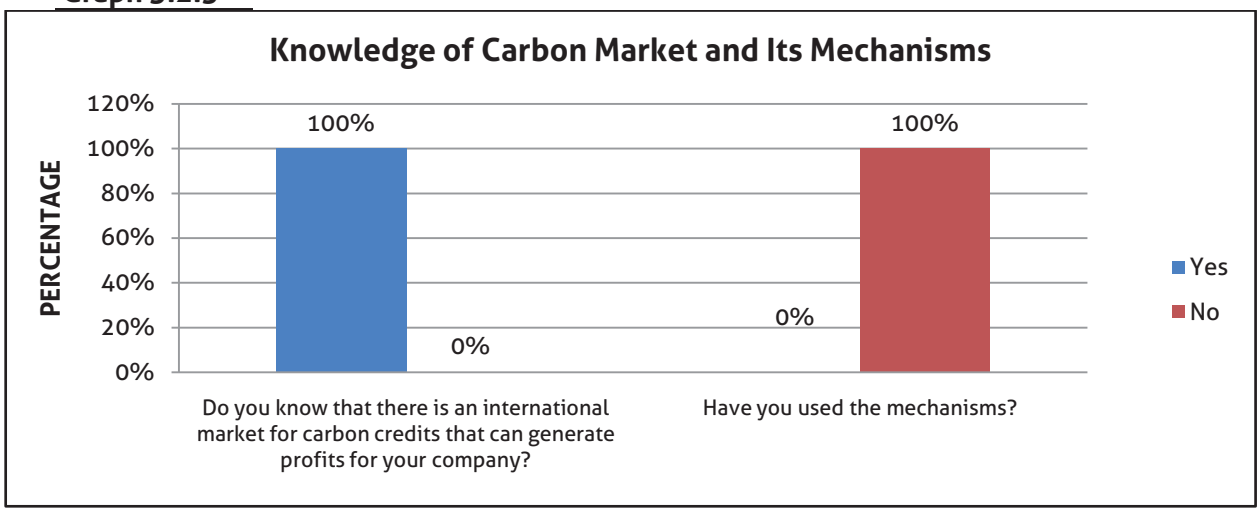
Graph 3.2.4



According to data collected and shown in Graph 3.2.4, 80% of companies say it is fairly difficult to find human resources trained in climate change and the environment and only 20% indicate that it is easy to find such resources. Additionally, companies were asked if in the near future they plan to contract skilled personnel on climate change and 71% strongly confirm this action, which indicates a growing labor demand in these areas.

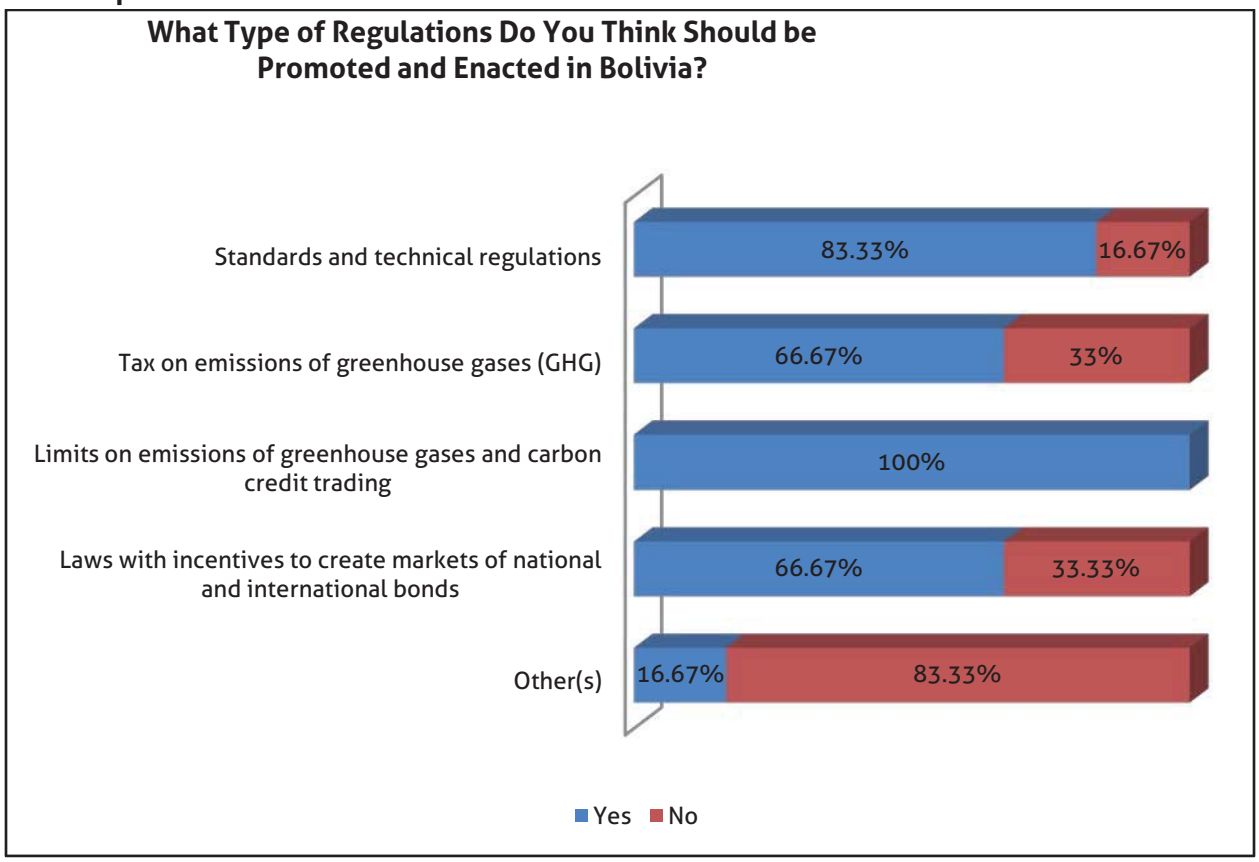
Regulations on climate change. An unprecedented result occurred when 100% of companies claim to know about the market for carbon credits and their benefits (see Graph 3.2.5), but absolutely none, 0%, have used these mechanisms, due to lack of information and technical capacity to use them. Therefore, 80% say they are very interested in developing the capabilities to use these mechanisms.

Graph 3.2.5



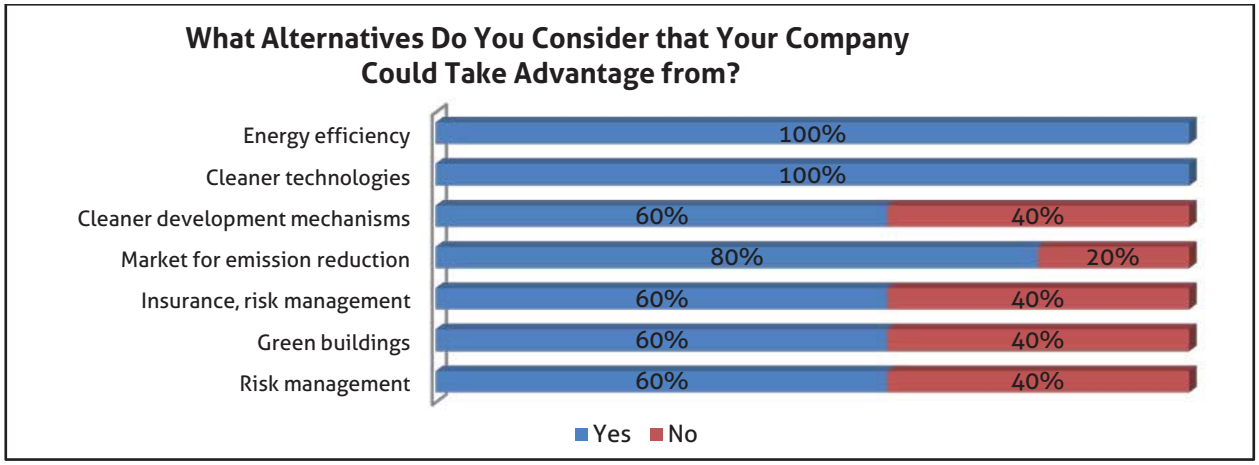
A clearly identified priority by companies is the need for regulation on environmental issues and climate change in Bolivia as 100% of respondents answered positively. This is because it is an area where lack of regulations is becoming increasingly obvious and harmful to the environment. A subsequent question was asked inquiring what kind of regulations would be needed. The most significant result was 100% support for the establishment of limits on emissions of greenhouse gases and carbon credit trading. When further clarification was asked, (Graph 3.2.6) 83.33% supported the development of standards and technical regulations; 66.67% supported both tax burden on emissions of greenhouse gases and the legislation ruling on incentives of national and international bonds. Multiple choices were possible. Data not shown here, indicate that 86% of companies believe that such regulations should be enacted as soon as possible.

Graph 3.2.6



In addition, there is great interest (100%) by companies to take advantage of environmentally friendly alternatives such as energy efficiency, cleaner technologies, as well as opportunities in the market for emission reduction (80%). This data is shown in Graph 3.2.7.

Graph 3.2.7

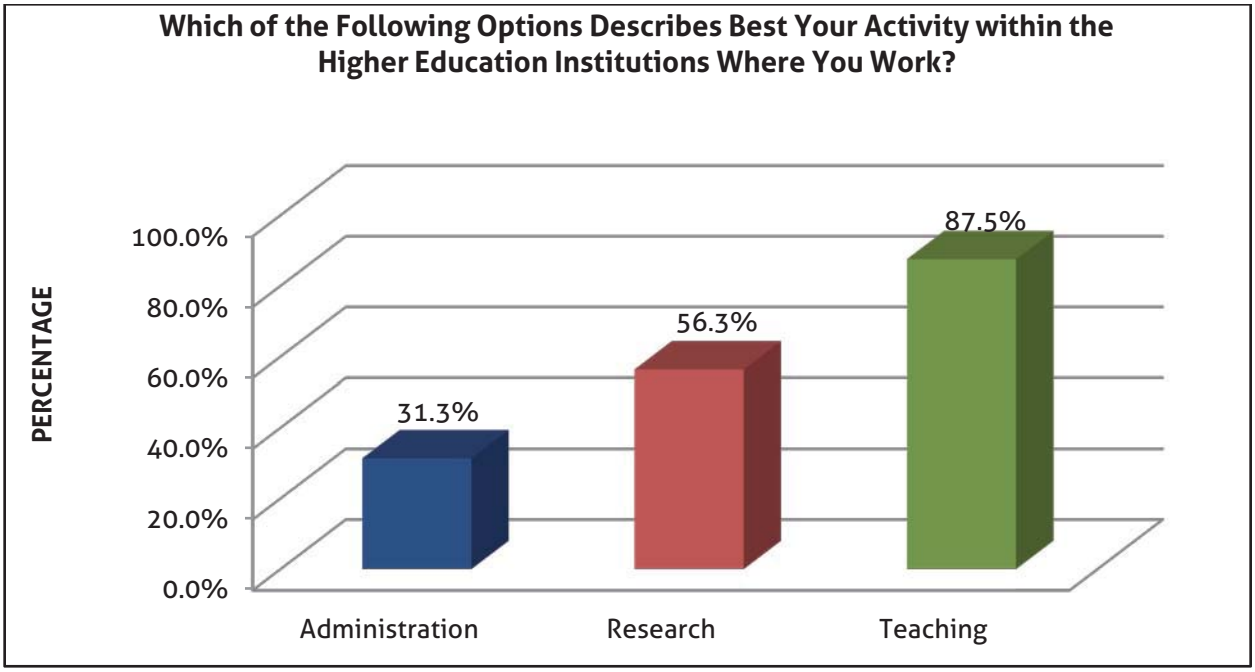


Finally, respondents were asked about interest in the creation of Technology Transfer Centres and their answers show a 100% unanimous support for this initiative. In addition, respondents in an open ended question responded that the creation of such Centres would not only generate knowledge and appropriate techniques to adapt and mitigate the effects of climate change but would also help strengthen university-industry links and allow the generation of skilled human resources required by companies in these areas.

3.3 Survey Results Addressed to University Staff.

Profile of interviewed staff. The survey was conducted in various national universities with professors and university researchers whose work is closely related to environmental issues and/or climate change. We interviewed a total of 32 professors, whose ages range from 20 to 60 plus years, however 34% range from 35-39 years. When the respondents were asked about the last academic degree obtained, 17% indicated having a doctorate degree, 54% have a master's degree, and 31% have an undergraduate's degree. This indicates that one third of respondents do not have specializations in environmental issues. Regarding the position of respondents within their institutions, 63% are full professors, 31% are researchers in a project or area, 25% are research project managers, 19% are heads of Department of Research, 12.50% are assistant professors, and finally the options referring to Deans or Vice-deans, Director of Research Institute and Director of educational area have a 6.30% representation each. Multiple choices were possible.

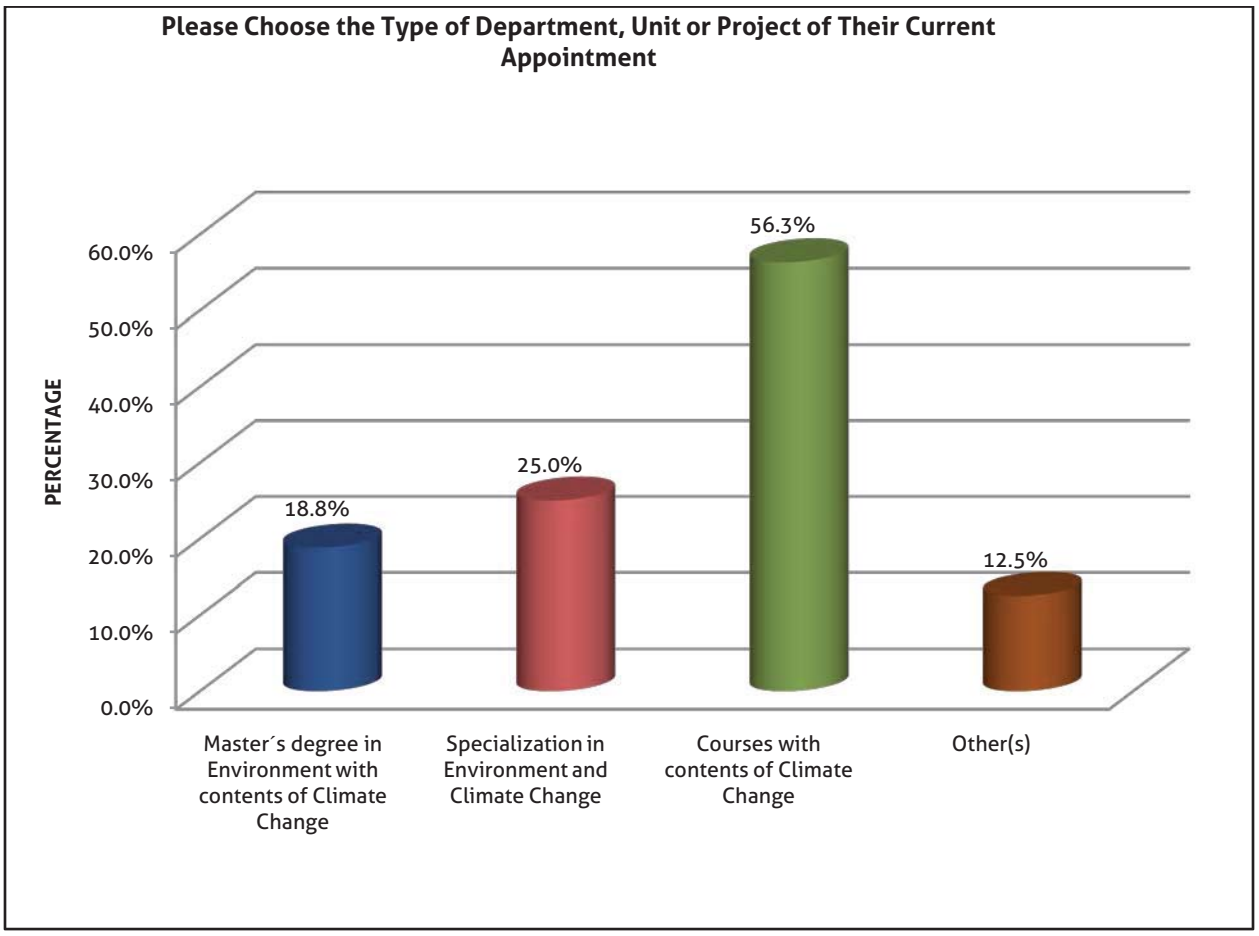
Graph 3.3.1



Complementing the previous question, respondents were asked to provide what type of activity they perform. Eighty-seven and a half percent indicated teaching, 56.30% are devoted to research and 31.30% are dedicated to administrative activities. Multiple options were also possible in this question. On the other hand, in data not shown here, 56% answered that they have worked within their institution for more than five years, while the remaining 44% said to have worked between less than a year to three years. This creates a degree of stability in terms of teaching staff inside universities and thus strong and consistent views on institutional needs in the educational area.

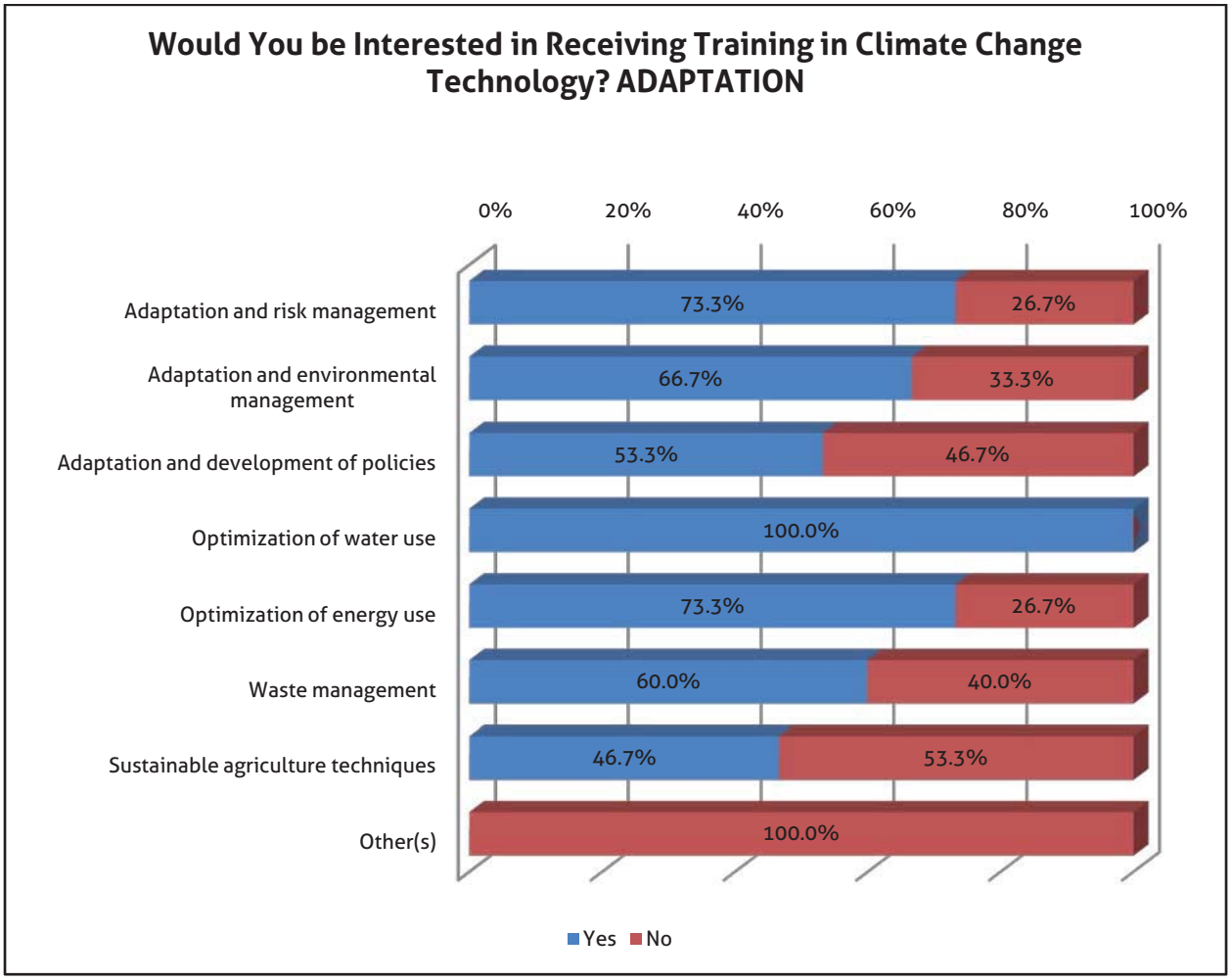
In the area of teaching as shown in Graph 3.3.2, 56% of respondents indicated that they teach courses with content on climate change, 25% teach some specialization in environment and climate change, 19% indicated as teaching in the masters programs which have contents in environment and climate change. Multiple options were possible. This is also complemented by the fact not shown here that 13% of respondents consider themselves experts on the issue of climate change, 69% of respondents considered themselves to have sufficient knowledge and experience in the field, and 18% to have poor knowledge on the subject.

Graph 3.3.2



Training needs. The interviewed agents revealed in Graph 3.3.3 about their training needs and interests. One hundred percent are interested in receiving at least one or more specific skills in adapting and/or mitigating climate change. In the area of adaptation to climate change, most of the proposed capabilities have a high level of interest (over 60%) and those most in demand are (in descending order): optimization of water use (100%), adaptation and risk management (73.30%), optimization of energy use (73.30%), adaptation and environmental management (66.70%), and waste management (60%). All these capabilities are first class and their expansion would result in significant environmental, economic, and social benefits.

Graph 3.3.3



Similarly in the area of mitigation (data not shown here), the capabilities of most interest include: capture and storage of carbon dioxide (75%), research and development (68.75%), advanced renewable energy (68.75%), and heating and conventional renewable energy (68.75%), demonstrating a keen interest in the energy field.

Training and qualification requirements on climate change. When respondents were asked about the training and qualification needs on climate change as depicted in Table 3.3.1, the answers show that they identify the following as very important needs: improving research infrastructure along with greater collaboration among universities and enterprises in the area of climate change. With regard to just important needs, they mentioned the following as priorities: participation in scientific and teaching events on climate change (50%), and access to a scientific database of climate change which adds both "very important need" (43.80%) to a "major need" (31.30%). Finally, 75% mention the need for technological changes as one of the objectives of the CELA project when the former both categories are added.

Table 3.3.1 How Would You Describe Your Need Regarding the Following Activities and / or Abilities?

Responses	No need	Minor need	Definite need	Major need	Very important need
Improve their technical/professional knowledge and skills in the teaching/research area	0.00%	31.30%	18.80%	37.50%	12.50%
Keep up-to-date to the great technological changes in the Climate Change issue	0.00%	6.30%	18.80%	37.50%	37.50%
Acquire skills in Climate Change in the curricular design	6.30%	6.30%	25.00%	31.30%	31.30%
Better research infrastructure as laboratories, instruments, materials and equipment	6.30%	0.00%	6.30%	31.30%	56.30%
Access to a scientific database on Climate Change	0.00%	0.00%	25.00%	31.30%	43.80%
Participate in scientific and teaching events on Climate Change	0.00%	0.00%	18.80%	50.00%	31.30%
Increased collaboration among universities and enterprises in the area of Climate Change	0.00%	0.00%	18.80%	31.30%	50.00%

Strengthening climate change issues. Respondents were asked if the issue of climate change needed to be strengthened in their universities. The answer not shown here was a definitive "Yes" with 100% support. On the other hand, answers on the measures to be undertaken to strengthen the issue of climate change in Bolivia, as it is shown in Table 3.3.2, among the needs identified as very important, it is stressed the need for more labor practice for students in companies with high impact on climate change. The need to improve research in developing mitigation technologies (56.3%) and adaptation (50%) to climate change were also stressed. The options also prioritize a greater development of exchange programs among universities, companies, and institutions and the need for partnerships between the same actors to develop expertise on climate change which are considered as very important needs (with values above 50%).

Table 3.3.2 Which of the Following Measures Do You Consider Important to Strengthen the Climate Change Issues in the Country?

Responses	No need	Minor need	Definite need	Major need	Very important need
More academic programs devoted to climate change impact on the market	0.0%	0.0%	31.3%	43.8%	25.0%
Development of exchange programs and collaboration among universities, companies and institutions	0.0%	0.0%	25.0%	25.0%	50.0%
Partnership among universities, companies and public institutions to develop knowledge	0.0%	0.0%	25.0%	18.8%	56.3%
Research to develop technologies for adaptation to mitigate climate change effects	0.0%	0.0%	25.0%	18.8%	56.3%
Research to develop technologies for adaptation to climate change	0.0%	0.0%	12.5%	37.5%	50.0%
More Internship opportunities for students in companies with high incidence of climate change	0.0%	0.0%	18.8%	18.8%	62.5%
Constant analysis and design of occupational plans on climate change due to technological changes and economic behavior	0.0%	6.3%	37.5%	25.0%	31.3%

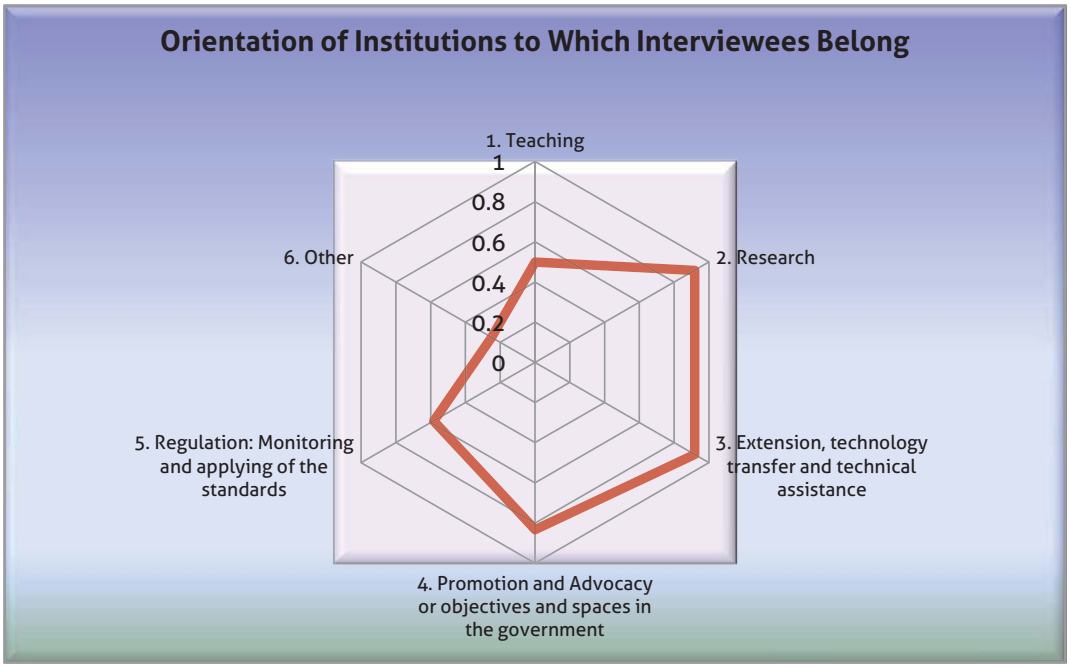
As in the case of Decision-makers, in data not shown here, the participants were questioned about the interest in the creation of Technology Transfer Centres in universities. They showed a great interest (94%) in such a goal. They see these Centres involved in applied research (100%) and training at universities and in curriculum development for the generation

3.4. Survey Results Addressed to Decision-makers

Profile of interviewed institutions. Questionnaires were used with Decision-makers within different Bolivian institutions related to environmental and/or climate change. They were mostly public institutions (58.3%), followed by universities (41.70%). Fifty percent of respondents had postgraduate studies and the remaining 50%, an undergraduate degree. The vast majority of respondents indicated to have sufficient knowledge or to be experts on the issue of climate change (75%) and only 25% of the respondents considered themselves trainees in the field.

The survey results made evident, as Graph 3.4.1, shows that the focus of the institutions, is research (91%); extension, technology transfer, and technical assistance (91%); followed by promotion, advocacy of objectives and spaces in the government (83%); and the regulation and monitoring of standards (58%); and teaching (50%) that is attributable to the Decision-makers in universities. Only 25% identified alternative proposed approaches. This is complemented by data not shown here about the Decision-makers perception regarding the level of awareness of their colleagues on climate change. Fifty-nine percent confirmed that their collaborators are aware of the key issues even though they have a vague understanding of the subject. While only 25% do not understand climate change or maintain a skeptical attitude. The remaining 17% say they completely understand the issue and the institutional strategy to cope with it.

Graph 3.4.1

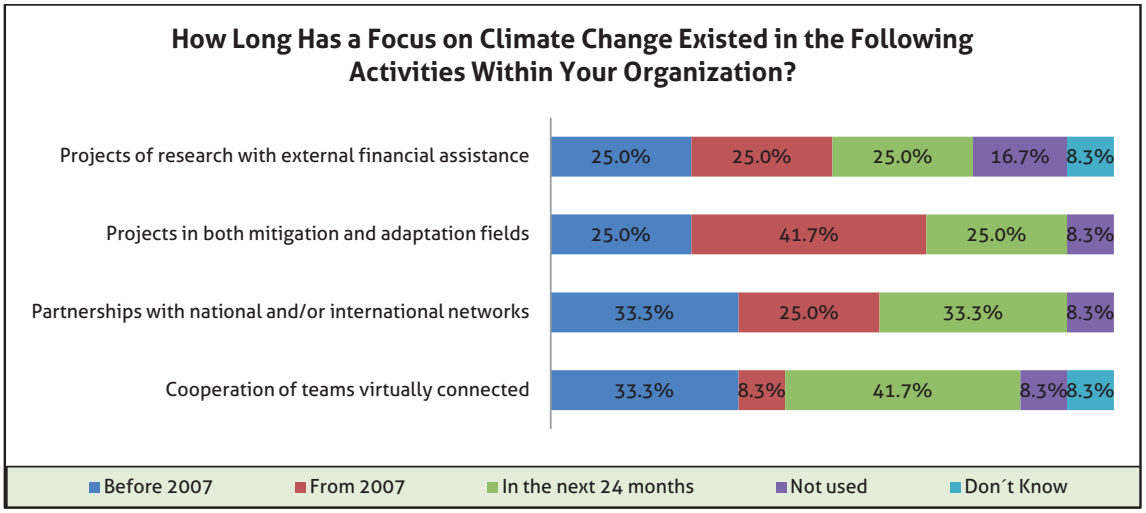


Conducts, strategies, and opportunities related to climate change. In this section the Decision-makers were asked about the activities and/or programs that are performed at their institution. As shown in Graph 3.4.2, it is remarkable that 68% of the surveyed institutions say they are currently working on projects related to climate change mitigation and adaptation, with most new projects having started after 2007. An additional 25% of the institutions indicated

that they will begin with such projects in the next 24 months. Thus, in two years, it is expected that 93% of the institutions have some kind of project on adaptation and/or mitigation ongoing. As long as research projects with external financial assistance, 25% of the institutions have projects of this type before 2007, 25% has these projects since 2007 and another 25% indicated that in the next 24 months they will have this type of project. On the other hand, partnership with national and international networks is one of the most widespread practices, 58% of the institutions are a member of some related association and 34% have plans to become a member of some association of this kind.

The questionnaire also included some specific activities in the field of climate change mitigation and adaptation. Through these questions, it was verified that the institutions have a greater preponderance for adaptation activities to climate change than to those for mitigation activities. Within adaptation projects, 86% of institutions reported to be working in the development of public and institutional policies, having the vast majority, 58%, of activities started after 2007. Seventy-one percent of institutions indicated to be performing activities for promoting policy formulation for climate change adaptation. Similarly, 86% of the institutions are working in monitoring and/or monitoring and evaluation of adaptation actions. In the field of mitigation, the development activities of public and institutional policies (86%), and promotion and formulation of regulations (73%) were the major activities whose higher level of intensity started after 2007. Next in order, it is emergency response with 58% of the institutions that perform this task, and finally monitoring activities, like evaluation of mitigation measures with 45% of institutions.

Graph 3.4.2



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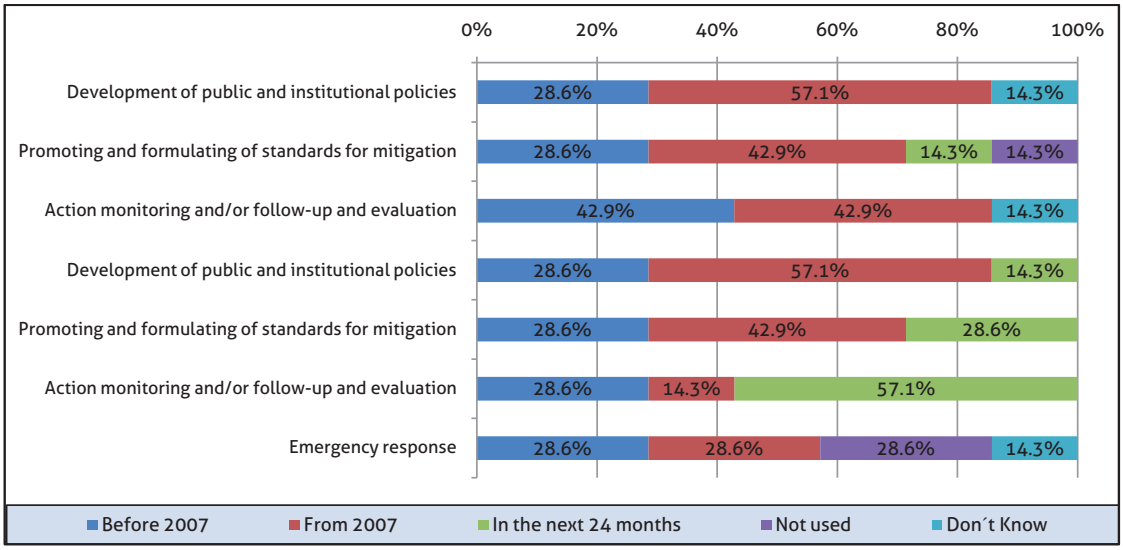
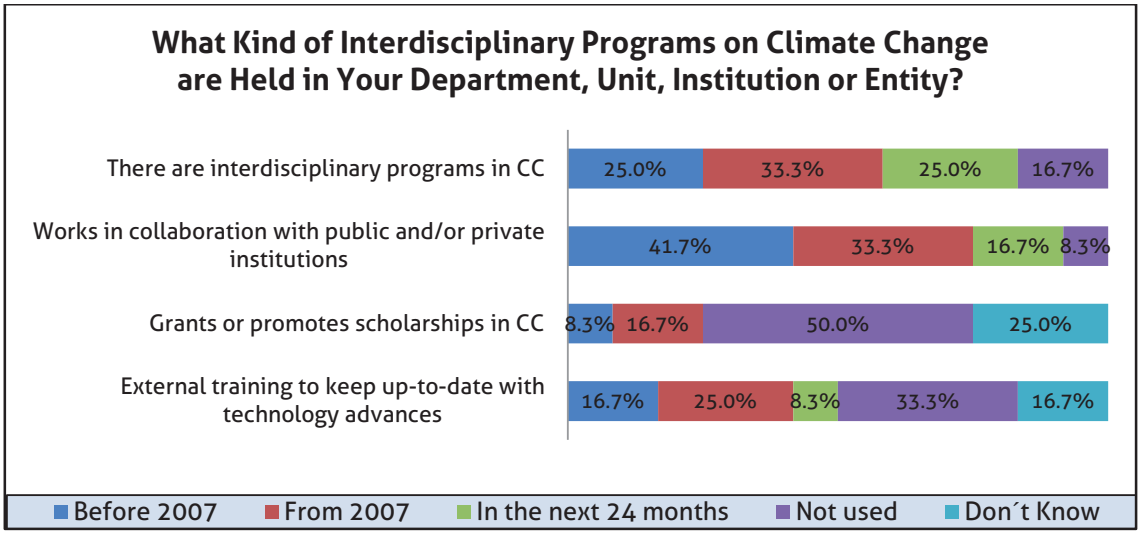


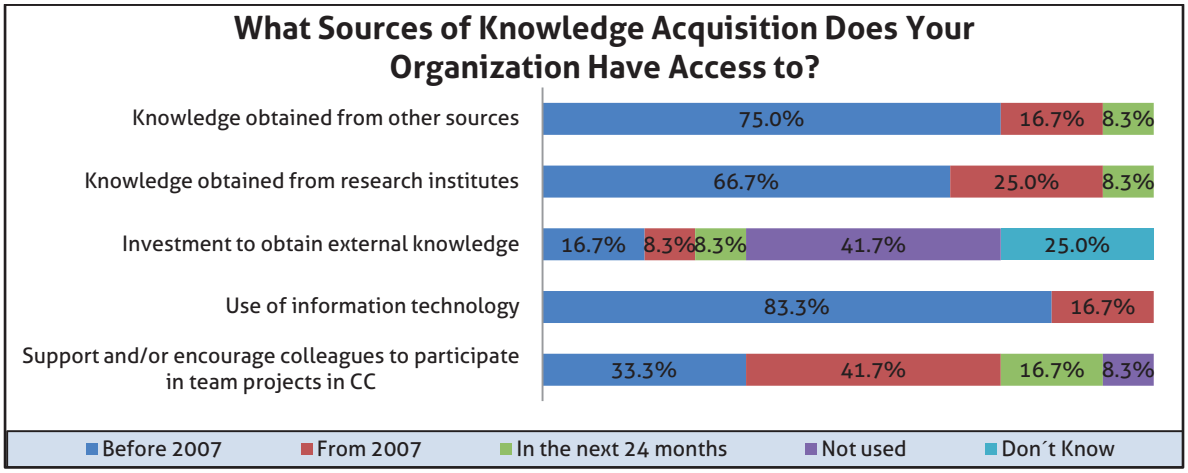
As it is seen in Graph 3.4.3, from the institutions surveyed, 75% indicated that they are working in partnership with public and/or private climate change programs, and an additional 16% said that they will start with these programs in a 24 month time horizon, and only 8% do not think about associating with any other entity. Fifty-eight percent of institutions have interdisciplinary programs on climate change and an additional 25% will have these programs in the next 24 months. The offer of scholarships is limited (25%) in institutions of this field, and by 2007 it was even more. External training is also a little used program (41%) and its plans for expansion in the next 24 months are hardly an additional 8%. This data demonstrates the lack of interest by the institutions to strengthen the capacities of its staff and incorporate them into a more competitive global network.

Regarding the acquisition of knowledge as depicted in Graph 3.4.4, sources used by the organizations, information technologies are reported to have the highest penetration (100%), followed closely by the knowledge gained from other sources: Universities, NGOs (91.70%), and knowledge obtained from research institutes (91.70%). In addition, participation in team projects is a new trend that has grown over the years (75%), especially since 2007.

Graph 3.4.3



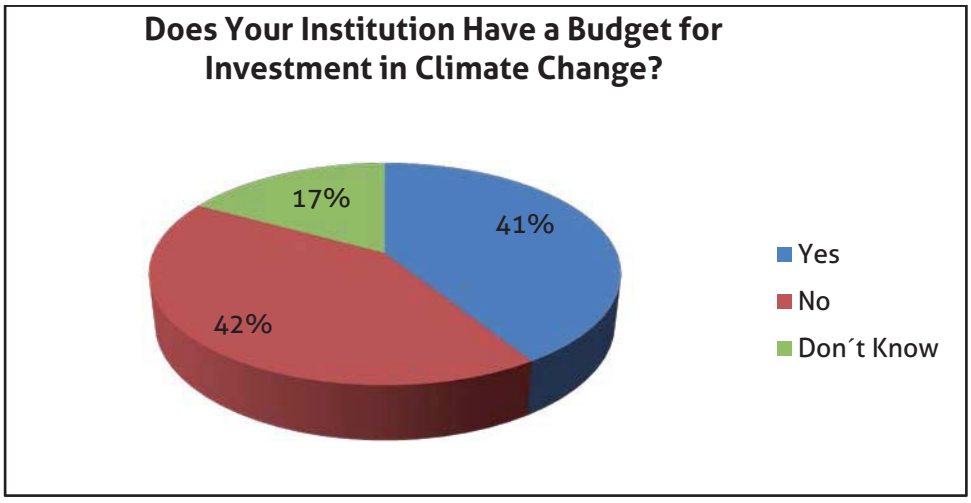
Graph 3.4.4



Policymakers were asked, in data not shown here, if their institution had a strategic plan to guide the decision-making process, and 75% claimed to have this plan while 25% indicated not having a strategic plan, showing a significant institutional weakness. This situation was aggravated by asking for a qualification for the degree of implementation of such plans, where 44% indicated that the strategic plan meets expectations little and/or more of less, and only 22% say the plan met the prescribed goals in a high degree.

In addition, questions regarding financial resources dedicated to climate change in institutions were asked in Graph 3.4.5. Forty-one percent indicated that they have a budget for investment in climate change and 59% do not have or know of its availability. In the case of institutions related to the environmental area the lack of specific budgets in climate change is a latent weakness at the national institutional level. Finally, they were asked about the approval and expediency of the creation of Technology Transfer Centres at universities, and 100% of the respondents revealed the need for such facilities under arguments such as strengthening research capacities, strengthening of human resources dedicated to environmental issues, improving local technical capabilities, information dissemination, and a greater awareness of environmental issues of the various actors.

Graph 3.4.5



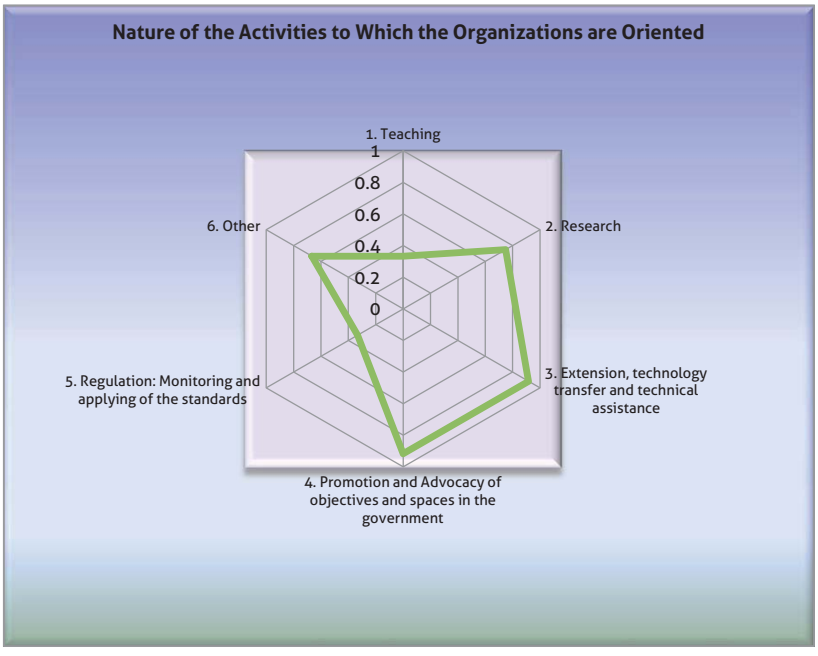
3.5. Survey Results Addressed to NGOs

Profile of interviewed institutions. We interviewed 24 people in various non-governmental organizations (NGOs) and/ or institutions such as embassies that work in Bolivia on projects related to the environment or climate change. Fifty-eight percent correspond to NGOs and the remaining 42% to entities such as embassies and international aid agencies, falling into the category of "Other." Among those selected for the survey, 50% had an undergraduate degree, 33% a master's degree and the remaining 17% a doctorate. Thirty-three percent considered themselves experts in the field of Climate Change, 33% considered having sufficient knowledge on the subject, and the remaining 34% considered themselves novices on the subject.

Graph 3.5.1, shows that 92% of the institutions are focused on the extension, technical assistance, and technology transfer. Another 92% indicated that the promotion and advocacy of objectives and spaces in government are one of their fundamental objectives. Research is also an approach with a high level of intervention (75%). While approaches such as teaching (33%) and the regulation and monitoring of standards (33%) are considered secondary among the respondents. As for the "Other" category 66% of the organizations highlighted approaches for financial support to projects and dissemination of content in these areas.

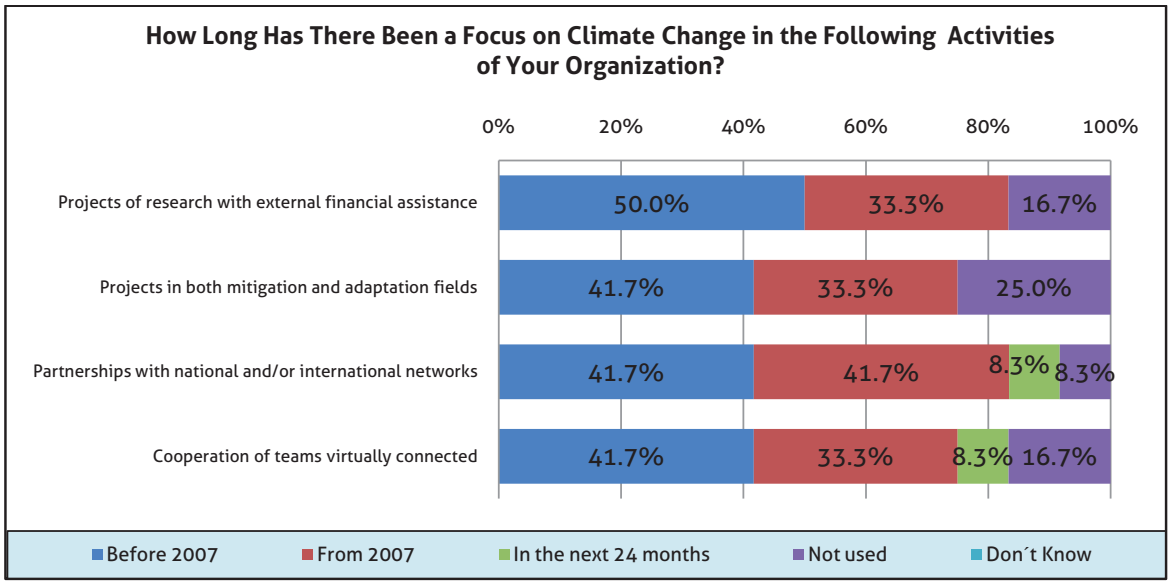
Conduct and strategies. In this section the NGOs and institutions were questioned on the activities and/or programs that they have been working on or are planning to implement within their institutions. As this group is financed mostly by foreign countries and international banks, it is not surprising that Graph 3.5.2, shows 83.3% are currently working on research projects with external financial assistance. Eighty-three percent of these institutions are in some sort of partnership with national and international networks, thus strengthening the links between actors on climate change. It is also noteworthy that 75% of these institutions are working on projects to mitigate and to adapt to climate change. In all these activities at least half of them are activities that have been in progress since before 2007.

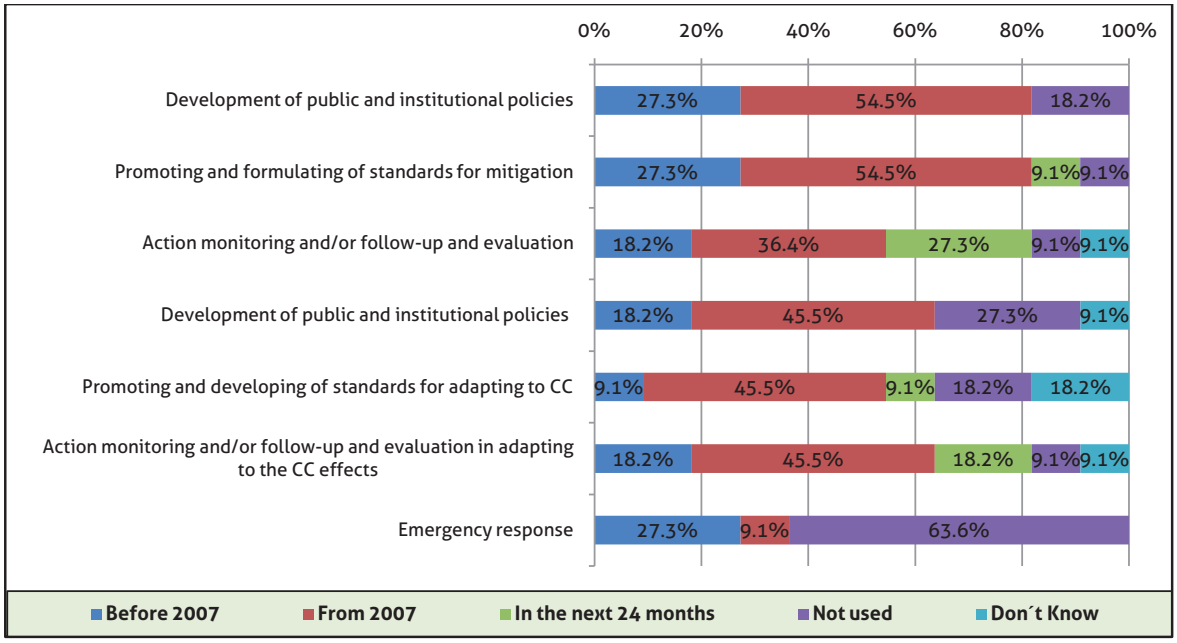
Graph 3.5.1



Regarding the specific activities on climate change in relation to mitigation, Graph 3.5.2 highlights that 82% of the interviewees indicated "Develop public and institutional policies in mitigating the climate change"; similarly another 82% is dedicated to promoting and developing standards for mitigation; and an additional 9% indicate to have this matter in their future plans. The monitoring and evaluation of regulatory actions are activities with a 55% share and further, 27% have firm expansion plans in the upcoming years. In the case of adaptation activities, it is observed that 63% of the interviewed agents indicate the development of sound public policies in the area of adaptation, which shows less intervention in this area than in the area of mitigation. Sixty-three percent of respondents reported that they were working in monitoring and/or follow-up and evaluation of regulatory actions on climate change adaptation and an additional 18% intend to move into this area in the next two years.

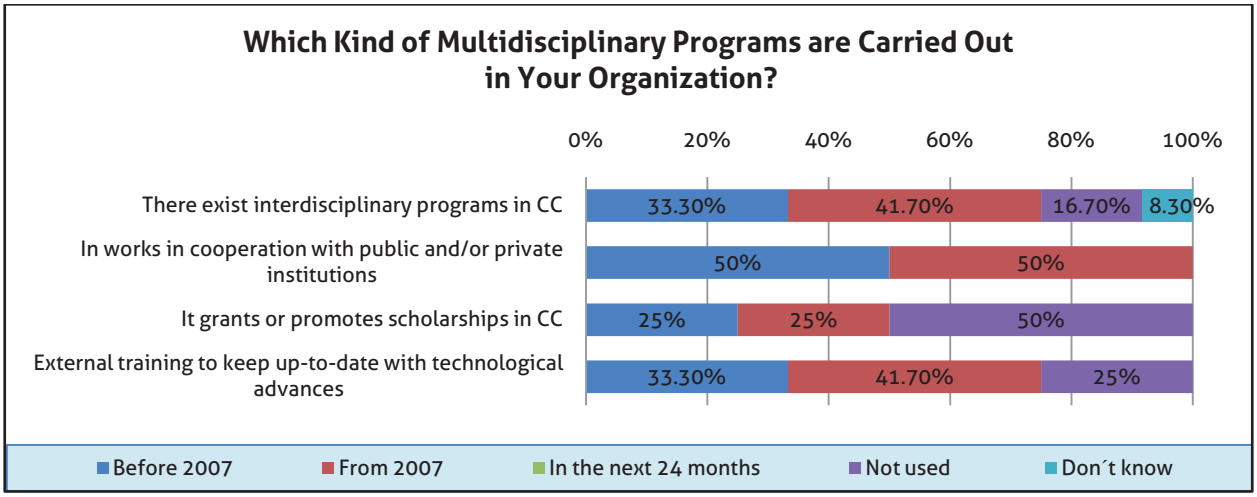
Graph 3.5.2





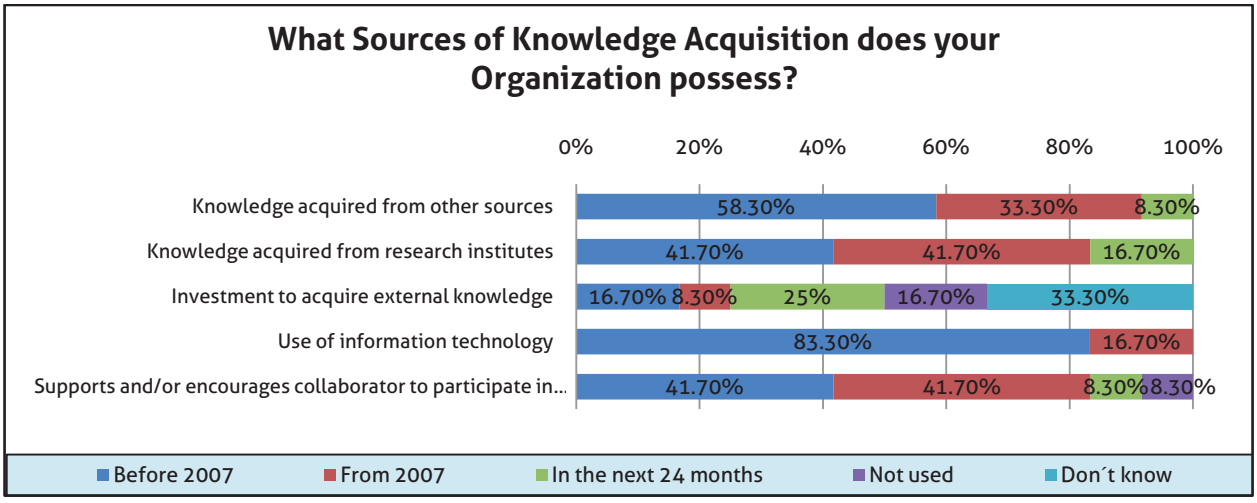
As it can be seen clearly from Graph 3.5.3, among the interdisciplinary programs executed by these institutions 100% are engaged in collaborative work with public and/or private organizations and 75% have interdisciplinary programs on climate change. In addition, 50% of the organizations indicate to grant and to promote scholarships on environmental issues and climate change and 75% to train people externally to keep up-to-date with technological advances. Multiple options were possible.

Graph 3.5.3



Graph 3.5.4 shows that 100% of the surveyed organizations report to be using information technology to acquire knowledge while 92% of organizations indicated obtaining knowledge from other sources: the market, NGOs, and universities. On the other hand, 83% get their knowledge from research institutes and another 83% supported and encouraged their affiliates to participate in team projects on climate change. Hardly 25% of the organizations invest to obtain external knowledge, even though 25% argue that they will begin to do it in the short-term. The good news is that all surveyed organizations have at least more than one source of knowledge that is consulted for their planning activities.

Graph 3.5.4

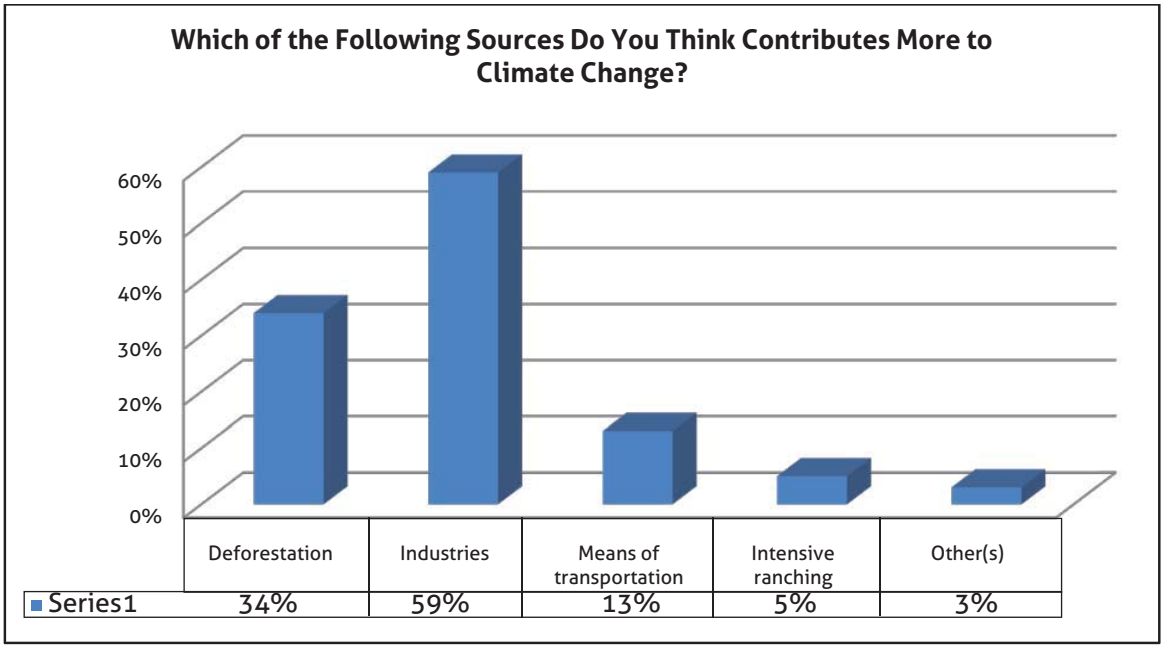


Investment in climate change. When asked whether they have a budget for investment on climate change, 58% of organizations said they had such resources. Out of this 58%, 48% indicated that their investments can be considered very high, while the remaining 52% considered these allocations between medium and low. With regard to the applicability and usefulness of NGOs and other institutions on Technology Transfer Centres, the response was an unanimous 100%. Motivation for this support is access, application and expansion of these technologies in the region; capacity building to replicate external experiences; the possibility of leading the development of their own technologies and techniques; and to prove the economic, environmental, and social benefits of clean technologies oriented toward mitigation and adaptation to climate change.

3.6. Survey Results Addressed to Students

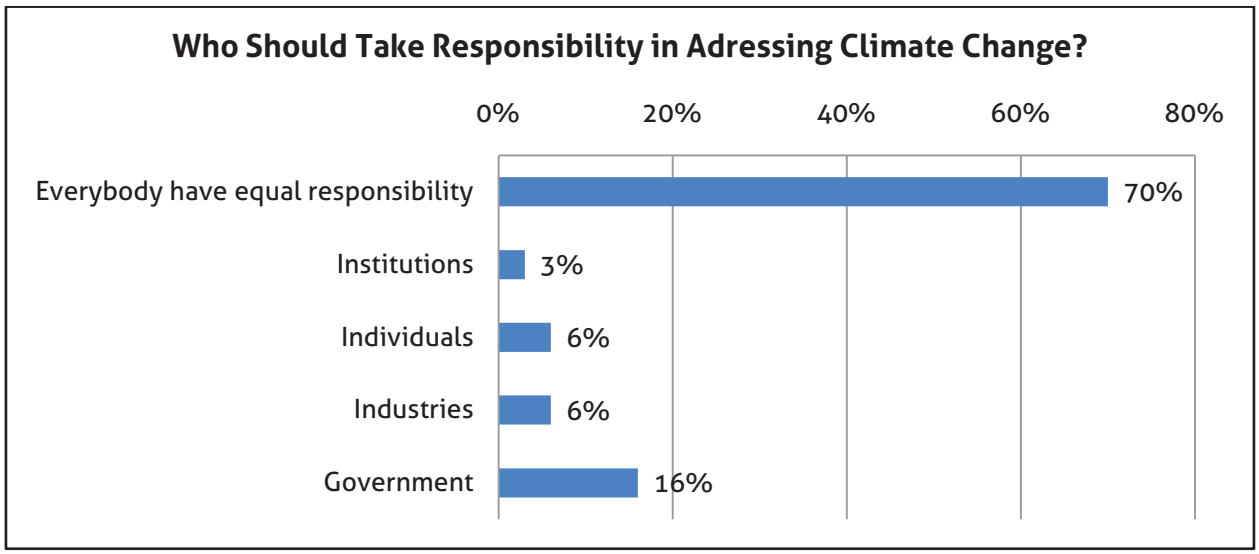
A simple questionnaire was carried out for students with 12 multiple-choice questions to simplify the data collection process. Students completed a total of 148 questionnaires, where 54% of the sample was men, and the remaining 46% women. Questions answered and not shown here, inquired first about the level of information that students had on climate change and 47% said they were quite knowledgeable on the subject and an additional 21% were very conscious of the subject. The data show that nearly 70% of the students responded that they had an adequate level of information on the subject. The remaining 30% had little or no knowledge on the subject, which gives room for some capacity building. Eighty-two percent of students believed that anthropogenic activity was a significant cause of climate change while only 14% disagreed with this statement and 5% did not have a clear position on this issue yet. In addition, 60% of the sample agreed with the statement that we are on the brink of an environmental crisis and an additional 25% strongly agree with this information, demonstrating a high level of readiness to cope with this challenge. Furthermore, the students feel the need to act immediately to stop this crisis. Students were asked about clear evidence of climate change and 63% of them claimed to have knowledge and awareness of such evidence, while the remaining did not respond the question.

Graph 3.6.1



Graph 3.6.1 shows the question asked to students about the sources and/or most influential causes of climate change, 59% identified industries as the main source of pollution that is contributing to climate change, 34% identified deforestation, 13% means of transportation, and just 5% to ranching. A disappointing fact, found in data not shown here, was to identify the lack of information of students' organizations and/or activist groups working in the environmental sector in the city, given that only 29% indicated to have knowledge of an institution of this kind. Graph 3.6.2 asked about who should take responsibility in addressing climate change and a resounding 70% indicated that the responsibility to act against climate change should be on the entire society as a whole, meaning that we are all responsible, a second group identified that it is the government's responsibility (16%) and therefore any initiative must come from the public sector.

Graph 3.6.2

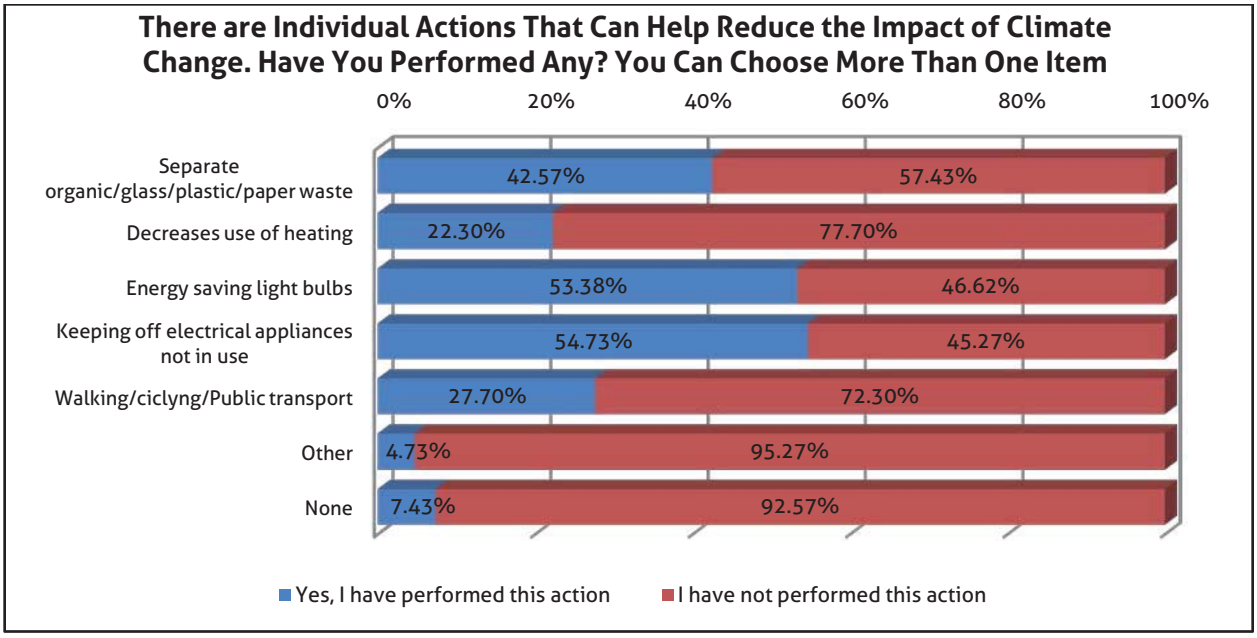


Another question to find student's involvement on the subject under study, was about individual actions to slow climate change that they perform or have performed as Graph 3.6.3 shows. A large percentage of respondents mainly performed simple tasks, including: keeping electrical appliances off if they are not being used (54%), using energy saving light bulbs (53%), and organic waste separation among paper, plastic and glass (43%). Activities such as the decreased use of heating (22.30%), walking, cycling, and using public transportation instead of using their own cars (28%) had low levels of participation. These data show how few are engaged in real efforts by society to reduce the environmental impact of human activity on the environment. The fact that only 50% of the respondents reported using low energy bulbs or keeping off electrical appliances not in use, shows a clear lack of education in the application of such simple but forceful measures to lessen our carbon footprint.

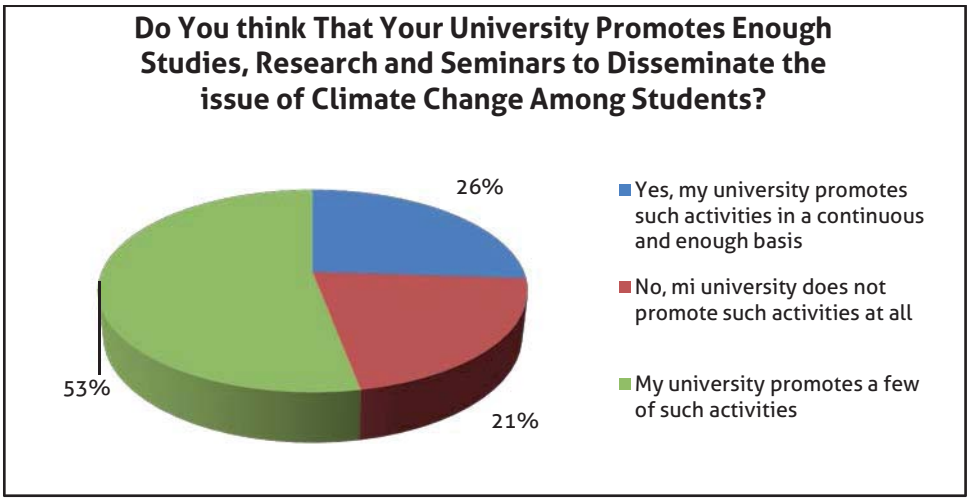
The next question that was asked to students referred to their perception about the role of the university to promote activities such as studies, research, and seminars to disseminate the

issue of climate change to the student population (see Graph 3.6.4). Only 26% of respondents think that the university generates enough activities to consider disseminating climate change information adequately, and the remaining 74% indicated little or no diffusion of the subject by their university. It is interesting to consider the great interest of the students to increase their knowledge on climate change since 90% are open to receive knowledge in this field (data not shown here). Out of this group of stakeholders, 42% indicated a preference for seminars taught by professors and experts in the field, 34% would prefer young activist groups to build capacities in specific actions. Only 24% preferred the specialized courses on climate change.

Graph 3.6.3

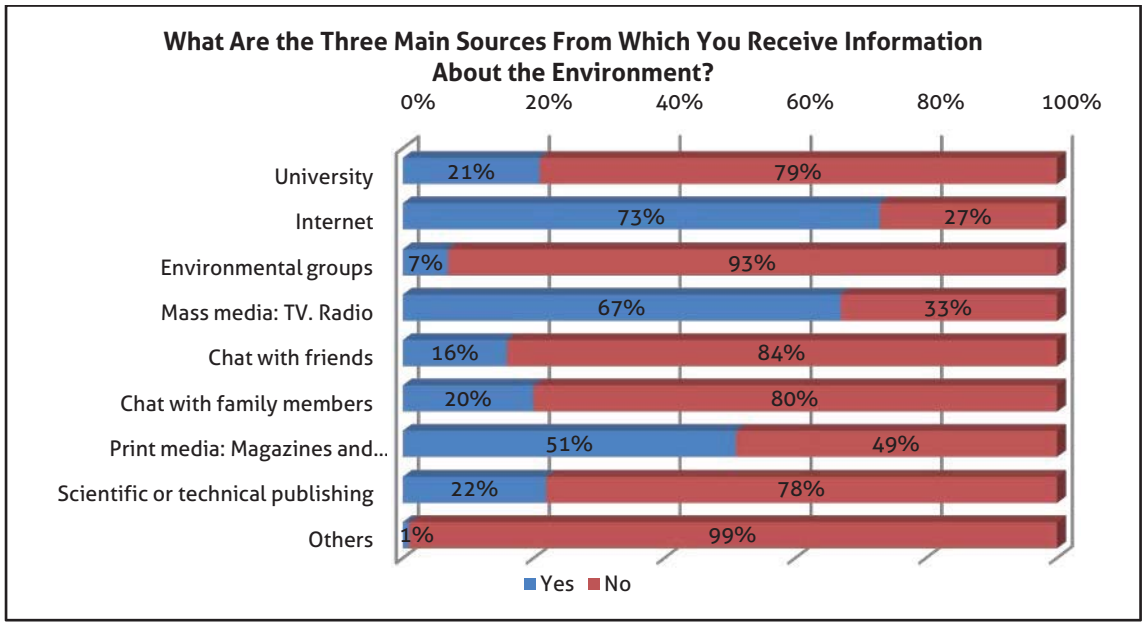


Graph 3.6.4



The last question asked to this group was aimed to identify the main sources from which students receive information on the environment and climate change, which is shown in Graph 3.6.5. As expected, the power of the Internet fulfills its role as the principal source of information for a large number of students (73%), followed in importance by mass media: TV, radio (67%), and print media (51%). The relevance of the university is low compared to the other options, so that the scholarly dissemination of high value and content have not yet reached the heights it should. At this point it is necessary to raise the value of the information that students can find on the Internet as this is the most relevant media indicated. It is important that professional blogs and pages on the subject are more widespread, because of the large amount of irrelevant information showing lack of professionalism that can be found on the Internet. There is a need to strengthen the role of universities as creators of web content, knowing that this is the most powerful media today.

Graph 3.6.5



3.7 Conclusions and Recommendations

The survey results addressed to companies

1. Companies act with a high level of sensitivity within the free market, carefully assessing the weaknesses and needs that a country might have in specific market areas. This survey was no exception. Although almost exclusively small and medium-scale companies were interviewed, information obtained is of great value and impact. A significant percentage of them identified climate change and the need for responses to it, as a business priority

considering the knowledge of economic and social damage that extreme weather effects can inflict to their operations.

2. Companies not only identified their fears and concerns about climate change, such as damage to property and assets, and the necessary legislation clarifying the institutional framework, but also showed clear need regarding the growing recruitment of qualified staff and the difficulty in finding it.

3. Another observation made by companies' representatives, is the lack of technical capacity to use carbon bond markets, since this activity might bring benefits to companies if mitigation and adaptation projects are implemented.

4. Companies are also quite aware about the role of regulation on environmental issues, claiming that appropriate legislation on various environmental issues is necessary in order to reduce GHG emissions and mitigate climate change. They highlight that this approach will also create conditions for the emergence of new market opportunities for businesses. The establishment of GHG emission limits and the need for standards and technical regulations for companies on these issues has more supporters than options such as direct taxation.

5. Companies know the potential of closing ties among universities and companies and thus fully support the establishment of Research and Technology Transfer Centres that allow for a greater involvement of academics in these issues thereby generating the necessary skilled human resources that would eventually be absorbed by companies.

The survey results addressed to university staff

6. Higher education institutions that participated in the survey have some level of activity in the environmental and climate change areas, but it is still insufficient. From the professors that were interviewed, a lack of greater expertise on these issues were revealed that are needed to teach and strengthen student knowledge in a proper way, with updated ideas and content.

7. Professors clearly expressed their training needs and interests. It was emphasized by them that the optimization of energy and water use, adaptation and policy development, alternative and/or renewable energies, constitute fundamental issues and contents on which majors, studies, or courses, should rely. The great interest shown in these courses also implies a lack of these skills in the professors surveyed, which is a fact that has to be prioritized and urgently changed.

8. The great majority of respondents supported the initiative of Research and Technology Transfer Centres, feeling that they are important and invaluable for the development of these subjects in the national framework. These observations also reinforced the requirement expressed by professors to improve research infrastructure at the universities, specifically referring to specialized laboratories in converging and promoting technologies to tackle climate change.

9. Responses also showed a low level of university staff involvement and therefore of the universities, with companies. This lack of association reveals clear shortcomings that should

be resolved immediately. For example universities that are not aware of this gap show a lack of practical applications of what they teach at the classroom level, reducing the possibility of positioning the university as a mentor and a generator of adequate trained staff. Therefore, this cooperation should be increased without doubt.

10. All professors interviewed said that it is necessary to strengthen the issue of climate change in universities, for which they mentioned innovations and initiatives that should start immediately, such as more work practices, better coordination of university-industry-government sectors, and greater research in all major related fields. The idea of Research and Technology Transfer Centres will provide grounds for strengthening these institutions and their cooperation.

The survey results addressed to Decision-makers

11. There is a clear diversity of actors and Bolivian institutions that work and play in the field of environment and/or climate change. This diversity demonstrates a range of needs pertaining to technology transfer and climate change that the different actors have, as well as the perceptions and degree of inter-relationships among them.

12. In Bolivia, the level of awareness of Decision-makers and their staff reached satisfactory responses but still they must be strengthened regarding the approaches of these institutions. It is clear that most of the institutions established in Bolivia acquired a more active role than just a regulatory and disseminator. Investigative areas, outreach, and technical assistance are the most important activities and it is around these axes that there are clear needs around which they revolve.

13. It was discovered that, in the short term, almost all of these institutions will have an active project on adaptation and mitigation of climate change. This is the result of new developments that are occurring in Bolivia and the urgent needs of having trained people in the subject, more funding, and the establishment and strengthening of networks and partnerships, among other initiatives.

14. The development of public policy in both adaptation and mitigation of climate change and the monitoring and/or follow-up and evaluation of these actions are specific activities that call for consolidation. This need to formulate public policy emphasizes the role of government as legislator and monitor of various areas related to the subject, thus allowing the establishment of an informative foundation that might increase its interaction with the rest of society. This synergy created among the institutions and government is essential to establish a plan and/or strategy for adaptation and mitigation of the environment.

15. In order to achieve the objectives set by these institutions, it is known that the source of acquisition of knowledge among them varies. Use of information technology is the most important among different actors along with the knowledge gained from research institutes and professional sources. Thus, there is a clear advantage and need of creating Research and Technology Transfer Centres as it would increase the technical capabilities of all these

institutions and this factor will be added to reach a convergence among these entities' goals.

16. Given the role of these institutions within the national framework, low investment exclusively devoted to climate change available in the industry and elsewhere will create a bottleneck in the growth and consolidation of this network of institutions. Beyond this shortcoming, at a macro-level, institutions involved in climate change present an encouraging picture whose level of activity is reflected in the activities they perform and the intensity these actions have mainly acquired especially since the year 2007.

The survey results addressed to NGOs

17. Surveys of NGOs and similar institutions in Bolivia released conclusive results. Among them it was understood through the survey, the approach that these entities have and where they are going with their plans and institutional activities. Technical assistance and through it, technology transfers, are reiterated here as the most prevalent specific activity at the NGO level. Demands generated by this area, will undoubtedly multiply agencies, which will allow germination of a greater number of new projects at the national level, since all technological transfers generate and allow the creation and development of these innovations nationwide.

18. NGOs are interested in promoting and lobbying objectives and closing gaps in government outreach. To a great extent, this experience together with the exposure they have had, through their Directors, with pioneer countries in environmental issues, make their role strategic in any plan for the future. They have an outstanding role and they are leaders in establishing concerns and priorities on climate change at the national and institutional level in Bolivia.

19. Consistent with the above, activities that NGOs develop such as the endorsement of public policies on adaptation and mitigation as well as promoting and developing mitigation regulations, have turned them in natural disseminators of innovation practices in the field of climate change. NGOs have successfully replicated at the national level related key projects in priority areas such as energy efficiency, cleaner production, and sustainable agriculture, among many others.

20. NGOs are also creating links and networks. As seen in the survey, NGOs are increasing their relevance in the national framework and increasing the reputation of Bolivian efforts in projects aimed at addressing climate change. According to respondents, it is needed to increase the level of investment by these NGOs and the role of their resources promoting and strengthening ties and projects suitable for a rapid and effective technology transfer, including the establishment of the mentioned Centres. The satisfaction of these needs will increase the institutional capacity at the national level that NGOs also wish to strengthen in Bolivia.

The survey results addressed to students

21. The additional survey to students showed disconcerting results regarding students'personal perceptions in general terms. A great number of students seem to be well informed about

climate change. Nevertheless, they show a lack of detailed understanding of the issue. For example, the questions about whether there is evidence of climate change; the perception they have about it as an anthropogenic activity; and their simplistic conception of the biggest polluters and/or contributors to climate change, reveal a superfluous knowledge by students on this issue.

22. Misinformation groups and activist organizations on environmental issues is the clear image of a separation of college students and the real social environment where they live and operate. Nevertheless, there are glimpses of concern and awareness on their part, as evidenced by the fact that they perform small but helpful actions at home or in their daily lives, such as separation of garbage, and proper use of electricity, among others. They are, however, not completely managed by them.

23. Students are interested in the topic of environmental management and that is why a large majority indicates that their universities should take a more active role as promoters and disseminators of contents, emergencies, and capabilities in these areas. Furthermore, there is a clear interest to understand the issue through seminars given by experts and professors in these areas and creating youth activist groups and, in general, links among those interested in the subject.

24. One of the conclusions that has a stronger implication, is the priority given by students to the Internet as a source of critical information. This leads one to think about the great success that the creation of a Research and Technology Transfer Centre might have and its possible ability to allow students to access appropriate and professional-based information on adaptation and mitigation of climate change, sustainability, alternative energy, and environment in general. It must be noted that the Internet has diverse, controversial, and an ill-founded content. In addition, it is often accompanied by irrelevant personal opinions and frequent biased positions that distort reality, generating inevitably doubtful information. There is a need for dissemination of valid studies generated by research institutes, professors, and experts in the field, which could be replicated, and possibly reach college students more directly. In turn, this credible information has to be offered in a more attractive and amenable way.

3.8 General Conclusions and Recommendations

The survey conducted by the team in Bolivia CELA actors and organizations in the field of technology transfer and climate change has led to important lessons that reflect the interaction of the sector as well as aspects of the structure:

1. There is a weak link among universities and private and/or public institutions. This is demonstrated by the lack of capacities to address climate change, scarcity of technology transfer, and low incidence of universities in generating their own adapted techniques and technologies to the national scenario.

2. To overcome these challenges, the role of universities is transcendental. The university must generate enough capable professionals on issues of climate change technology transfer,

adaptation and mitigation. They should also start training their own teachers on these subjects. Furthermore, the university must generate partnerships with businesses and the public sector so as to give greater opportunity for job placement to its students through the improvement of this interaction process.

3. In Bolivia, the level of awareness of the different actors and institutions surveyed reaches fairly high levels, but that can and should be further strengthened, especially at the level where the levels of student knowledge and awareness of climate change are still scarce.

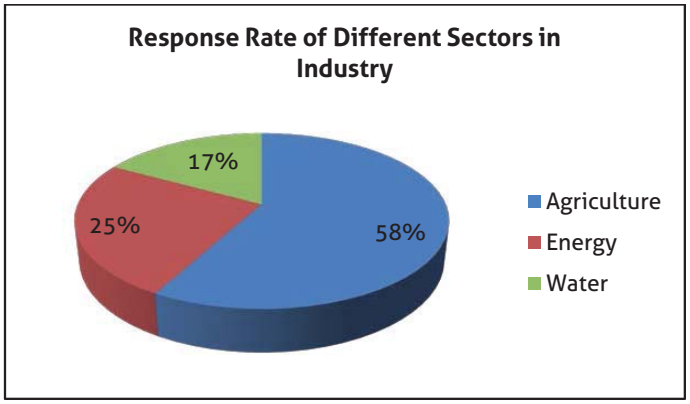
ESTONIA

3.1. Methodology

Research and report design. A qualitative survey of three distinctive sets of stakeholders (companies, universities, and Decision-makers) was carried out based on questionnaires, developed by the Guatemalan partner at the Galileo University. The questionnaires were translated from English into Estonian and modified slightly according to local conditions. Interviews were conducted through e-mail as well as direct contact with selected stakeholders, mainly university people. Some stakeholders were contacted by telephone and received the questionnaire by e-mail afterwards. None of the interviews were conducted solely by telephone. If the questionnaires were not returned, then a follow up call was made. In order to ensure similar interpretation and methods of data analysis and present more comparable results, reporting of major findings derived from the questionnaire was conducted in accordance with the structure of the German partners report at the Hamburg University.

Sampling procedure. The number of possible stakeholders who could be contacted was rather limited in Estonia. Therefore, it was decided to send out the questionnaires to all detected companies in relevant sectors as well as lecturers in universities, including the identified Decision-makers in those universities, public institutions, and environmental NGOs in the field of technology transfer and climate change. For the agricultural sector, it was decided to involve only larger agricultural companies that usually have hundreds or thousands of hectares of land and are responsible for major environmental impacts. It was assumed that the collected non-probability sampling that has been applied and a straightforward approach for tackling those defined target groups most related to the topic under analysis are representative for the intended selected sub-groups that finally were part of the sample and this could provide results with sufficient quality.

Graph 3.1.1



The survey results addressed to companies. For the business sample, the cases comprised of generally small enterprises from the agricultural, energy, and water sectors. Most of the enterprises in Estonia are small and/or medium size, therefore, the selected sample is representative of this situation. During the sampling procedure, all applicable companies in Estonia were considered. The contact data were taken from statistical internal databases. The survey results from different economic sectors were mainly calculated and interpreted on the basis of percentage distributions (Graph 3.1.1). More than half of the companies who replied represent the agricultural sector as there are more farms as well as agricultural companies than there are those active in e.g. water management or energy production.

The survey results addressed to University Staff. This sample included the largest public universities in Estonia—Tartu University, Tallinn University of Technology, Tallinn University, and Estonian University of Life Sciences. The survey respondents were chosen from different departments that work at least to some extent or have courses related to the issue of climate change. This background information was collected partly from the universities' Internet sites.

The survey results addressed to Decision-makers. The sample of Decision-makers involved the governmental ministries, universities' research institutes, industrial associations, and non-governmental organizations that are at least somehow related to the issue of climate change. The contact data of respondents was taken from statistical internal databases.

Data collection. Data collection started in the second half of June and continued into the beginning of July 2011. However, this was not the best time to collect data results, as this time period is a public holiday. Therefore, it was decided to repeat the data collection in September and October 2011. Some answers to the questionnaires were received even later, in November and December 2011. Alogether 207 questionnaires were sent out and 46 (22.2%) of the respondents replied (Table 3.1.1). Companies had lower return levels than university staff and Decision-makers.

Table 3.1.1 Survey Response Rate of Three Distinctive Sets of Stakeholders

Sample	N	Returns	Response rate %
Companies	138	12	8.7 %
University staff	23	12	52%
Decision-makers	46	22	48%

As Table 3.1.1 demonstrates, the response rate of university staff and Decision-makers was surprisingly high and the collected data can be assessed as representative for the selected sub-groups. The response rate of companies, when compared to acceptable response rates in other social science studies, calls into question whether these results can be considered as reasonable. However, as the sampling was non-probabilistic and the intention of the study was not to generalize the results or to test hypothesis, the response rate is sufficient in order to draw exploratory preliminary conclusions.

Limitations. It is likely that respondents were unable to understand all questions within the questionnaire or were unable to provide answers to particular questions. We believe that the length of the questionnaire and the corresponding interview also resulted in a low response rate, especially in companies. Most of the companies do not hire any employees who solely work on environmental issues. Moreover, due to the non-probability sampling, the evaluation of results had

only limited possibilities for sophisticated interpretations. The results from the three distinctive target groups are quite different. Nevertheless, the study results can be assessed as a starting point for further in-depth research in the field of market-oriented research and technology transfer needs in Estonia.

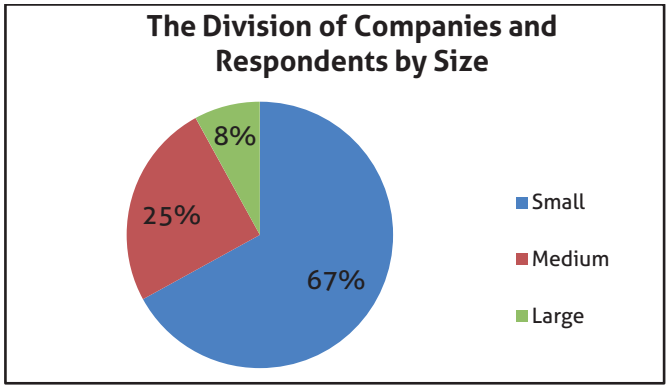
Research findings, descriptive analysis of research variables. The collected data are described by means of relative frequencies. The answers to open questions were clustered and summarized.

3.2 Survey Results Addressed to Companies

E-mails with survey questions were sent to 138 companies. Only 12 companies responded with completed survey questionnaires despite of the fact that most companies were targeted at least twice. Lack of interest as well as inappropriate timing of the survey can explain this lack of response. None of the companies refused directly to participate. Some potential respondents indicated that the reason for not responding was simply lack of time as the instructions asked the highest authority or company executives responsible for the subject of climatic change within the company to fill out the questionnaire.

Profiles of companies and respondents. Most of the companies that responded (67%) employed up to 50 people and are categorized as small companies. Medium sized companies (51-250 employees) account for 25% and large companies (more than 251 employees) account for 8% (Graph 3.2.1). This division between the size categories is quite representative for the companies in Estonia where small and medium size companies are overwhelmingly dominant.

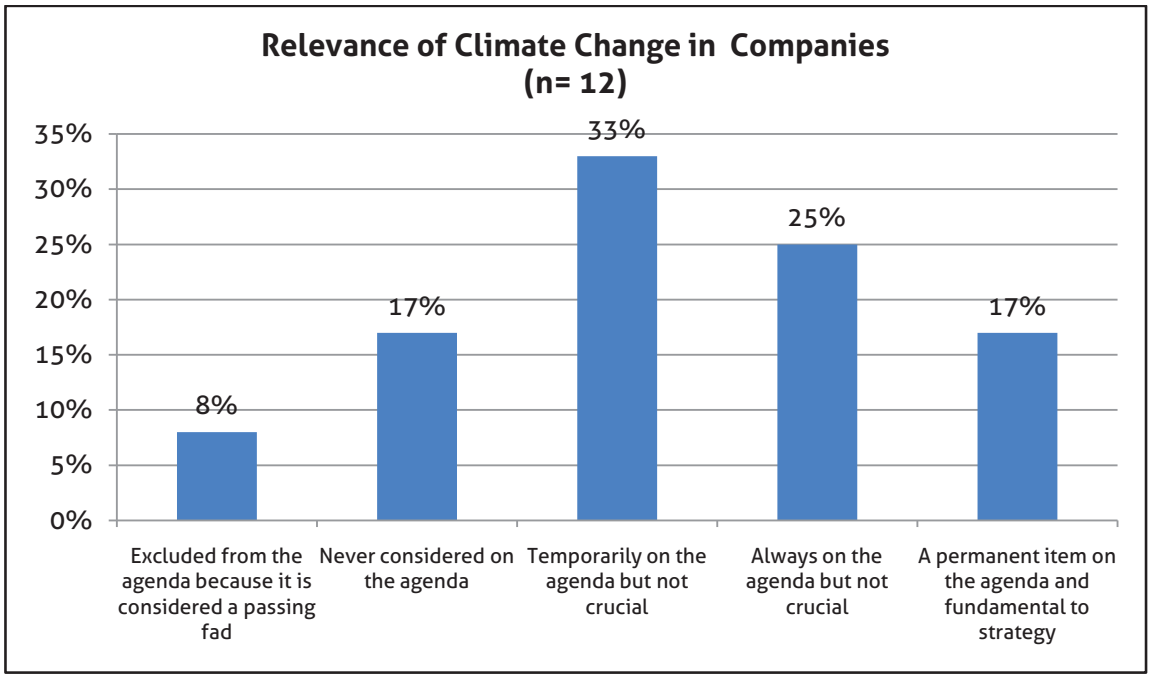
Graph 3.2.1



The annual revenue of the companies is quite minimal according to data not shown here. 50% of the companies have an annual revenue of 1-5 million EUR; 33% of the companies 100–500 thousand EUR and only 17% of the companies' annual revenue is more than 10 million EUR. Apart from the Estonian market, 75% of the companies are doing business in Europe and other parts of the world (1 company is doing business in Central America). The age dispersion of the respondents indicates that 91% of them are older than 40 years. The gender dispersion shows that there is a greater proportion of men (75%) than women among respondents. All of the respondents have a university diploma (67% of the interviewees have master's degrees) and two hold doctorates.

Business development and climate change. Seventy five percent of all interviewed companies state that climate change and its impacts are taken into account in the company's business decisions (see Graph 3.2.2). The respondents reported that overall business strategy, investment planning, and corporate reputation are the most important areas within their business activities where climate change issues are considered.

Graph 3.2.2



In the mid term, companies expect some change resulting from climate change to influence their business activities. The most important challenge is expected to be the growing need for innovation in order to set business apart from the competition (very high priority for 55%). In two years time companies also expect to have difficulty attracting and retaining talented people (very high and high priority for 90%), need for sales growth, cost-reduction, and increasing efficiencies (see Table 3.2.1). The need to respond effectively to the dangers and opportunities of globalization, a major contributor of climate change was at the same time was considered mostly a medium priority target.

According to the respondents, energy and water are generally seen as important or very important strategic resources for the companies. To optimize energy use, companies have implemented different measures, such as; insulation of the buildings, use of energy saving windows and heating systems, automated and systematically maintained boiler house, energy savings, and water pumping at night when the price for energy is lower. In order to ensure water supply in the long term, the companies implemented water saving toilets, permanent control of leakage, optimal use of technological water, etc.

The level of climate change knowledge and its effects on the respondents were defined as satisfactory in data not shown here: 75% of the interviewed persons marked that they (executive heads) are learning or already have sufficient knowledge about this subject. The answers from

the companies' executive heads indicate at the same time that in most cases their employees understand and are aware of climate change but only vaguely (58%). 17% of the executive heads marked that their employees fully understand the climate change issue and are aware of company's carbon footprint and the strategy being employed.

Table 3.2.1 Upcoming Challenges for Business within the Next Two Years

Challenges	Priorities				
	Low Priority	Low to Medium Priority	Medium Priority	Medium to High Priority	High Priority
The need to innovate in order to set ourselves apart from the competition	0%	9%	18%	18%	55%
Sales growth	0%	16%	17%	17%	50%
Reduction of cost and increased efficiency	17%	17%	8%	0%	58%
Increased profitability and customer retention	0%	30%	20%	30%	20%
The need to attract, retain and motivate talented people	0%	10%	0%	60%	30%
The need to increase adaptability and the speed of operation	18%	0%	36%	27%	19%
The need to respond effectively to the deterioration of our business model	14%	44%	14%	14%	14%
The need to respond effectively to the dangers and opportunities of climate change	29%	14%	29%	14%	14%
The need to respond effectively to the dangers and opportunities of globalisation	25%	12%	63%	0%	0%

Human resources management and the role of universities. In most firms the number of employees associated with work on climate change is limited to 1-2 people. The majority of these employees, however, are working in the general administration area (53%), and the rest in logistics (26%), or commercial (17%) departments. None of the interviewed persons/ companies plan to hire additional personnel or plan to train their employees on the issue of climate change. They also do not intend to organise any training opportunities for its staff in the near future. Generally, it can be concluded that the need to respond effectively to the dangers and opportunities of climate change were mostly considered as low- or medium priority target and the companies are not fully recognizing the challenge that they are faced with regard to climate change.

According to the respondents in data not shown here, areas and business activities that consider climate change include investment planning and overall corporate strategy. Corporate reputation and brand management are also recognized as important factors to be considered. This opinion may be driven by anticipation of an increase in pressure from interest groups to address climate change. However, there is no urgent demand yet to build or extend specific capacities in-house. High priority issues resulting from climate change therefore refer to the

typical business development themes such as, profitability and innovation, (demand for new products or services and possible interruptions in the supply chain) as well as efficiency.

Cooperation with universities. It is impossible to draw any clear picture about university-business cooperation. Contracting, internships or apprenticeships, joint research, patents, and supervised practice were all mentioned equally. With regard to the question about integration of the subject of climate change in university programmes, the interviewees suggest including it mainly in the following courses of study: engineering (83%), economics and business administration (83%), and agronomics (75%).

Climate change and legal environment. The majority of interviewees consider climate change to be a priority issue in Estonia, but affecting mostly selected sectors like Government, NGOs, and some companies according to data not shown here. The respondents also suggested that Estonia is only moderately prepared to cope with problems related to climate change (58%). Seventy percent of the company's executive heads agreed that it is necessary to legislate on climate change in Estonia. With regard to necessary changes in the regulation system, respondents almost unanimously mentioned implementing technical standards and rules (58%), tax and limits on greenhouse gas emissions (58%), carbon credits trading (50%), and laws with incentives to create national and international credits (58%).

With respect to the question concerning the time frame of enacting necessary policy instruments, the interviewees differed greatly in their opinions and suggested time lengths from one up to more than eight years. When asked about specific international system of carbon credits, the majority of respondents marked that they know that there is an international system of carbon credits that can generate revenue for their companies (82%), but only 11% answered that participants actually use it.

Climate Change Research and Technology Transfer Centres. With regard to the work universities perform, the majority of companies (73%) would agree that there is a certain need to establish Climate Change Technology Transfer Centres in universities in order to:

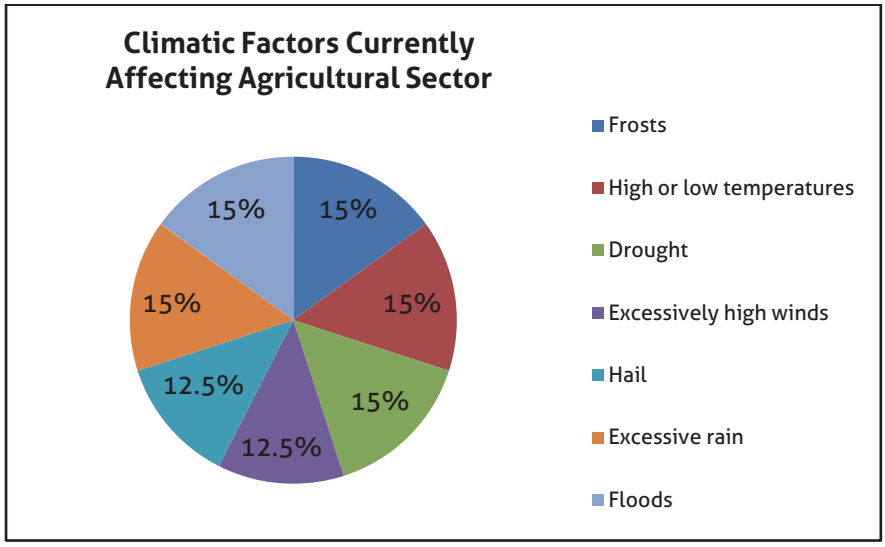
- Find the best solutions for the companies;
- Carry out research for assessment of the real situation;
- Make prioritization of actions and needed resources.

Moreover, development of environmental friendly and energy efficient technologies are considered one of the priorities for the Climate Change Technology Transfer Centres.

Impacts, opportunities and adaptation strategies. Almost a unanimous amount (91%) of respondents confirmed that climate change will result in a rise of additional costs for their businesses. However, the ability to provide specifics examples of additional costs that will arise in near future did not impart clear results. The respondents believed that additional costs might vary from less than 5% up to 20%. The biggest effect of climate change experienced by companies in recent years was communication breakdown due to stormy weather (26%) as well as interruption of production (21%). When dealing with climate change on a strategic and operational level, companies see benefits, mainly related to enhanced energy efficiency, clean technologies, and green building.

Impacts, opportunities and adaptation strategies in the agricultural sector. Respondents from the agricultural sector gave almost equivalent answers to the question about the extent they were currently suffering different climatic events affecting their output.

Graph 3.2.3



In the coming years farmers expect to observe drought events and temperature variations. The temperature changes will most likely force farmers to use new crops and varieties, change planting and harvesting dates, and make them more aware of pest and disease controls. A change in planting and harvesting dates is also considered to be the most significant challenge in the case of alterations in precipitation. Farmers consider excessive cost the biggest difficulty in adapting to climate change.

3.3 Survey Results Addressed to University Staff

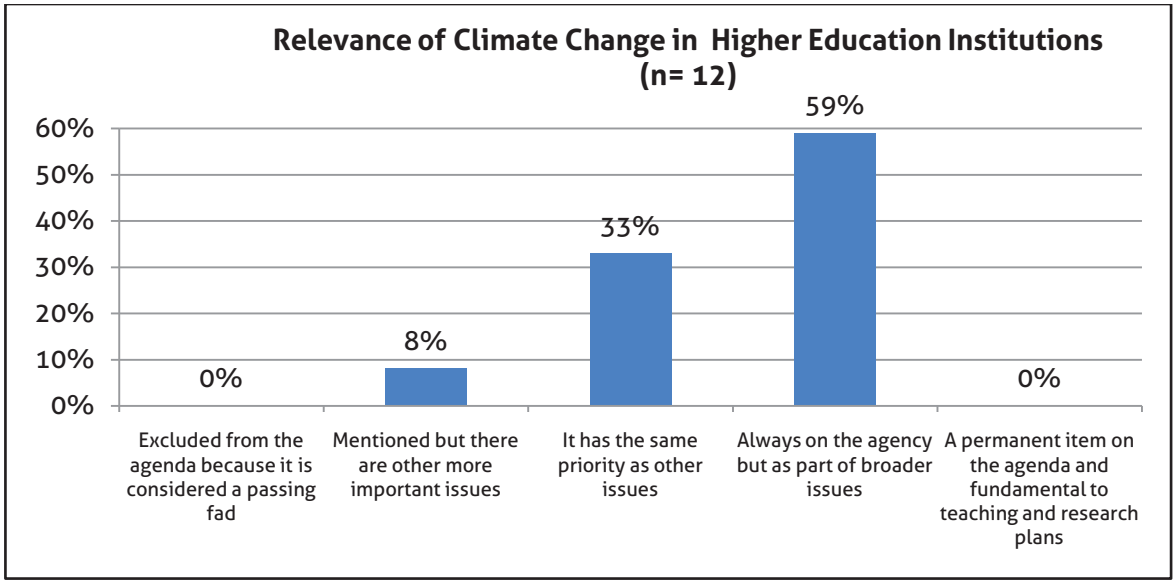
From the list of 23 university staff members that were contacted 2-3 times by e-mail, telephone, or in person, 12 were willing to respond. This equals to a response rate of 52%. Possible reasons why individuals failed to respond is lack of interest or time. Nobody refused directly to participate.

Background characteristics and attitudes toward climate change. The average age of respondents in the target group—teaching staff was estimated to be 47 years old with a gender dispersion of 67% female and 33% male. All had obtained a university diploma and at least 42% had a master's degree, while the rest 58% had a doctorate. The overwhelming majority of interviewees (75%) have been working in universities for more than 5 years, indicating that research and teaching activities (both 45%) as their main working area in the higher-education institution (HEI). During 2011, survey participants were quite active at their respective universities. They taught an average of 2.5 courses and produced 2-3 scientific publications.

The specialisations of interviewed lecturers included: environmental engineering, hydrobiology, hydrology, chemistry, and environmental protection technology. With regards to their core research and development areas the interviewed participants marked hydraulic efficiency technologies (35%), energy efficiency technologies (24%), the construction of

bridges and roads (6%), urban planning and architecture (6%), and markets development (6%). As "others" participants mentioned waste management technologies and sustainable use and protection of large lakes. The majority of respondents describe their knowledge level in the field of climate change issue to be sufficient (42%), or neither a lot nor a little knowledge (33%). Only one respondent considered himself as knowledgeable or an expert on the subject. Furthermore, the priority of climate change issues in HEI teaching and research areas is rated to be quite high, being always on the agency but usually as part of broader issues (58%) (see Graph 3.3.1).

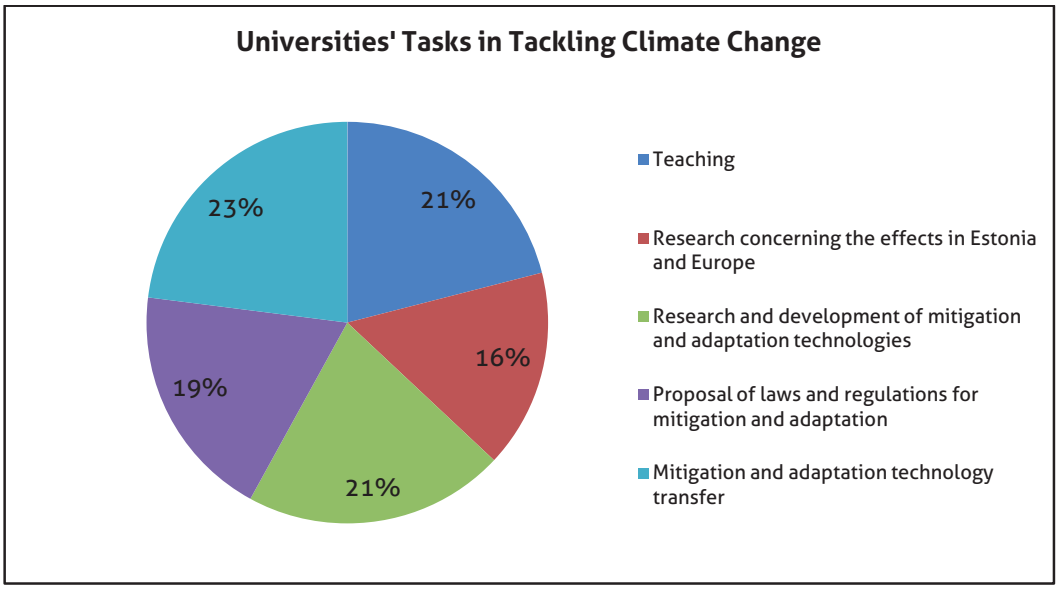
Graph 3.3.1



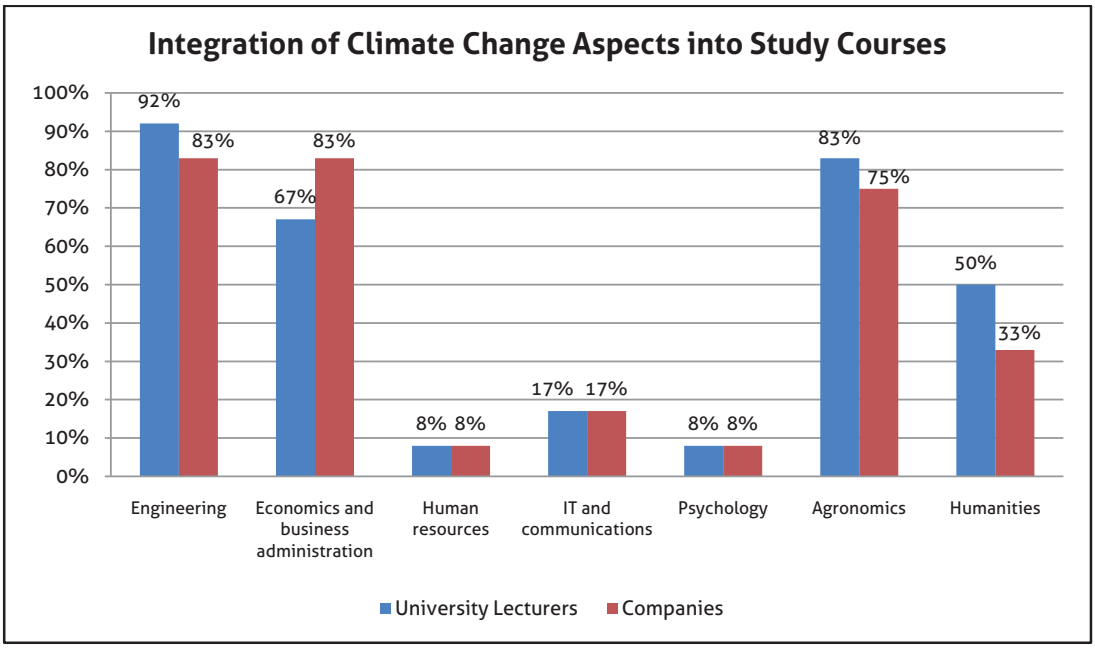
The university respondents had almost identical appreciation to the importance of different missions of HEIs on climate change (See Graph 3.3.2). The most important issue seems to be the transfer of mitigation and adaptation technology, followed by general teaching about the climate change as well as development of climate change adaption and environmental protection technologies. Nevertheless, only 2 respondents out of 12 marked that apart from teaching and research activities in HEIs they also give technical assistance on climate change to companies, NGOs, or the government.

With regard to the question about the necessary integration of climate change subjects in university programmes, university respondents suggested that is could be included with courses in: engineering (92%), economics and business administration (67%), and agronomics (83%). As "others" interviewees mentioned courses related to medicine, chemistry, and limnology. In comparing Company responses with university teachers about integration of the topic of climate change into courses of study did not reveal any major differences. Not surprisingly, the companies ranked integration of the topic of climate change into economic and business courses somewhat higher (See Graph 3.3.3).

Graph 3.3.2



Graph 3.3.3



Training interest on climate change. Interviewees marked the fields of adaptation and environmental management (83%), optimization in water use and adaptation and risk management (both 50%), and waste management (33%) as their biggest interests in data not shown here. Research and development was the main interest regarding training in mitigation (75%), followed by renewable heat and energy field (42%), as well as nuclear power, advanced renewable energy, and application of carbon capture and storage

(all 25%). Forty two percent of all respondents were interested in receiving training in curricular development for graduate level programs. The demand for other training topics can be considered as negligible. Some of respondents mentioned a need for training on the development of teaching modules in the subjects such as: bio-energy, environmental protection and sustainable development, climate change (national and international aspects), handling of storm water, atmospheric deposition, industrial wastes, urban wastes, trans-boundary pollution and policies, and innovations in sustainable development.

Institutional strengthening on climate change. All respondents were unanimous in their opinion that there is a definite need for reinforcement of climate change subjects at universities and HEIs. As the most important goals, interviewees reported a need for the following:

- Development of exchange programmes and educational cooperation between universities, businesses, and public institutions to improve ability to address the problem of climate change;
- Research to develop technologies for adaptation to climate change problems;
- Research to develop technologies for climate change mitigation, particularly the efficient management of energy and water.

Feasibility of Research and Technology Transfer Centres. Thirty-six percent of respondents, in evaluating the feasibility of Technology Transfer Centres at Estonian universities deemed these Centres as feasible but 28% remain uncertain whether these Centres could succeed. The remaining 36% of respondents marked that Technology Transfer Centres could be established in universities but believed that this process would be confronted with many problems.The main goal of Transfer Centres, according to the sample under analysis (ranked in order of perceived importance):

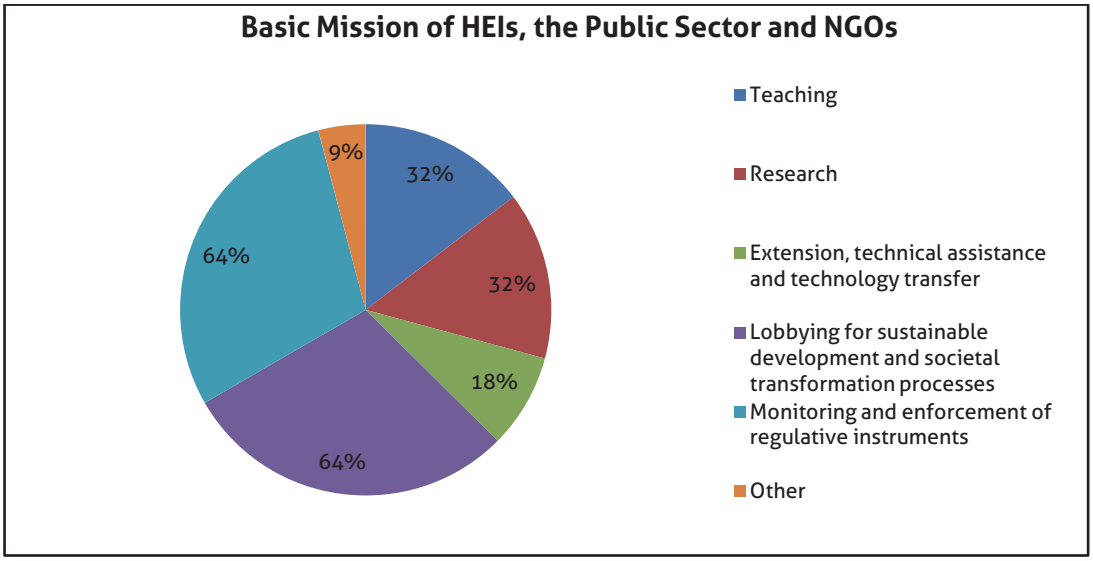
- Capacity building, i.e. skills training in technical and applied subject areas of climate change (100%);
- Policy consulting, i.e. contribution to codes and regulations concerning climate change (82%);
- Training in curriculum development in universities and content programming for public, private, and non-governmental bodies (73%);
- Generation of patents with access to royalties derived from them (18%).

3.4 Survey Results Addressed to Decision-makers

From the list of 46 Decision-makers in universities, public institutions, and non-governmental organizations that were contacted 2-3 times by e-mail, only 22 were willing to respond, including 11 women and 11 men. This is equivalent to a response rate of 48%. Non-response can be attributed to lack of interest or shortage of time. None of the Decision-makers refused directly to participate.

Characteristics of the organizations. The sample represents nine public institutions, seven non-governmental organizations, five universities, and one other type of organization. The majority of interviewees were 55 years old and above (52%). Fifty percent of the interviewees hold master's degrees and 32% doctorates. 14% of respondents marked that their organisational activities are limited only to the capital city of Tallinn and 82% of respondents declared that these activities cover all Estonia. The main mission of their organizations with regard to problems arising from climate change is seen as monitoring and enforcing regulative instruments and lobbying for sustainable development (See Graph 3.4.1). Teaching and research activities were also mentioned quite often.

Graph 3.4.1

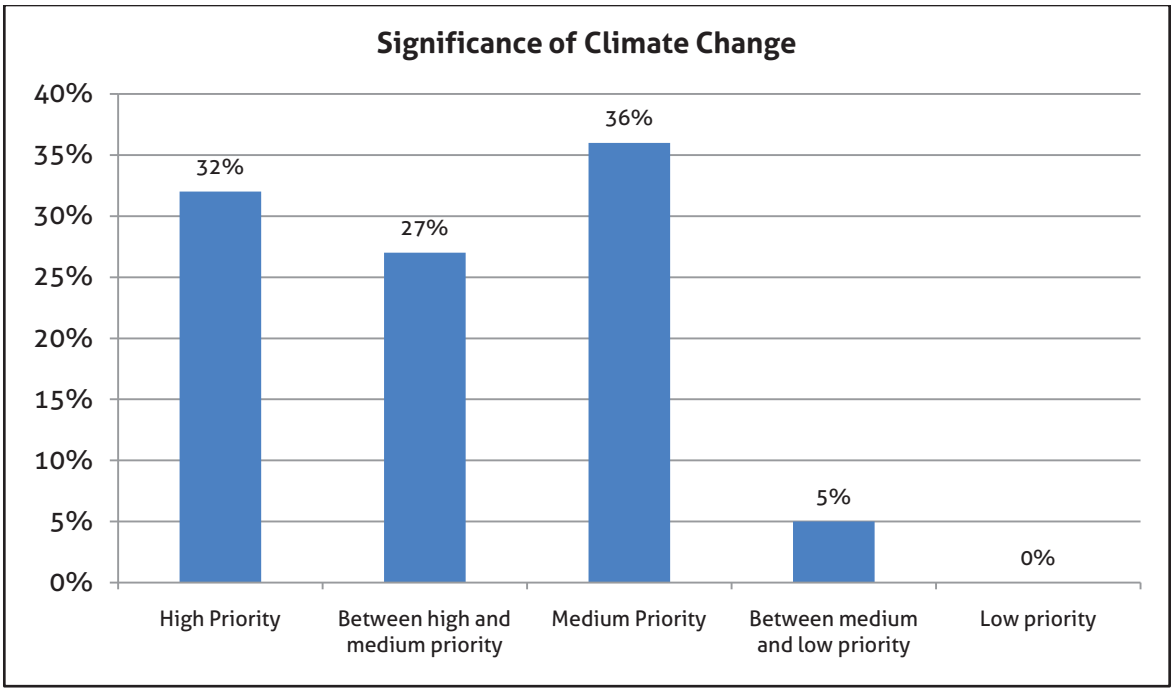


The majority of respondents reported to have sufficient knowledge about climate change (55%), whereas some stated to have expertise (14%) or basic understanding (27%). According to the interviewees assessment, the awareness of their colleagues is considered to be relatively high: they usually fully understand the issue and are aware of the carbon footprint and the strategy being employed (45%) or they at least have a vague understanding the climate change issue (25%). According to the opinion of the Decision-makers, many (30%) of their colleagues are skeptical and do not believe that climate change is a reality. Generally, the topic of climate change is given average priority, as displayed in Graph 3.4.2. On the other hand, in data not shown here, both water and energy are considered very important strategic resources for organizations (77% and 72% respectively).

Behaviors and strategies toward climate change. The majority of the respondents, 36% stated that they have conducted research and applied projects related to climate change before and after 2007. Only 27% of respondents did not apply and do not plan to apply them in the future. Cooperation with national and/or international research networks on climate change as well as with virtually connected teams seems to be quite sufficient. On average, 56% of the respondents stated to have been active in this field before and after 2007, and another 26% are planning to be so in near future.

Public institutions and NGOs in data not shown here, reported to be actively involved in the process of development and monitoring of public and institutional policies to mitigate the effects of climate change or are expected to be involved within the coming 24 months (in average 45% and 38%, respectively). Thirty-six percent of participants declared to be active in development of climate change adaptation policies before and after 2007, and 44% assured they will be involved in the coming 24 months. Monitoring of adaptation policies showed activity before and after 2007 in 27% of respondents while 41% are planning to do this in the near future.

Graph 3.4.2



Investments on climate change. Most of the respondents stated in data not shown here, that they do not have a specified budget line for investments on climate change (46%). Another 18% did not know the correct answer and 36% responded positively. If there is a budget, available investments are considered as "medium" by the majority.

Openness to a Research and Technology Transfer Centre. Respondents were quite skeptical about the establishment of a Climate Change Research and Technology Transfer Centre (56% of interviewees found it not feasible) assuming e.g. that it will not provide anything new compared to the already existing Technology Transfer Centres or research institutions. Still, interviewees responded positively that it might bring the following possible benefits:

- Design and implementation of cleaner technologies;
- Development of measures for adaptation;
- Improved accounting system for greenhouse gases;
- Training of people;

- Development of technologies suitable for local conditions and assistance to the companies;

- Delivery of information.

3.5 General Conclusions and Recommendations

1. The study results provide good insight into the ideas within companies, universities, and NGOs. Further the study results identify climate change information needs as well as the demand for capacity building in terms of training and other supportive measures. Hopefully, the CELA project and its Technology Transfer Centres will be able to offer these services in the future.

2. Not all respondents considered climate change important to both their organizations' policy and strategy. This topic is usually on the agenda only temporarily and assumed not crucial as of yet. However, most of the respondents evaluated their knowledge on climate change issues as sufficient or even good.

3. Nevertheless, university staff marked a definite need for reinforcement of climate change issues in university curricula. Training and a permanent development of competences for university lecturers were also marked to be quite important.

4. According to the survey results, climate change does not yet influence the business sector in Estonia. Companies see the biggest impact of climate change in growing demand for new products or services by the consumers. However, as this sample was rather limited, the picture may change, when considering other industrial sectors.

5. According to the summarized answers of three distinctive sets of stakeholders, the main mission of the Climate Change Research and Technology Transfer Centre seems to be the design and implementation of cleaner technologies together with training in technical and applied areas and the provision of scientifically credible information. These results are in agreement with the conclusions of another study that aimed to assess the regional conditions, problems, and potentials due to Climate Change (Wiréhn, 2011) in the Baltic Sea region. According to this report, Estonian respondents considered scientific reports as the most reliable sources of information followed by training courses as the second most reliable source on climatic change.

6. The Climate Change Research and Technology Transfer Centre in Estonia has been set-up at Tallinn University of Technology as part of the project CELA with a focus on water quality, quantity and adaptation. Therefore, especially the findings of this survey that provide guiding in this specific area are extremely valuable in defining the future activities of the Centre.

7. Decision-makers from universities, public institutions, and NGOs gave relatively low credit to the need of establishing Climate Change Research and Technology Transfer Centres in universities compared to all other respondents. Perhaps, they had an opinion that they do not need any new or parallel structures to develop mitigation and adaptation measures to handle the climate change problem.

8. Most of the respondents consider that Estonia is only moderately prepared to cope with the problems derived from climate change events. Therefore, a further assessment of needs for market-oriented research and technology transfer in Estonia is needed.

GERMANY

3.1 Methodology

Research design. Three distinctive sets of stakeholders in technology transfer, (i.e. companies, university staff, and Decision-makers) were assessed. Due to limited time and budget, the Hamburg team decided to conduct a qualitative survey based on questionnaires that were developed by the Guatemalan CELA partner. These data gathering instruments were translated and modified slightly according to local conditions. Concerning the methodology, telephone interviews were conducted, with the first sample belonging to companies, which consisted of medium-size enterprises. Supported by a semi-structured interview guideline, respondents belonged to business development and sustainability departments. In the course of the survey, it was noticeable that some of the respondents were reluctant to provide often-sensitive answers via the phone, therefore the method was changed. The other target groups were just contacted by phone and received the questionnaire by e-mail afterwards. If questionnaires were not returned, then a follow up call was made one week later.

Sampling procedures. A non-probability sampling process was applied and focused on specific actors in the field of technology transfer and climate change. To apply a non-probability sample is a straightforward approach for tackling a target group most related to the topic under analysis. Due to the qualitative nature of the study and as inferential statistics were not intended, the research team estimated that a non-probability sampling was appropriate. For the business sample, the sample comprised of medium-sized enterprises from the following sectors of industry: manufacturing, energy, water, and agriculture. According to their specific classifications of economic activities in the European Union (NACE[1]), companies were filtered[2] and ranked according to two further criteria: The businesses had approximately 250 employees and the business had to be based in the Hamburg metropolitan region (postal code: 2). Contact data was taken from existing internal databases and collected using the B2B information services offered by the Hoppenstedt Group and 147 contacts were selected according to this procedure out of several hundred database entries.

For the university lecturers, the sample comprised of staff from universities in general and universities of applied sciences within the metropolitan region of Hamburg. The respondents were chosen and ranked according to their affiliation to departments in the fields of engineering, geography, meteorology, biology, and general life sciences (74 out of 79 contact data). The Decision-maker sample comprised of state ministries, other public authorities, research institutes, chambers of commerce and agriculture, industrial associations, and non-governmental organizations. The respondents were drawn from the extensive HAW Hamburg database and ranked according to perceived importance as well as being based in the Hamburg metropolitan region (49 out of 384 data entries).

[1] NACE: Classification of Economic Activities in the European Community.

[2] In this study, the sample comprised the following attributes: A1.6 agriculture and post-harvest-crop activities, seed processing; C10 manufacturing of food products; C17.1 - Manufacture of pulp, paper and paperboard; C20 Manufacture of chemicals and chemical products; C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations, C22 Manufacture of rubber and plastic products, C24 Manufacture of basic metals, C28 Manufacture of machinery and equipment, C29 Manufacture of motor vehicles, trailers and semi-trailers, C30 Manufacture of other transport equipment; D35.1 - Electric power generation, transmission and distribution; E36 - Water collection, treatment and supply)

Table 3.1.1 Survey Response Rate of Three Distinctive Sets of Stakeholders

Sample	N	Returns	Response rate %
Companies	147	26	18 %
University staff/administrators/researchers	74	13	18 %
Decision-makers	49	16	33 %

Data collection. The company sample was interviewed between June 20, 2011 and July 20, 2011 followed by data administration and processing. Due to public holidays, the Decision-makers sample was approached in the period between August 4-20, 2011 followed by data administration and processing. The university lecturer sample was interviewed from October 19-31 2011, followed by data administration and processing.

In the business sample, 26 interviews were conducted out of a total number of 147 companies that were contacted. This equals to a response rate of 18 %, which may be considered a reasonable amount when benchmarked against average response rates in other social science studies. However, as the sampling was non-probabilistic and the intention of the study was not to generalize the results or to test hypothesis, the response rate is sufficient to draw preliminary conclusions that may be used as marketing information for tailored support programs in the field of research and development, innovation, technology transfer, and capacity building. The relative completion rate related to the other two target groups is slightly higher, with 18% for the university lecturers' sample and 33 % for the Decision-makers sample.

Limitations. Concerning the limitations of this study, it is difficult to draw reliable conclusions due to the "one-size-fits-all" questionnaire design which may be appropriate for the Latin American countries, yet the length of the questionnaire and the corresponding interview resulted in a low response rate in Germany. Moreover, due to the small sample size and non-probability sampling, the evaluation of results had only limited possibilities for sophisticated multivariate and interferential interpretation. It is therefore not surprising that in most items the results from the three distinctive target groups are quite different, as the relative description of results will show. Nevertheless, this study resembles a starting point for further in-depth research in the field of distinctive climate change technology needs in the Metropolitan area of Hamburg and provides valuable information for the set up and implementation of Climate Change Technology Transfer Centres.

Research findings, descriptive analysis of research variables. In the following section the collected data will be presented by means of relative frequencies in percentages. The answers to open ended questions were clustered and summarized. A more sophisticated treatment is not efficient due to the low response rate or not possible due to construction of the scales. However, we do not expect that further data treatment would have resulted in more valuable insights.

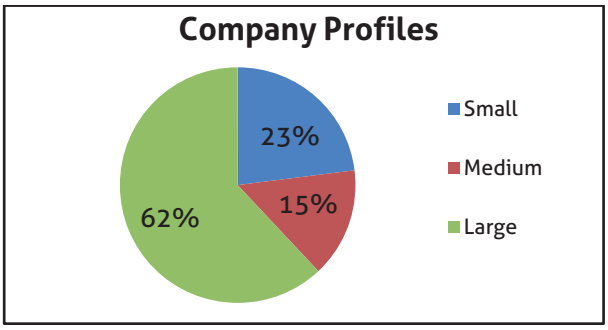
3.2 Survey Results Addressed to Companies

From the list of potential businesses to be interviewed via telephone, 26 enterprises were willing to respond. Non-responses can be classified as systemic, i.e. lack of interest and subsequent refusal to participate.

Profiles of companies and respondents. Almost two-thirds of the companies interviewed (62%) employed more than 251 employees and as such belong to the category of large

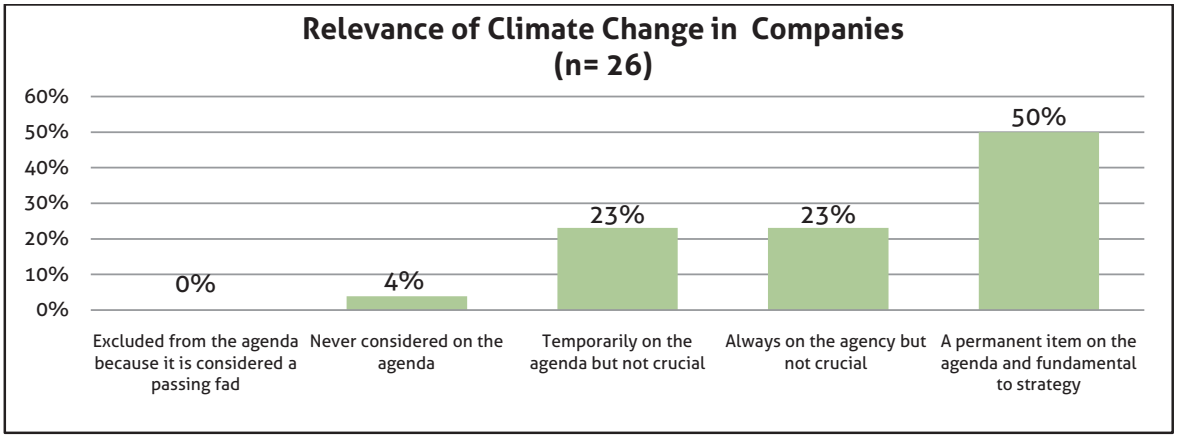
businesses. Small companies (<50 employees) account for 23 %, medium sized companies (51-250 employees) account for 16%. Fifty-two percent of the companies have an annual revenue of more than 101 million EUR, hereof 26% more than 500 million EUR. Whereas all companies are based in the Hamburg metropolitan region or the northern part of Germany, 77% are also doing business in European and international markets (35% European markets, 42% global markets). The age of respondents shows that 81% of the interviewees are 40 years or older. Most of them have obtained a university diploma and two of them hold a doctorate.

Graph 3.2.1



Business development and climate change. In 96% of all interviewed companies, respondents stated that climate change and its impacts are taken into account in the company's business decisions. Fifty percent of all interviewees responded that climate change and its impacts resemble an essential part of the business strategy leading to environmental management, marketing and to a certain degree also affects the supply chain (see Graph 3.2.2).

Graph 3.2.2



Respondents indicated that they see innovation needs related to generate unique selling propositions (USPs) to enhance their competitiveness through differentiation from competitors. Cost reduction and increasing efficiencies (high priority for 42% and medium priority for 29%) remains an important strategic issue. Companies perceive growing pressure from customers and interest groups to act on climate change, and state that they are confronted with more

regulatory pressures related to greenhouse gas (GHG) mitigation. This is reflected in the finding that combating climate change and finding effective responses are considered to be of medium to high priority by the majority of the companies (76% rated it with a score of 3 or higher).

Table 3.2.1 Upcoming Challenges for Business within the Next Two Years

Challenges	Priorities				
	Low Priority	Low to Medium Priority	Medium Priority	Medium to high Priority	High Priority
The need to innovate in order to set ourselves apart from the competition	8%	8%	15%	15%	54%
Sales growth	17%	8%	29%	17%	29%
Reduction of cost and increased efficiency	4%	8%	27%	19%	42%
Increased profitability and customer retention	20%	0%	8%	28%	44%
The need to attract, retain and motivate talented people	12%	0%	8%	44%	36%
The need to increase adaptability and the speed of operation	13%	4%	29%	38%	17%
The need to respond effectively to the deterioration of our business model	32%	5%	27%	27%	9%
The need to respond effectively to the dangers and opportunities of climate change	16%	8%	40%	20%	16%

Energy in data not shown here, is generally seen as a strategic resource, whereas water consumption plays an important role, especially in food industry. Thus, companies take different actions from measuring carbon footprint (12%) or other indicators (31% monitor GHG emissions and 27% energy efficiency figures) to investments in energy efficient technologies (65%), insulation or efficient vehicle fleets. While 23% of the companies in the sample apply energy management systems, more attention is paid to consumption control and energy savings, of course with employee involvement. The level of climate change knowledge of the interviewed persons was deemed as sufficient. The answers from the executives suggest that only 7% of their employees may have a full understanding of climate change and are aware of company's carbon footprint as well as the environmental strategy being employed. Ninety-three percent of the employees within the target group have at least a vague understanding or are aware of key climate change issues but it is not outstanding in the priority agenda. This trait shows opportunities for capacity building programmes.

Human resources management and the role of universities.

Within the enterprises. Respondents' state that in the majority of organizations, dedicated employees (numbers varies between 2 and 10) are directly involved with managing aspects of climate change which align with corporate strategy as it relates to climate change issues. The

majority of these employees are working either in marketing and sales (69%), logistics (35%), and administration (31%) or in other company units, e.g. manufacturing/production, project management, corporate responsibility, procurement, engineering, department for environmental protection, or one where future technologies are addressed. Almost two-thirds (64%) of the interviewed companies do not expect to have any need for additional personnel trained on climate change related know-how in the near future. The majority (72%) of corporations do not plan any training in the field of climate change at the moment. One of the interviewed companies stated that they are organizing yearly trainings in environmental protection for all employees.

Generally, the conclusion can be drawn from these data that companies recognize that they are faced with the challenge of climate change. However, there seems to be no urgent demand yet to build or extend specific capacities in-house or by means of external experts. High priority issues, therefore refer to the typical business development themes such as innovation, efficiency and profitability. Therefore, the need to respond effectively to the dangers and opportunities of climate change is given medium priority by the majority of companies.

Cooperation with universities. Internships or apprenticeships are the leading type of university-business cooperation and as such preferred by 84% of the respondents, followed by mutual cooperation agreements (80%), and joint research activities (76%). Corporations mentioned cross-sectoral cooperation with scientific facilities, to foster know-how transfer and synergies as one of the "Other" possibilities. Furthermore, student jobs and full usage of governmental support programmes was mentioned. According to the overwhelming majority of interviewees, companies suggest to integrate climate change into the following study courses: Economics and Business Administration (100%), Agronomics (92%) as well as Engineering (88%). As "Others", participants also named natural sciences, insurance, medical science, meteorology, and environmental sciences. According to two participants this aspect should be a part of every course of study.

Climate change and legal environment. The issue of climate change is regarded as an important policy issue in Germany. Generally, Germany seems to be neither highly nor fairly prepared to cope with climate change challenges (42%) according to the perception of interviewees (data is available in our files and not shown here). Surprisingly, companies state that it would be necessary to design and enact specific legal regulations immediately in Germany (88%), i.e. laws related to technical standards and rules (92%), carbon tax for industry, emission limits, and emissions trading regimes[3]. Interviewed persons also called for political frameworks and incentives to foster more environmental friendly technologies, more authorities and effective control, as well as a focusing the polluter-pays-principle to include external cost related to climate change risks.

Some interviewed persons mentioned examples for measures to climate change mitigation and adaption in the building/infrastructure, transportation, and energy sectors. In the latter case, electricity supply should be based on 100% renewable energy sources, whereas Carbon Capture

[3] A minority of respondents argued for emission limits but against credit trading schemes

and Storage (CCS) devices may be needed as an intermediate technological solution, which is to a certain degree not mirrored in Germany's energy policies. Asked for specific international climate policy instruments, respondents stated that they are familiar with the international carbon credit trading system and 36% have also used it in terms of buying and selling certificates. The reforestation mechanism is generally quite unknown compared to the general system of carbon credits. Only 27% of participants heard about it before and only have 4% used it.

Climate Change Technology Transfer Centres. The overwhelming majority would appreciate it if universities setup Research and Technology Transfer Centres with specific expertise in climate change to support companies and other actors, i.e. by:

- Organizing information hubs and know-how-transfer (best practices, legal framework, guidelines, norms, limits/thresholds, technical innovations on resource and energy efficiency), i.e. via websites, newsletters etc.;

- Organizing regular workshops, capacity building modules, congresses (i.e. for regulatory framework of ETS, energy consumption monitoring, decentralized system for generation, storage and transport of energy, employee motivation, and awareness raising), and expert-exchange-forums;

- Establishing permanent contact points and expert databases related to company specific measures and best practices;

- Offering services to companies, such as studies on efficiency of installed facilities and calculation of emission reductions and carbon footprints, scenario and strategy workshops.

Impacts, opportunities and adaptation strategies. The majority of the companies estimate, despite the difficulty of assessment, that their additional cost burden caused by climate change would amount to 5-10%. Up until now, climate impacts have not been experienced very often in the majority of the companies under study (Q: VII.2). However, when affected by extreme climate events, nearly a quarter of interviewees experienced impacts in terms of interruption of supply, production, distribution or communications nets or damages to infrastructure. However, when dealing with climate change on a strategic and operational level, as stated before, companies see benefits, mainly related to enhanced energy efficiency and clean technologies and emissions trading.

3.3 Survey Results Addressed to University Staff

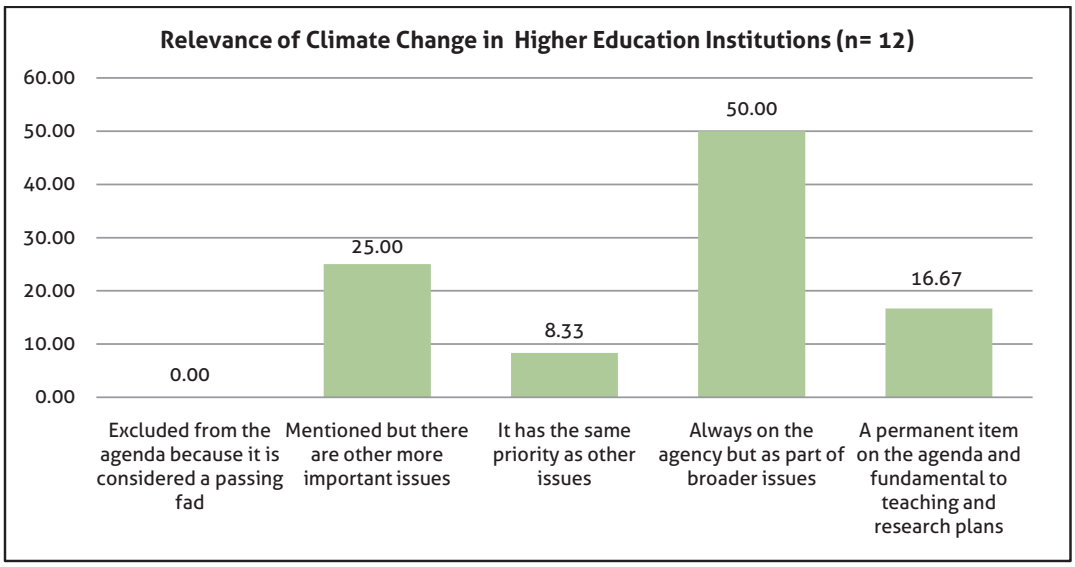
From the list of potential university staff to be interviewed 13 lecturers were willing to respond. Non-response can be classified as systemic, i.e. lack of interest and refusal of participation.

Background characteristics and attitudes toward climate change. The target group, teaching staff, can be characterized as highly experienced in higher education activities. The majority of the respondents are professors, directors of academic programs or project leaders

with main activities not only inteaching and research, but also in administration. The respondents were active in HEIs for more than three to five years and can demonstrate broad expertise, i.e. publications, not only in climate change but also in other fields of environmental sciences. Main activity areas in research and development are: energy efficiency technologies (16%), urban planning and architecture (8%), disaster prevention (23%), adaptive farming (15%), and technology transfer (23%).

Responders evaluated themselves as having sufficient understanding or even expert knowledge in the field of climate change. However, the respondents see the state of climate change in teaching and research in HEIs as important as a permanent item on HEIs agenda but mostly in a broad manner (50%), connected and in addition to other disciplines and topics (see Graph 3.3.1).

Graph 3.3.1



According to Graph 3.3.1, respondents see the main tasks of universities as sharing and transferring knowledge about climate change; in research related to climate change impacts in Germany and Europe; as well as development of climate change adaption and environmental protection technologies. Adaptive technology transfer is given a priority as the task of universities. Apart from that, 67% of the respondents stated that they do not give any technical assistance more than teaching and research and development to companies, NGOs or government.

As can be seen in Table 3.3.1, respondents in this cohort see nearly the same courses to be enriched with climate change topics, than those suggested by respondents in the survey addressed to companies.

Graph 3.3.2

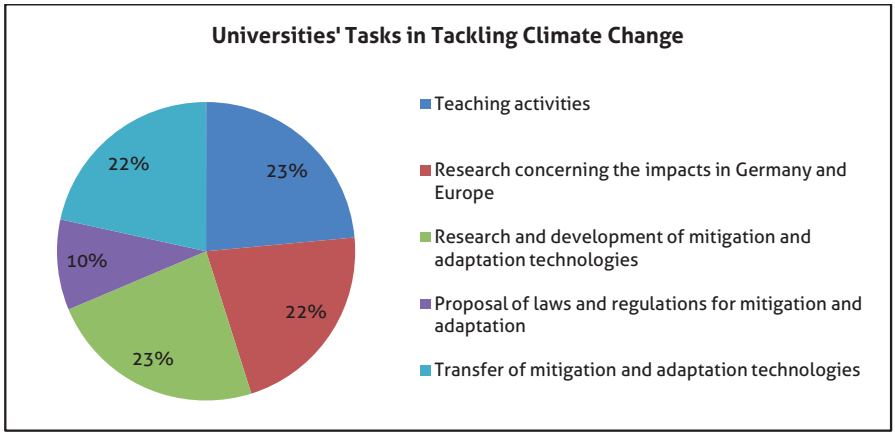


Table 3.3.1 Integration of Climate Change Aspects into Study Courses ("Others" Neglected)

Courses of study	Business sample	Teachers sample
1. Engineering	88%	100%
2. Economics and business administration	100%	100%
3. Human resources	35%	15%
4. IT and communications	54%	85%
5. Psychology	23%	69%
6. Agronomics	92%	100%
7. Humanities: sociology, political science	73%	100%

Training interest on climate change. Regarding training in adaptation, in data not shown here, respondents mainly stated interest in the field of energy optimization (31%), risk management and agriculture (both 20%), and to a lower level water resource and waste management (both 13%). The top topics selected in mitigation strategies are efficiency of electrical grids, climate-neutral fuels, renewable energies, as well as evaluation and certification of operations. There is only a limited demand for training related to curriculum development, and if this was the case, suggestions were focused on (international) graduate schools and doctorate programs. There is some demand for training in management of research and development projects, i.e. leadership (27%), funding (23%), and administration. However, there is a definite need related to requirements for training and further education, i.e. exchange and discussion with colleagues, i.e. at scientific and educational events, in addition to:

1. Technical/professional skills in the area of teaching/research;

2. Regular information related to major technological changes;

3. Better research infrastructure such as laboratories, instruments, materials and equipment.

Institutional strengthening on climate change. All respondents stated that the issue of climate change needs to be strengthened at universities and HEIs. The following aspects may be considered according to the data (ranked related to perceived importance):

1. Research and development on GHG mitigation technologies, energy and water efficiency;

2. Research and development on climate change adaptation technologies;

3. Internship opportunities for students.

The participants in the study mentioned the following aspects as not yet in great demand:

1. Academic programmes dedicated to the market impact of climate change;

2. Analysis job creation potential;

3. Networking and partnership between universities, companies, and public institutions;

4. Exchange programmes and educational cooperation between universities, businesses, and public institutions.

Feasibility of Research and Technology Transfer Centres. The majority of the respondents evaluated the feasibility of Technology Transfer Centres at German universities as "feasible" (30%) and "absolutely feasible" (31%), though there are some critical remarks related to this feasibility. The mission and rationale of those Transfer Centres, according to the sample under analysis (ranked related to perceived importance), might be:

1. Capacity building, i.e. skills training in technical and applied areas of climate change subjects;

2. Policy consulting, i.e. contribution to codes and regulations concerning climate change;

3. Training in curriculum development in universities and content programming for public, private and non-governmental bodies;

4. Generation of patents with access to royalties derived from them.

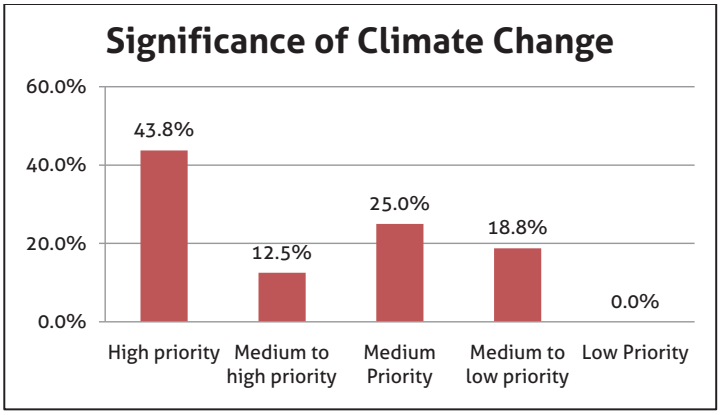
3.4 Survey Results Addressed to Decision-makers

From the list of potential Decision-makers in universities, public institutions, and non-governmental organizations to be interviewed, 16 subjects responded. Non-responses can be classified as systemic, i.e. lack of interest and refusal of participation.

Characteristics of the organizations. The sample represents two public institutions and eleven non-governmental organizations and three other types of organizations. The age of the majority of the respondents range from 49 to 60 and hold either bachelor degrees or doctorates. They work mainly in the context of lobbying for sustainable development and

societal transformation processes, monitoring and enforcement of regulative instruments, as well as in lecturing and capacity building, event management, and public relations. Respondents declared to have sufficient understanding of climate change (57%), whereas some stated to have expertise (19%), or basic understanding (13%). The same is true in the estimation of the knowledge of colleagues which is described sufficient (56%) to vague (17%), though there is in some cases also specialized knowledge, i.e. related to the organizations carbon footprint and mitigation measures. Generally the topic of climate change is given a high priority, as displayed in Graph 3.4.1.

Graph 3.4.1



Data not presented here, shows that there is a rather heterogeneous perception of water and energy as strategic resources for institutions. While energy is considered as (very) important by the majority, there is no clear picture regarding water, which clearly reflects the general situation in Germany, where water scarcity is not yet seen as a problem.

Behaviors and strategies toward climate change. This section is related to questions on behavior, projects, and strategies to cope with climate change events. The results are heterogeneous due to the questions asked. The majority of the respondents stated that they have conducted research and applied projects related to climate change before 2007 (approx. 30%) until recently (ca. 22%). However, a considerable number of respondents have not conducted any projects in the past and do not plan to in the future (40% no research, 21% no applied projects). Fifty percent of the respondents are not active in terms of engagement in associations and other collective forms of alliances, where 25% stated to have been active in these dimensions before 2007.

The majority of the respondents have been active in development of institutional and legal frameworks as well as in monitoring and evaluation of existing legal regulations on climate change, according to data not shown here. However, 33% of the respondents declared not having any intention to be active in this field, which is supposedly related to the general mission of the organization. The majority (64%) of the organizations are not active in regional risk and disaster management. External knowledge dominates the acquisition of knowledge (i.e. external, research institutions and conferences) on climate change, where investments (i.e. access to databases, participation fees etc.) are taken and information and communication technology

(ICT) is used. All organizations under study contributed or plan to contribute to projects in terms of cooperation with public or private bodies but have not initiated their own interdisciplinary projects. Also, the majority does not offer scholarships or related financial project support.

Organizations' contributions. Decision-makers gave some examples for important contributions of the organization in the field. The list included more than 30 different projects and instruments in the following areas:

- Learning events;
- Knowledge sharing activities;
- Internet information platforms;
- Strategies and concepts;
- Research programs and
- Consulting.

Investments on climate change. Most of the respondents stated that they do not have a specified budget for investments in climate change. If there is a budget available, investments are considered as "medium" as opposed to "high" or "low" in the amount of resources they have at their disposal by the majority.

Openness to a Research and Technology Transfer Centres. Generally, that is 77% of the organizations, appreciate the establishment of Technology Transfer Centres to support their own work, which is a rather high percentage from a comparative perspective. In particular, business organizations value information sharing and know-how transfer, expert databases, services (i.e. energy efficiency measurement, carbon footprint calculations etc.). Other services to be offered by these Centres could be policy consulting, i.e. contribution regulations and incubator activities aiming at patenting of innovative applications.

3.5 General Conclusions and Recommendations

1. The purpose of this study was to identify climate change information needs as well as the demand for capacity building in terms of training and other supportive measures which may be offered by the CELA project and its Technology Transfer Centres in the future.

2. All respondents considered climate change and related issues like water and energy management as important both in policy and strategic aspects of their own organizations. It can be observed that businesses in Germany do not yet seem to be impacted heavily from climate change variability and impacts. However, as this sample was rather limited, this picture may change, if for example, the mobility and logistics sectors are included.

3. The level of knowledge on climate change in the cohort itself and in the organizations, as evaluated by the respondents, ranges from sufficient to expert knowledge. Some organizations take action on climate change mitigation and adaptation both on the strategic and operational level, i.e. measuring/monitoring GHG emissions and resource consumption, capacity building, management systems. Even though there seems to be no clearly articulated demand for training offered by external institutions focused solely on climate change, this may offer an opportunity for courses which integrate climate change aspects in typical educational courses which deal with general business management and administration activities. In this line fits the finding that the role of universities and the necessity to integrate the topic into current curricula and increased research and development on efficiency and adaptation technologies, was emphasized in all target groups. Universities, therefore, call for institutional and financial strengthening.

4. Respondents appreciate the establishment and supportive work of Climate Change Technology Transfer Centres.

5. As stated before, it is difficult to draw reliable conclusions from this study due to the design of the questionnaire, which creates difficulty for purposes of comparison and limited possibilities for sophisticated multivariate and interferential interpretation. It is not surprising that in most items the results are quite different as relative description shows. However, some indications for future activities of Climate Change Research and Technology Transfer Centres may be drawn:

    a. Technology Transfer Centres can serve as valuable intermediate organization;

    b. Activities should be focused on knowledge transfer mainly with a pragmatic and solution oriented content;

    c. Widening the scope of the topic should be considered, as respondents stated in open comments, that the challenge of climate change is systematically connected to different social, economic and ecological issues. In-house trainings focusing only on climate change may be extended to more general environmental management aspects if the target group of private companies should be attracted.

Bearing in mind that the Climate Change Research and Technology Transfer Centre in Germany has been set-up at HAW Hamburg as part of the project CELA, the findings of this survey will be valuable in guiding some of the future activities of the Centre.

GUATEMALA

3.1. Methodology

Sampling procedures. Three different groups of stakeholders were analyzed for this study and include: companies, university staff, and Decision-makers. Within these identified groups, those interviewed for this study include: directors of agricultural companies (32 interviews), industries (39), university staff (64), Decision-makers represented in universities and public institutions (40) and lastly, NGOs (31). The sample size determined was based on the ability to comfortably manipulate the data.The sample represents the most significant actors, who belong to the private sector, public sector, and civil society. With regard to companies, they were selected using a scale of 1 to 5, from less important to most important. The same methodology was used for NGOs. The ones with the highest scores were selected. For the other stakeholders, we made an extensive list and used a systematic random selection.

Limitations. There are some limitations of the sample that can be identified. One such limitation is the sample selection chosen by judges as their selection was not random. However, our main interest was to emphasize the most important companies because those are the ones that can make a difference in the market and be models for the rest of the companies. This also applies to NGOs. With regard to professors, managers, and Decision-makers in higher education institutions and public institutions, a bias can be alleged with regard to populations that live in the Capital City; however, these structures are national, with offices in the rest of the country and their projection is present throughout the country. In the samples of companies and Decision-makers, only those in the highest of the hierarchy of the firms and organizations were interviewed in order to guarantee the validity and reliability of the information gathered. The lists of companies and entities whose directors and authorities were interviewed were obtained from the directories of the Guatemalan Exporters Association, the Chamber of Industry, and public information on the webpage, and for both, that information was verified by key informants. Other partial limitations are noted throughout the analysis. While the identified limitations impact generalizations made, the Technical Team is confident that the results provide reliable and valid.

Description of the fieldwork and sampling procedures. As can be seen in Table 3.1.1, the first step was to identify potential interviewees from lists obtained through associations to which these targets groups were affiliated. This provided a significant number of cases and was reduced in size by using random numbers and key informants. While the criteria of being related to environment and climate change was not considered in the case of the companies, it was taken into account for the selection of university staff. The same can be said of Decision-makers at universities, public institutions, and NGOs. The overall criterion for the selection of companies was size and influence on the market regardless of their relationship to specific actions related to the environment and climate change. Although the same criterion of size and importance was used for the selection of NGOs, an additional critery was added and the entity associated to the lists should be related to the environment and climate change field.

Table 3.1.1
Identified Populations From Which Samples were Obtained and Number of Interviews Finally Completed in the Fieldwork.

Identified Stakeholder		FREQUENCY			
		Obtained Lists (Number of cases equivalent to Stakeholder)	Planned number of cases on the basis of lists drawn at random and through judges	Completed interviews	% of interviews completed over planned samples
1.	Companies				
	a) Agriculture	531	40	32	80.00
	b) Industries	845	40	39	97.50
2.	University Staff	157	64	64	100.00
3.	Decision-Makers				
	a) Government and Universities*	87	40	40	100.00
	b) NGOs	106	30	31	103.03

**This list was elaborated through key informants. Out of the 40 cases, 14 belonged to highest authorities in university programs and 26 were from public offices, at the same level of authority.*

Table 3.1.1 shows the steps described above from left to right. First, the most extensive lists were elaborated; secondly, a random sample was drawn for university staff, government and universities; third, judges ranked those in the first lists, according to their size and importance; fourth, from this ranked list, the number of planned cases were drawn for companies and NGOs, going from highest to lowest, until the number of cases were planned; finally, in a fifth step, thanks to having all the data needed to locate the cases, interviewers asked for appointments and proceeded to apply the questionnaire. Finally, in the last column to the right, the degree of success in fulfilling what was planned is reported. As can be seen, rejections were negligible and cooperation was almost unanimous. Repeated calls were made, replacements were selected using the same procedure to complete the number of interviews planned.

3.2. Survey Results Addressed to Companies.

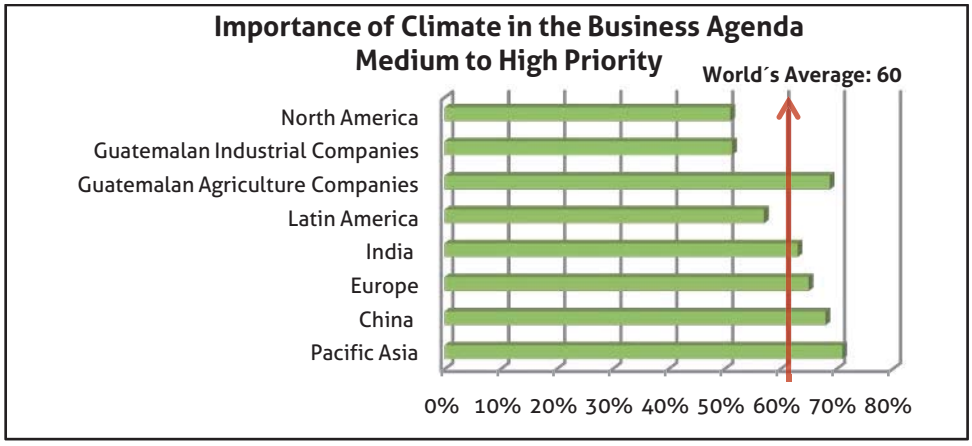
Profile of the Interviewees. Participation of women in mid and top managerial levels in the companies interviewed was lower than participation of women in the economically active population (EAP), (National Statistical Institution, 2011). Participation of women is lower in agricultural companies, 21.88%, than in industrial companies, 28.21%, but is still low when compared to the EAP, 36.10%.

Attitudes towards climate change. Agriculture companies (68.8%) are more concerned than industrial companies (51.3%) regarding the challenges that climate change presents. Agricultural companies are more vulnerable to effects of climate change, which is why their

executives consider climate change a strategic priority. For this reason, agriculture companies show more interest in technologies and methods that increase their resilience and ability to adapt. It is considered that in a technology transfer initiative, those companies will act as early adopters and other industries will follow. (Rogers, 1976).

In general, environmental matters and climate change are important parts of the agenda in the short-term for companies around the world, and they show serious concern about the subject in the mid to long terms. More than 50% of company leaders in the world as Graph 3.2.1 shows find these matters among the three most important issues to consider in the companies' agendas in the future, but it is not incorporated in their corporate strategy today. In Latin America, however, 57% of leaders consider climate change as an important matter to include in a company's strategy today (McKinsey, 2007[4]). For agriculture companies, climate change is one of the three central and urgent matters to address, while for industrial companies this matter is among the seven most important issues. This coincides with the damages caused by the storms and hurricanes that have devastated Guatemala in the last few years. Table 3.2.1 reflects that the damages caused by these catastrophes have been four times more important for agriculture than for industries.

Graph 3.2.1



Source: McKinsey, 2007; data for Guatemala elaborated by the authors.

For Central American companies, recurrent climate disasters have become "normal" it is just about waiting for the unexpected, and storm E-12 confirms it. Central American companies have to adjust and become resilient to the new normal of disasters (ECLAC, 2011). Currently, the accumulated loss in the Central American region is 1.5% of the GDP and the risk is that if resilience and adaptation response measures are not implemented, that cut could increase to 4.7% a year. A summary of recent disaster is shown in Table 3.2.1.

Priorities in the business agenda. In order to determine what strategic actions companies are taking with regard to climate change, companies were asked to identify key subjects that are

[4]McKinsey: *"60% of the interviewed executives consider climate change as strategically important, and most consider it important for product development, investment planning and brand management. However, despite that widespread opinion, few companies work on that. More than a third said that their companies never consider climate change when developing the general strategy".*

traditionally top management's agenda. In Table 3.2.2, answers were put in order to determine agenda priorities.These priorities were derived from the ranking made by the interviewees and are translated from percentages to a rank order of priorities, 1 is high and 9 is low priority. Effective response to climate change threats and opportunities is the third priority for agriculture companies and seventh for industrial companies. Moreover, the companies´ answers match the perception of danger and threat to each sector. For instance, innovation is the number one priority for agriculture and second for industrial companies. The highest priority for industries is to reduce costs and increase efficiency.

Table 3.2.1 Economic Impact of Climate Events in Guatemala. (Millions of Dollars)

	Hurricane Mitch 1998	Storm Stan 2001	Storm Agatha 2010	Storm E12 2011	Total Damage
Agriculture, livestock and fishing	3,244.00	593.59	646.80	215.80	4,700.19
Industry	406.65	432.60	317.60	105.97	1,262.82

Table 3.2.2 High-Priority Matters in the Business Agenda. Multiple-Choice

High-Priority Matters in the Business Agenda	Industrial Companies	Agriculture Companies
Innovate in order to be different from rival companies	2	1
Attract, keep, and motivate talented people	6	2
Effectively respond to threats and opportunities of climate change	7	3
Effectively respond to threats and opportunities of globalization	4	4
Sales growth	3	5
Reduce costs and increase efficiency	1	6
Increase profitability and customer retention	5	7
Increase adaptability and operational speed	8	8
Effectively respond to the deterioration of the business model	9	9

Data not presented here, shows that agricultural companies incorporate the subject of climate change in their strategic agenda but their inclusion is a lower percentage than industrial companies, 34% and 41%, respectively. A small fraction of the surveyed companies considered the subject of climate change to be a passing trend and therefore, it should not be included in the company's strategy. Nevertheless, more than 60% of companies answered that this problem appears permanently on the agenda, with different degrees of strategic importance, which indicates, somehow, that companies consider unexpected changes in climate to be a normal part of their business now and in the future.

Industries consider climate change impacts first when planning their investment (89%), second, in environmental subjects management, like carbon footprint reduction, and third, in

the design of their corporate strategy. With regard to agricultural companies, the most important aspect is the environmental subjects management, then investment in assets, and third, the corporate strategy. In the United States, the main reason to promote action, regarding climate, is corporate reputation; motivations in Guatemala are different.

Impact in operational costs. When asked about expectations on the costs increase derived from the risks and dangers of climate change, in both samples, most interviewees, 51.3%, said that they estimated that the increase in their costs would be from 5% to 10%. Another group within the sample, 23%, considered that the increase in their costs would be lower than 5%. Furthermore, 12.8% of interviewees said that they thought that the increase in their costs would be from 10% to 15%. Only 10% thought that the increase in their costs due to climate problems would be higher than 20%. Companies are concerned about the high cost of climate disasters, as a rise of 5% to 10% is higher than the inflation rate in Guatemala. Also because these costs are uncontrollable as they exceed the internal control capacity of the company, directly affecting profitability.

Perception of the problem. Agricultural companies are concerned about pressure from outside groups to address the problem of climate change. Data not shown here, demonstrates that more than 81% of interviewees said that this matter is of medium to high priority, but that it does not create crisis. Twenty-one percent consider it a matter of the highest priority. Despite the pressure made by NGOs and civil groups, and in some cases, communities that reject investment in these projects near residential areas, businessmen consider this is not an impossible problem to solve. Graph 3.2.2 compares the order in priorities of the interviewees, regarding climate threats in the medium and long terms, distinguished by the type of company. We can see a difference in the perspective that industrial companies have when compared to agricultural companies, which show more concern in this matter.

Impact in companies. The threat of climate change problems is not only more significant to agricultural companies, but also directly linked to their survival. As we can see in Graph 3.2.2, expected impacts are severe. In order to solve these problems it is necessary to develop new technologies, techniques, and methodologies. The most important barriers considered by this group are the high cost of those changes, the lack of agriculture insurance, and the lack of technology. For industrial companies, the problem is different, typically impacting the supply chain, both incoming (46%) and outgoing (46%). Eighty-seven percent of interviewees say their companies have not experienced any climate change-related problem in the past.

Training needs for human resources and the role of universities. Company directors think that there is a minimal awareness and understanding of climate change problems and their associated risks to their organizations. Data not presented here, shows that 58.5% of industries and 62.6% of agricultural companies consider that their employees do not understand the subject or have only a vague idea of climate change. Additionally, more than 90% of interviewees in both sectors think that in the future they will have to hire professionals and people with knowledge on the subject to reduce risks and face the challenges that climatic catastrophes demand. Regarding training needs, interviewees said they considered curricular reforms to include climate change in the following university programs:

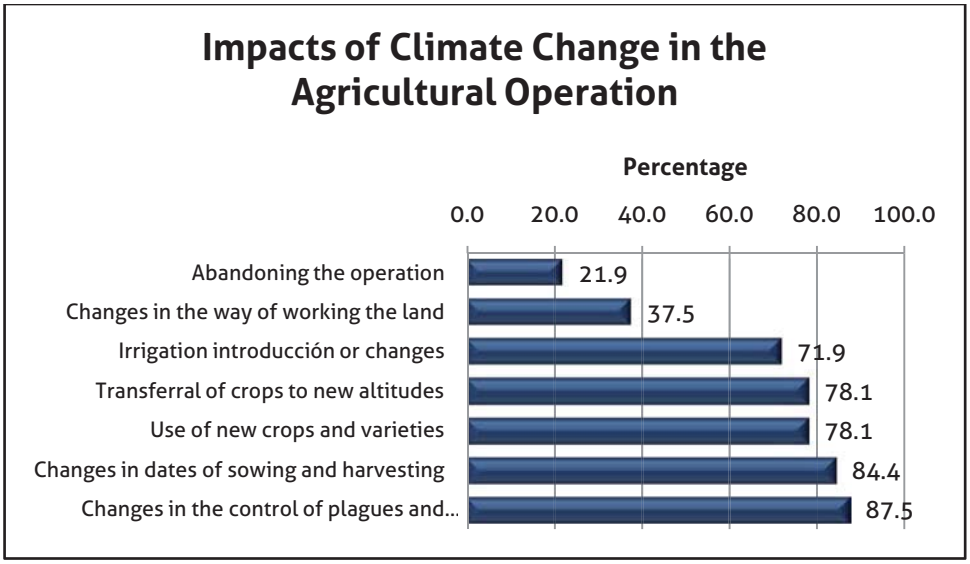
1. Engineering: 96% agriculture companies, 100% industrial companies;

2. Agronomy: 97% agriculture companies, 87% industrial companies;

3. Business Administration: 81% agriculture companies, 74% industrial companies;

4. Information Technology and Communication: 62% in both sectors.

Graph 3.2.2



Companies showed preference for training in the company, learning at work and distance learning, in that order. This forces universities to change educational paradigms to go to customers and satisfy these growing demands.

Climate change and the legal framework of companies. Companies, from both samples, state that it is necessary to create climate change regulation in order to reduce risks and vulnerability of companies, persons, and their respective countries. Interviewees consider these regulations important and they have to be carried out in order to create:

1. More order and transparency to these processes;

2. Better standards and technical regulations;

3. Incentives for the creation of bonds markets, and

   a. Reduce carbon emissions;

   b. Recycle water creating a market of this resource.

Companies think that these regulations should be disseminated immediately or at most in two years. Companies recognize the seriousness of disasters, and the impact disaster economically as well as the human as well as social aspects. Moreover companies do not believe that the country is prepared to efficiently face those problems.

Climate Change Technology Transfer Centres and university-company cooperation. Contrary to popular belief, companies are interested in university-industry collaboration, both to solve technological problems and to train personnel. Further, they are open to this collaboration using different medium. Some of the goals are:

1. Mutual research actions;

2. Multiple agreements;

3. Strategic alliances;

4. Internships or temporary jobs;

5. Supervised Professional Training;

6. Service provision;

7. Patent generation.

All companies think universities should have Climate Change Technology Transfer Centres that work jointly with companies in order to develop technologies needed regionally and nationally. Bigger opportunities are found in agricultural companies, given their high vulnerability; however, industries also demand new technologies. Specifically, the efficient use of water as a strategic resource is a concern in both kinds of companies. Table 3.2.3 shows these demands.

Table 3.2.3 Priorities in Suggestions To face Climate Change Regarding Energy and Water By Sector (Agricultural and Industrial)

A. Energy Management

Priority	Agricultural	Industrial
1	Methods and technologies to control plagues and diseases	Technologies for green buildings
2	Technology to modify sowing and harvesting dates	Clean Development Mechanisms (CDM) Carbon Markets
3	Adaptation and introduction of new crops and varieties because of climate changes	Technologies to reduce emissions
4	Technologies of crop adaptation to new altitudes	Risks management
5	Technology and methodology for land management	Technologies to improve energy efficiency
6		Clean production technologies
7		Clean technologies

B. Water Management

Priority	Agricultural	Industrial
1	Irrigation technology	Water recycling technology
2	Technology for the efficient use of water	Technology for the efficient use of water
3	Technology to preserve water sources	Technology to preserve water sources

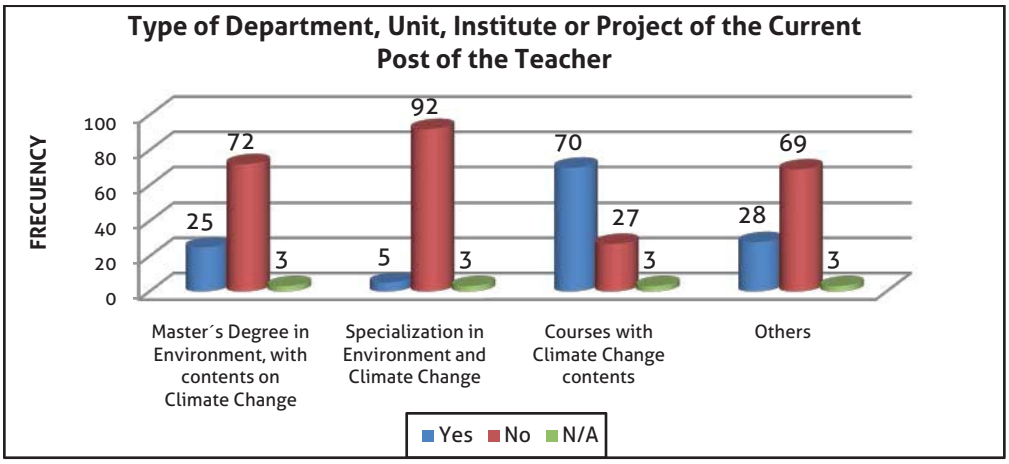
3.3 Survey Results Addressed to University Staff

The questionnaire for this survey was given to 64 people including: teachers, administrators and researchers. Some interviewees do more than one of these activities simultaneously. Details on the population and sample selection are presented in the methodology section. Its limitations are also specified in this section.

Characteristics of interviewees and attitudes towards climate change. In data that is not presented here, distribution of gender consists of 75% male and 25% female, which demonstrates a gender deficit among the teaching staff in the main Guatemalan universities as it relates to the field of environment. In terms of age distribution, the distributions were as follows: 32.8% were aged 35 to 39; 20.3% from 40 to 44 years old, which shows that the access of universities to this subject is relatively new. Regarding educational levels, 59% have a master's degree, 31% are specialized in diverse disciplines, and 35% have no specialization. These statistics point to the fact that in absence of related programs in universities, professionals from different academic disciplines have become involved in these areas and are self-taught or gained experience in the labour market.

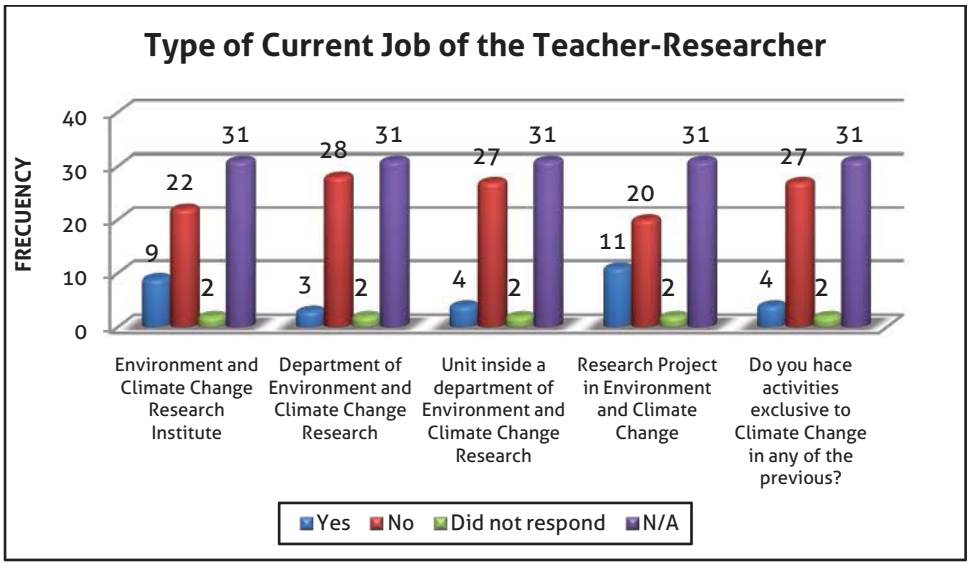
Within universities, teaching was cited as the most frequent activity by 70.3% of interviewees. It is important to observe, however, that most of them not only teach but also do research work and administrative work, the latter being more infrequent. Forty-three percent of interviewees have worked at a university for more than 5 years. Furthermore, teachers who do research do not publish their findings; thereby their work in the environmental field is hardly noticeable. The same can be said about generation of patents; there is no evidence of that in the survey. In most cases interviewees do temporary courses in different universities. Some respondents, around 35.9%, also do managerial activities jointly with teaching and research. Graph 3.3.1 shows that 70.3% have courses with climate change content, but from this, only 25% are within master's degree programs related to environment. The distribution shows that, in general, specialization in climate change is not common (4.7%).

Graph 3.3.1



Also, regarding teachers-researchers, we find that most of them work in companies related to the environment; only 4 teachers are involved in climate change activities, as we can see on Graph 3.3.2. This distribution proves our previous thoughts. Climate change topics are not an exclusive topic to be taught in structured courses in universities. We could say that the subject is recent and the challenges it carries have been taken in by courses on environment in general.

Graph 3.3.2



Ability level of teachers and HEIs. With regard to teachers' knowledge on climate change, 46.9% have enough knowledge on the subject, only 6.3% (4 teachers) considered themselves experts on the subject. This piece of information shows the importance of reinforcing capacity building activities. Also, the results on the teachers' perception of the climate change situation

in the priorities of teaching/research in higher education institutions show that 64.1% of them consider that although it is mentioned in the agenda, there are other fundamental problems that distract from it. Therefore, the priority to include the subject of climate change is diluted.

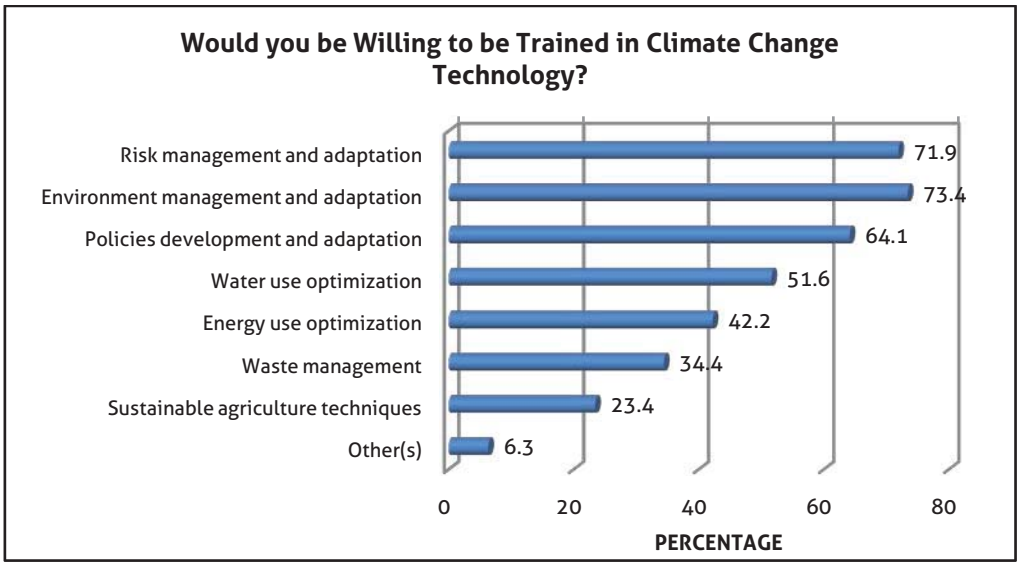
With regard to the mission of HEIs on the subject of climate change, 84.4% think that teaching is the answer. Nevertheless, the same percentage, 84.4%, also think it should be research on the effects of climate change in Guatemala and Central America and 65.6% think that it should be research and development of mitigation and adaptation technologies. On the other hand, 53.1% think it should be technology transfer for mitigation and adaptation, and finally, 29.7% think it should be about law and regulatory proposals for mitigation and adaptation. Regarding what programs HEIs should include we found that all of them think that first should be Engineering, second Agronomy (98%), then Human Sciences, Sociology, Political Sciences (81.3%), then Information Technology and Communication (78.1%), and the rest think the subject of climate change should be included in all programs.

It is also interesting to see the opinion of teachers on competences or courses on climate change in HEIs. The observation here is that 18.8% think that there should be basic courses on climate change while 23.4% think that the focus should be on adaptation and mitigation and still 7.8% think that the effects of climate change and scientific culture should be priority. The remaining interviewees opined on diverse themes. It was also discovered that university staff provide climate change technical assistance services: 12% of the interviewees give them to interested companies, NGOs, or the government. However, they also say that they assist with subjects like disaster prevention and community organization for disaster prevention because of climate change. From these answers, it is possible to infer that there is some interest in the subject; however, engineering regulations for the construction of bridges and boulevards adapted to climate change demands are barely considered within suggestions made in urbanism and architecture.

The subject of technology came up and centred on energy or hydraulic resources efficiency. The total percentage of both responses was 51.5%, which shows interest from industries to cope with the challenges of water and energy. These resources are very important to their operations and companies also show interest in searching academic support or advise for this. Moreover, development of new crop genetic varieties adapted to climate change is also considered important by 54.7% of interviewees. Furthermore, disaster prevention techniques and community organization for disaster prevention has 78.2% of teachers developing activities for that.

Needs of training in climate change. Graph 3.3.3 shows the needs of training in climate change technology, 71.9% of teachers are interested in risk management and adaptation, 73.4% in environmental management and adaptation, and 64.1% in policies in development and adaptation. This means then that an average of 69.8% show interest in training on climate change adaptation. Furthermore, 51.6% and 42.2% of interviewees identified water use optimization and energy use optimization, respectively. Thus, an average of 46.9% show interest in training in the optimization of energy and water resources.

Graph 3.3.3



In data not shown here, 70.3% of interviewees would be interested in training in climate change technology on research and development. With regard to training in curricular development, 93.8% of teachers said they were interested. In general, the interest is showed mainly from teacher sat the master's degree level, followed by doctorates, and then associate's degree. With regard to interest in training in teaching modules development, 46.9% would be interested, which means 30 teachers, 20% would be interested in prevention and mitigation, 16.7% in adaptation and mitigation in the forest sector, and the rest, in different areas of the environment. On the other hand, 55% would be interested in research management training and 11% did not show interest. In addition, 62.9% of the 35 teachers that said they would be interested in research management training said they would also be interested in research funds management.

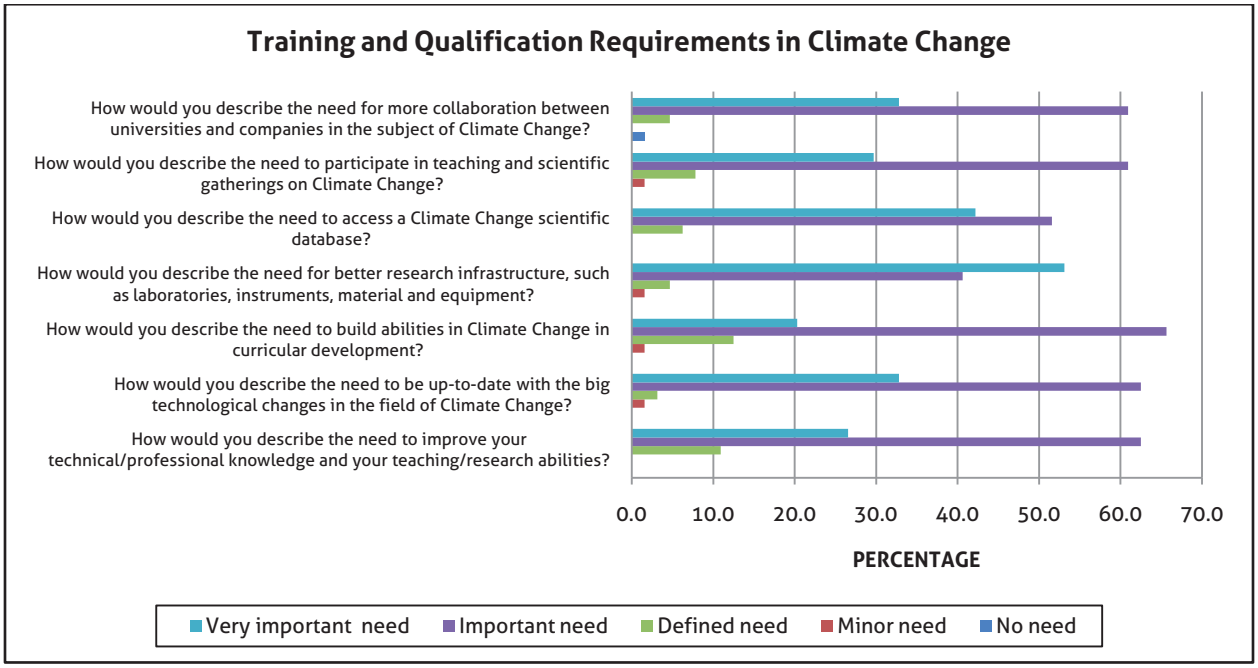
Training requirements and climate change qualification. With respect to training requirements and climate change qualification, the study measured this in a scale from "no need" to "very important need." Graph 3.3.4 shows 65.5% of interviewees identified the ability to build in climate change into curricular development followed by the improvement in Technical/ Professional knowledge and abilities in the area of teaching-research (62.5%).

Also, teachers who want to keep up-to-date with technological changes in the field of climate change, represent 62.5%. Also, 60.9% of interviewees sense the need to participate in teaching and scientific gatherings on climate change; and 60.9% desire greater collaboration between universities and companies in the subject of climate change, and 51.6% desire access to scientific databases. A question that falls into the category of "very important need" is the improvement of research infrastructure, such as laboratories, instruments, materials, and equipment with 53.1%. However, the category of "important need" has an interesting percentage of 40.6%.

Institutional strengthening on climate change. In data not shown here, 100% of interviewees consider institutional strengthening necessary. Furthermore, 75% of interviewees

see the importance of development of exchange programs and teaching collaboration among universities, companies, and public institutions to develop abilities to face the climate change problem. Interviewees also considered the association among universities, companies, and public institutions to share and develop knowledge on climate change and more academic programs dedicated to climate change impact in the market important (70.3% and 68.8% respectively).

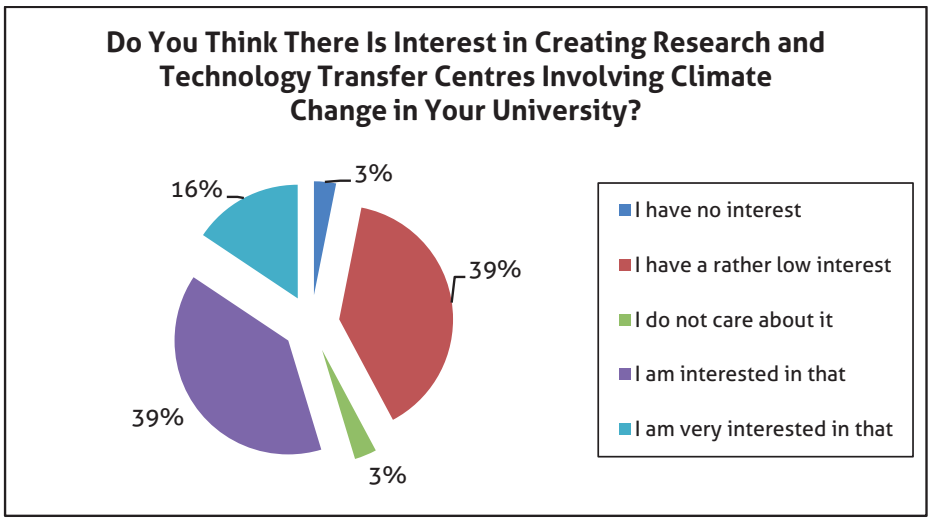
Graph 3.3.4



We asked an open question on other initiatives that were not included in the questionnaire and interviewees answered the following: help establish laws and regulations for a better use of technologies adapted to national conditions; contingency plans for natural disasters; development of defined strategies of social, economical, and environmental characteristics in order to give attention to climate change; inter-institutional networking; formalities to acquire state-of-the-art technology; involve the entire Guatemalan educational system to raise environmental awareness from the early years; programs with a more local approach; work with municipalities and communities; and create synergy because institutions are usually very secretive with the information they manage.

Applicability of Research and Technology Transfer Centres. Regarding the question on interviewee interest in creating Research and Technology Transfer Centres involving climate change in universities to which they are members, we can see on Graph 3.3.5 that 39% said they are interested. An equal percentage showed a rather low interest. Finally, 16% of interviewees were very interested in the creation of such Centres, 3% don't care about it and the rest have no interest at all.

Graph 3.3.5



Regarding the question where interviewees were asked their opinion on possible results produced by Technology Transfer Centres, it was found that 82.8% said applied research; 62.5% said curricular development training in universities and programs of contents aimed for public, private, and non-governmental institutions; 37.5% said contributions to codes and regulations related to climate change; 23.4% stated patent generation with access to royalties; and lastly, 25% think that "others" could be the products.

3.4 Survey Results Addressed to Decision-makers.

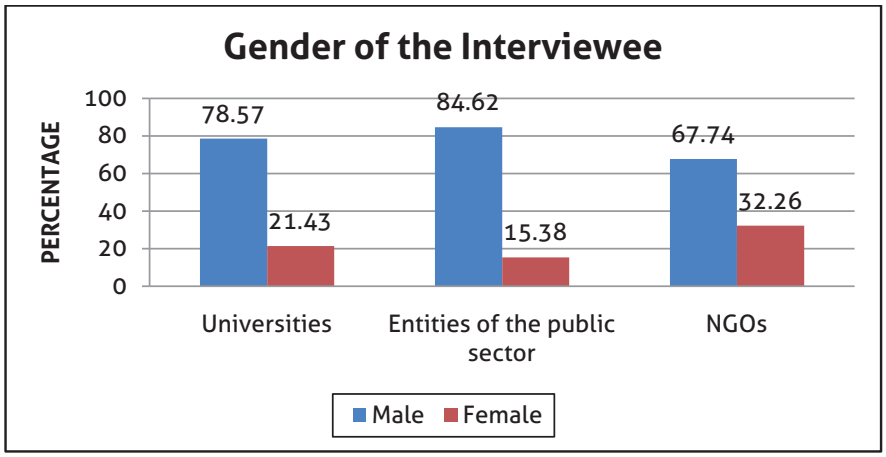
Gender deficits occur in all populations surveyed and this survey was no exception. A deficit was apparent in the surveyed entities: universities, public sector, and NGOs. As can be seen in Graph 3.4.1, the numbers show a double deficit. This double deficit consists of low female participation as a result of factors inherent to the social system that determine low percentages of women employed in the labor force. Also, this deficit is greater when it comes to women participation in executive positions in companies, universities, the public sector, and NGOs.

Age varied across organizations. Universities had the youngest age group but also had most educational degrees, especially doctorates. However, master's degrees seem to be an essential requirement for all Decision-makers. Interviewees' responses were characteristic of the entities they belonged to and the mission these organizations accomplish. Universities were interested in research and teaching while NGOs and public service organizations were more focused on technical assistance and technology transfer. On the other hand, NGOs are also interested in lobbying, regulations, and compliance of regulations and their applications.

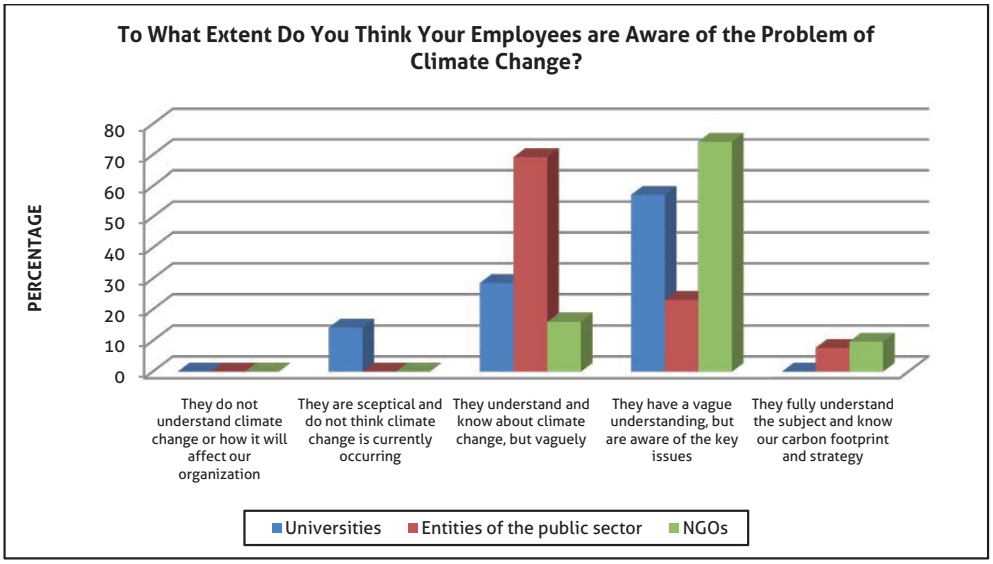
Conducts and strategies towards climate change. Graph 3.4.2 shows the attitudes of employees and how Decision-makers perceive them. Here, skepticism and vagueness appear in a relevant proportion. There is a long way to go to raise awareness about the climate change problem. However, if that can be generalized for all the actors in this process, we can also see

in global data, that there is an openness to incorporate capacity building programs across universities, companies, teaching staff, the public sector, and NGOs

Graph 3.4.1



Graph 3.4.2

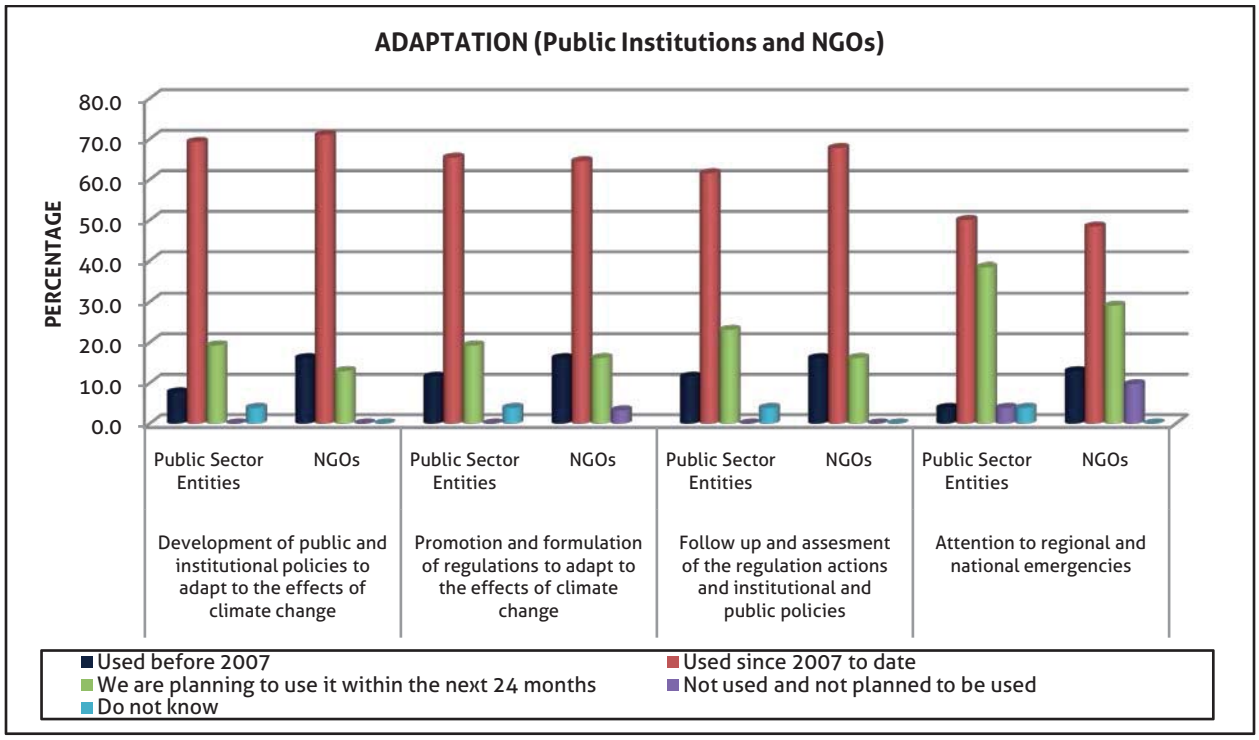


Activities and programs of all Decision-makers in surveyed entities show that 2007 was crucial for the beginning of activities related to climate change. This specific date coincides with the oil crisis. Graph 3.4.3 shows Decision-makers lack of attention to emergencies but also recognition that this subject needs their attention, though in the future.

In sum, according to the information gathered, but not presented here, the items regarding asset and human damage; demand of new products; and better emissions regulations are higher priorities to Decision-makers in universities. For the public sector and NGOs, there is more interest

on the impact on asset and human damage, but less in the supply and demand of the production chain. Moreover, while the public sector and NGOs showed less interest in the productive chain, they did acknowledge the threat of climate change to the supply chain and the need for better regulation on greenhouse gases.

Graph 3.4.3

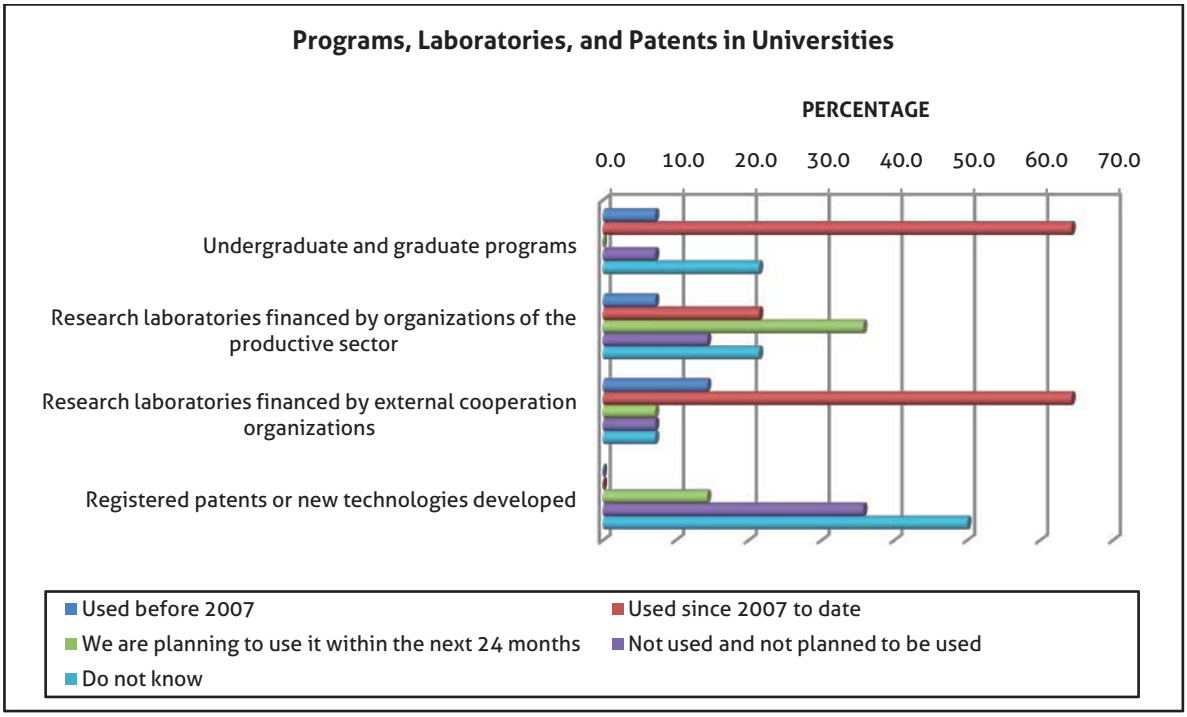


Contributions of organizations. In Graph 3.4.4, we see the generalized absence of research activity in both general and applied research, which leads to a high proportion of "Doesn't know" regarding patent generation. Interdisciplinary programs, which can be a correct approach to face the challenges of climate change, appear to be more relevant, as was expected in universities, which show that in 2007, we could anticipate a doubled effort in this direction. From the results, we can infer the lack of coordination of the different entities inside universities and universities themselves, with society at large. Certain withdrawal from non-academic activities is shown in universities. There is, on the other hand, a basis for a better cooperation between the public sector and NGOs given that both sectors lean towards city subjects.

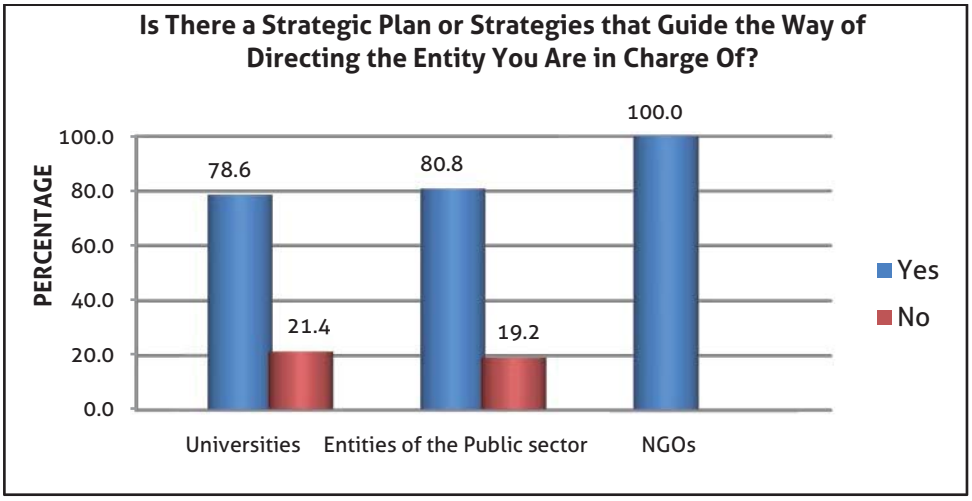
When interviewees were asked what other practices could be mentioned that were not in the questionnaire, some Decision-makers from universities stated the subject of pollution, alternative energies, and result assessment. The public sector pointed out environmental mitigation, creation of educational books, community and municipal activities. NGOs responded that the questionnaire had covered every practice of theirs. When examining exclusive dedication of Decision-makers in surveyed entities to the subject of climate change, it was found that most organizations are able to relate climate change with other broader environmental concerns, but

that they do not dedicate full attention to the subject. In all entities and even more markedly in universities, there is a deficit in the vision of the future and in strategy and making strategic plans, as we can see in Graph 3.4.5.

Graph 3.4.4



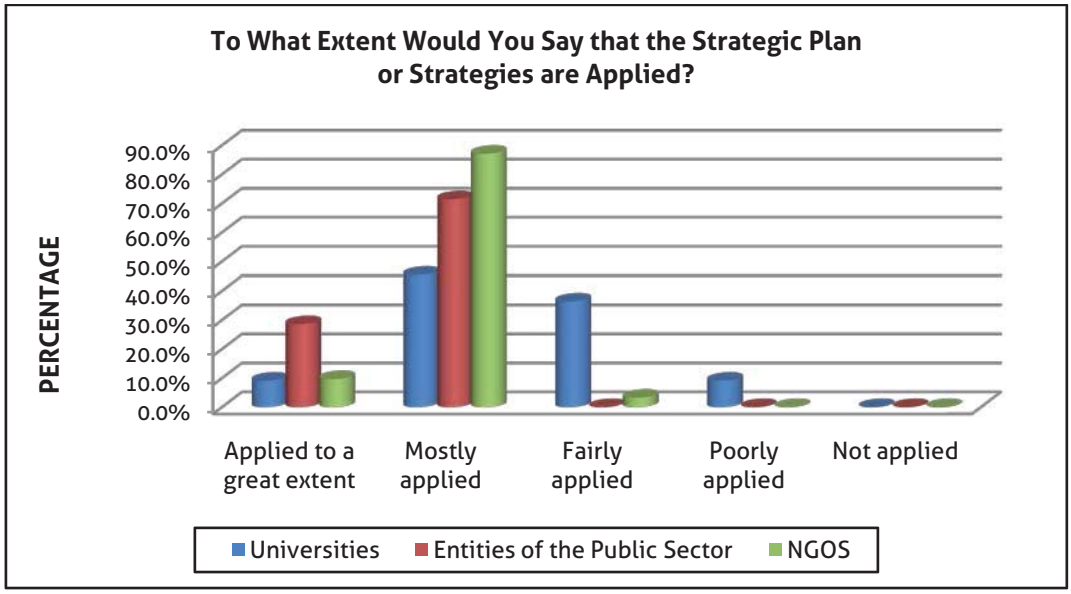
Graph 3.4.5



Within these institutions there is a trend of poor communication between those who make the plans and those who execute them. Also, follow up and assessment are absolutely absent.

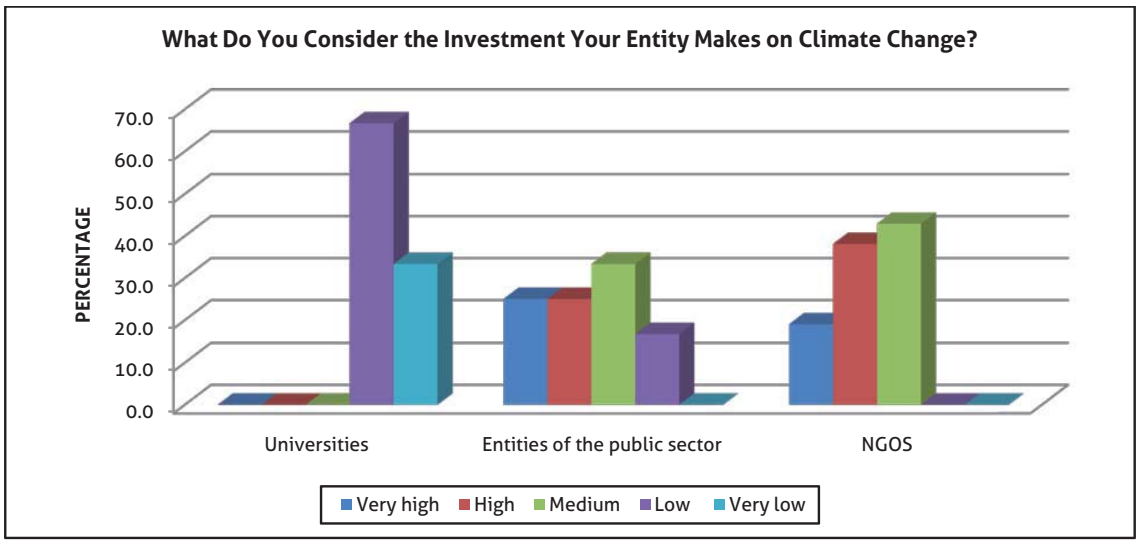
This could be a serious obstacle for the programming necessary to tackle the challenge of climate change. Graph 3.4.6 demonstrates this. Further, it can be inferred that if, for example, NGOs have a degree of implementation of around 80% or more, entities in the public sector only reach an approximate number of 50% or more, while universities achieve an effective degree of 30% or more.

Graph 3.4.6



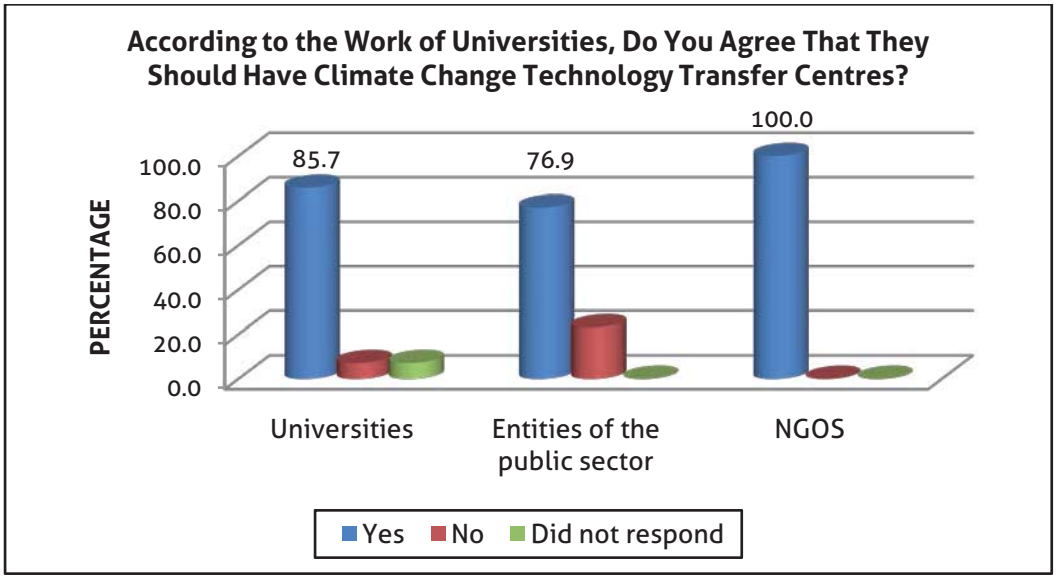
Investment in climate change. The average investment in climate change, which can be seen on Graph 3.4.7, is minimal, especially in universities.

Graph 3.4.7



Openness towards Research and Technology Transfer Centres. There is near consensus by all decision-makers on the importance of the creation of Research and Technology Transfer Centres on Climate Change, according to Graph 3.4.8. The contributions of these Centres, according to interviewees, include the consolidation and contribution of universities, which would result in the dissemination of research results, besides inspiring shared information and cooperation among institutions.

Graph 3.4.8



3.5 General Conclusions and Recommendations

1. Gender deficits were present in all groups interviewed and create a decrease in representation in the EAP and also in direction groups of all entities to which the interviewees belong.

2. In general, we can assert that in all groups considered: companies, university staff and Decision-makers, there is an openness towards incorporating the subject of climate change to their activities and from 2007 on, it has become a challenge, along with the dissemination of social responsibility values.

3. In the short term, there is a still-incipient demand for more knowledge, technologies, and products as well as a requirement for laws and regulations that might improve control standards of these events, mainly focused around disasters (excessive rain, floods, high and low temperatures and hail). Nevertheless, regarding governmental regulations on disasters, companies show concern on the possible impact in their costs and natural resources exploitation if those rules tend to be negative toward companies' goals.

4. From the results of this study, we seek to influence prevention and control of effects and vulnerability in Guatemala, mainly before disasters and emergencies, by intensifying adaptation and resilience processes. The staff expressed training and qualification; infrastructure construction, such as laboratories, instruments, materials, and equipment; and fund acquirement and administration in universities, as a very important need.

5. Agricultural companies show more awareness regarding climate change than industrial companies. However, the lower educational level of personnel in agriculture is a limitation for the introduction of new technologies, as well as the adaptation of innovations and openness to regulations.

6. The degree of priority assigned to climate change in every entity varies. Companies, in general, tend to consider climate problems when planning investments, managing environmental subjects and developing strategy. University staff, however, belong to programs and courses where the subject of climate change is still marginal in more general environmental subjects. And, Decision-makers say that they make strategic plans. However, little is budgeted for this area and that they do not have effective follow-up and assessment initiatives.

7. Agricultural companies were very specific when pointing out changes they consider necessary, suggesting: the development of new technologies; plagues and diseases control methods in sowing and harvesting programs; the design of new crop calendars; new techniques that allow to farmers to sow and harvest in non-common dates; the transferral of crops to new altitudes; and the introduction of new irrigation systems that are more efficient in water usage. Industrial companies suggest building capacities in green buildings technologies, Clean Development Mechanisms (CDMs), including carbon markets, technologies to reduce emissions, risks management, and improvement of energy efficiency. Industries report lower costs before disasters and climate events.

8. University staff provide the teaching and research needed as well as interdisciplinary programs to investigate the effects of vulnerabilities and disasters in Guatemala and Central America as necessary. Their lack of interest towards legal proposals and regulations is of note.

9. There are more similarities between Decision-makers from the public sector and NGOs than between these two entities and universities with respect to the environment.

10. Companies in general, according to their directors, find that their employees have limited awareness and understanding of the risks and problems as a result of climate change.This limited awareness and understanding is even greater in agricultural companies. Companies demand more training on methods to reduce risk and vulnerability to threats—mainly with regards to logistics operations to reduce the impact in the break-off of distribution and supply chains; and to improve the educational level of their employees. This training should be done, according to the companies, through distance learning methodologies focused on work.

11. Companies suggested reforms to the university curricula so that climate change is included in engineering programs, aiming for risks analysis, contingency plans, clean technologies, recycling, efficient use of water and energy, and the design of green buildings. In agronomy, companies mentioned new crops and varieties more resistant to drought, diseases and crop adaptation, reforestation and protection of water resources, and new techniques for soil management and irrigation technologies. In the economy and business administration, there should be similar courses to those in engineering, adding recycling subjects. For information technologies and communication, they consider the following important: communication and data protection systems and warning systems. Finally, for human sciences: early alert systems, social organization and risks planning.

12. University staff make similar suggestions. They also give priority to water resource efficiency, new crop techniques, and development of genetic varieties. Also, they see a need for training both in risk management and in industrial management and policies development, thereby putting emphasis on this subject transversally.

13. The subject of climate change affects the debate on priorities regarding mitigation actions versus adaptation. Many actors in this field, more linked to environmental subjects prefer that for developing countries, including Guatemala, the emphasis be made on adaptation, because the effects of climate change, caused by developed countries, make them victims of these phenomena. On the other hand, we see developed countries more interested in mitigation. Work is still needed in order to explore this debate.

14. Technology Transfer and Research Centres are necessary. Nevertheless, the idea provokes skepticism of their viability, curiously, among teachers. The reason for this skepticism is that in Guatemalan universities, professors have a very specific schedule. There are no research centres. Their daily work is also characterized by the lack of exclusive affiliation to the universities in which they work. A significant proportion of professors provide their teaching services to several higher education institutions temporarily.

15. There are potentially defined priorities for work in these Centres. These lines of action are:

    a. Joint research efforts that could link the business, university, public, and non-governmental sectors;

    b. Multiple agreements and projects among them, detailing collaborations;

    c. Multiple strategic alliances, based on objectives that could make up real networks in the field of interest;

    d. The creation of internships or temporary positions that could help students from universities to be immersed in the rest of the sectors, gaining professional experience;

    e. Supervised Professional Training arranged by all interested entities that demand and practice activities related to the curriculum of universities;

f. Provision of technical services from universities to companies, the public sector, other universities, and NGOs;

g. Planned development of patents obtained from the research work of all participant entities.

16. We can infer that the aforesaid conclusions should turn into building a system that could be managed in the short, medium, and long term by stakeholders from the university, private, public and nongovernmental sectors. Furthermore, these conclusions should be applied at the local, municipal, regional and national levels. Finally, these conclusions should be the basis of a strategic plan as strengths, opportunities, weaknesses, and threats are identified.

NICARAGUA

3.1 Methodology

The research methodology was based on a sample of interviews from three groups:

1. Private companies in the field of agriculture and other sectors, in two separate layers, which in the case of Nicaragua's population was defined by those companies that have any kind of process related to the issue of climate change and "cleaner production." The database of companies participating in the Award for Cleaner Production in Nicaragua was utilized to select interviewees.

2. Institutions of Higher Education, HEIs, University Staff: Professors, researchers and/or administrators. This group classifies all universities staff and is related to different programs and powers of these entities. The group of interviewees was selected from a list of professors and administrators of major higher education institutions. However, the main limitation is that most universities in Nicaragua had no activity related to climate change. Therefore a number of them was left out of this definition, especially in most private universities.

3. Decision-makers in HEIs, public institutions, and NGOs. This group of interviewees was selected from an initial list of institutions that have ties to the subject. Sampling was done by experts in the field belonging to the Nicaraguan Alliance on Climate Change (ANAC) and National Bureau of Risk Management (MNGR) (Amaro, 2011).

After defining the sample, we conducted fieldwork interviews, which were developed as follows:

1. Interviews with private companies: 33 (all were conducted by an interviewer).

2. Interviews with university staff: 17 (12 questionnaires were sent by email and 5 interviews were conducted by an interviewer).

3. Interviews with Decision-makers: 11 (all were conducted by an interviewer)

4. Total number of interviews: 61.

Later, data was processed through the Statistical Program for Social Sciences, SPSS, and its analytical software.

3.2 Survey Results Addressed to Companies

Profile. With regard to company size, as can be seen table 3.2.1, 51.5% of surveyed companies declared to have up to 50 workers, the other 48.5% ranges from 51 to 500 plus workers. Concerning company size by revenue,in data not shown here, 54.5% of the responding companies reported revenue up to US$5.0 millions per year and 15.2% of respondents stated that revenue was between US$5.1 and US$20.0 millions dollars a year. The rest of the sample was divided into different ranges of up to US$70.0 millions and 12.1% did not respond, which is a rather low percentage, considering that this is one of the most delicate questions for businesses and usually has a higher percentage of firms that refuse to give this information.

Table 3.2.1 Number of Employees

Number of employees	Frequency	Percentage
50 or less	17	51.5
from 51 to 100	2	6.1
from 101 to 150	3	9.1
from 151 to 200	2	6.1
from 201 to 250	1	3.0
from 251 to 300	3	9.1
500 and more	5	15.2
Total	33	100.0

Table 3.2.2 shows the percentage distribution of firms, concerning their business scope and territorial coverage. It was found that most companies surveyed (36.4%) conduct their operations in other countries of Central America as well as Nicaragua, while 27.2% have operations exclusively in the country. The rest of the companies operate in the United States and other international markets, as well as Nicaragua. Half of the sample was made up of small companies with little international experience and large companies with international experience mostly in Central and North America.

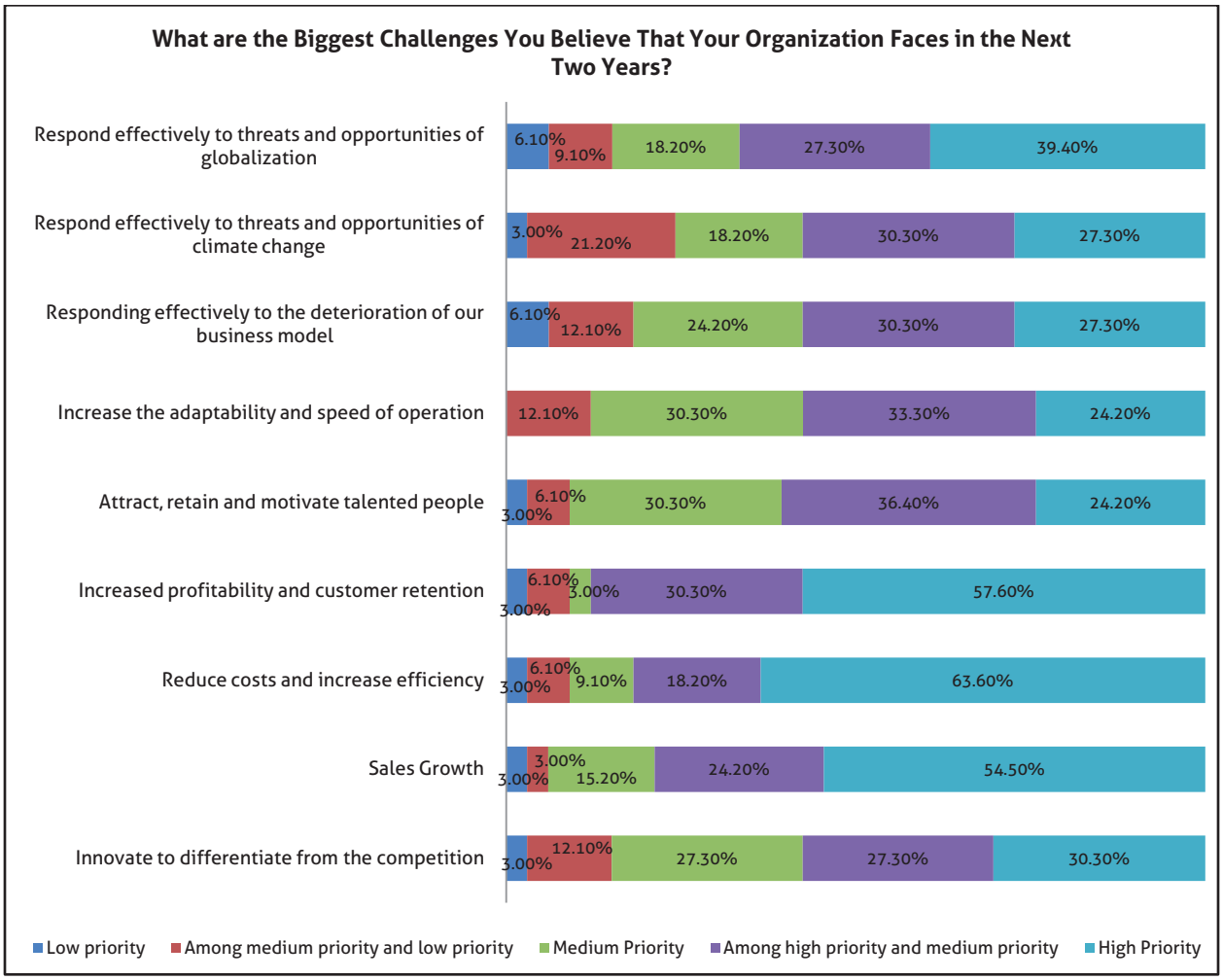
Table 3.2.2 In What Region Does Your Company Do Business?

Country	Frecuency	%
Only in Nicaragua	9	27.2
Central America	12	36.4
LatinAmerica	1	3.0
North America	6	18.0
Europe	2	6.2
Africa	0	.0
Middle East	0	.0
Australia	0	.0
New Zeland	0	.0
Asia	2	6.2
Global	1	3.0
Total	33	100.0

Interviewees' Profile. In data not shown here the educational level attained by respondents is as follows: 39.4% had high school diplomas and 33.3% had obtained an undergraduate degree. The remaining 24.2% of respondents had master's degrees and 3% have no diploma at all.

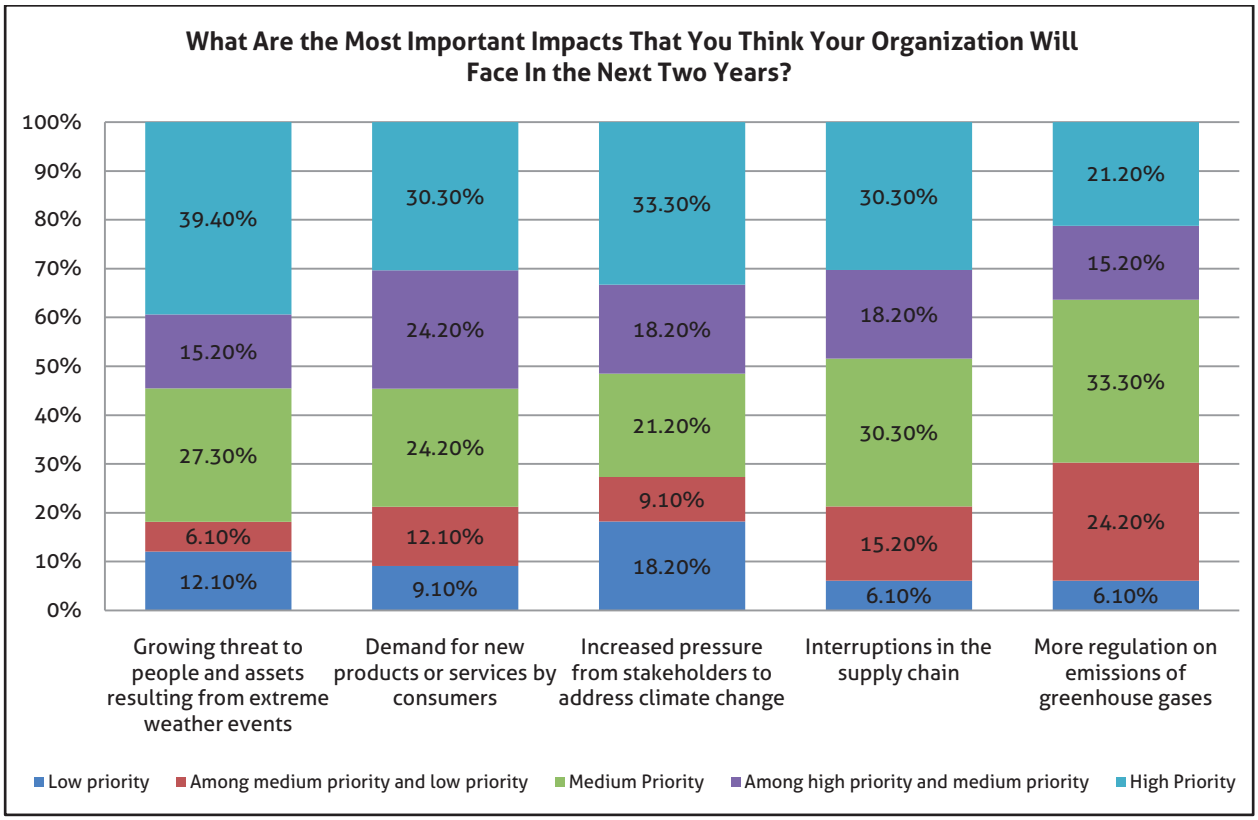
Business attitudes towards climate change. Graph 3.2.1 shows that cost reduction and increased efficiency is the most important issue in the Nicaraguan business community's agenda, followed by customer retention. Climate change is the third most important issue on the agendas of business boards in Nicaragua. Further, 81.6% of companies responded that cost reduction and increased efficiency has a medium to high and high priority, and 87.9% felt that increased profitability and customer retention was classified as high and medium to high priority. More than half of companies, 57.6%, consider climate change issues as having medium to high and high priority on their board agendas. While 42.4% of them consider this issue as having low to medium priority. On the other hand, 30.3% believe innovation to differentiate themselves from competitors is the fourth most important issue on board's agenda. Companies selected as fifth, the issue of attracting, retaining, and motivating talented people. All of this information means that companies have a medium awareness regarding climate change threats and risks. Nevertheless, Nicaragua is among the most at risk countries with regard to climate change, showing the distance between challenges and perception of risks and threats.

Graph 3.2.1



With regard to challenges faced in business by climate change, responses are displayed in Graph 3.2.2. Respondents consider their biggest challenge as the ability to cope with the threat to people and assets by weather events. Companies' second challenge is the pressure exerted by stakeholders to address climate change issues. Third, companies are concerned about interruptions in supply chains as well as increasing demand for new green products. The interruption of the supply chain (destruction of roads and bridges) affects both the supply of input and the delivery of products to markets. This perhaps suggests that companies are not fully aware of the effects on costs and market opportunities provoked by climate changes.

Graph 3.2.2



Human resources and universities towards climate change. In data not shown here, with respect to the level of knowledge of climate change issues expressed by companies' directors, only 30.3% of them consider having enough knowledge about climate change and its effects while 36.4% considered climate change an issue they manage and 33.3% believe they do not have sufficient knowledge. When asked about the extent to which their employees are aware of climate change, as can be seen in Table 3.2.3, 33.4% responded that they believed their employees understand the problem and the key issues to address its risks, while 42% believe their employees have a vague understanding of the problem, and 27.4% are skeptical that their employees have any idea how climate change may affect them. These answers confirm the perception that there is little awareness about the challenges faced by businesses in Nicaragua regarding the threats from and risks of climate change.

Table 3.2.3 How Much Do You Believe That Your Employees are Aware of Climate Change?

Level of Awareness	Frequency	Percentage
They do not understand climate change or how it will affect our business	4	12.1
They are skeptical and do not believe that climate change is happening now	4	12.1
Understanding and awareness of climate change present but vague	14	42.4
They have a vague understanding, but are aware of the key issues	9	27.3
Fully understand the issue and are aware of our carbon footprint and strategy employed	2	6.1
Total	33	100.0

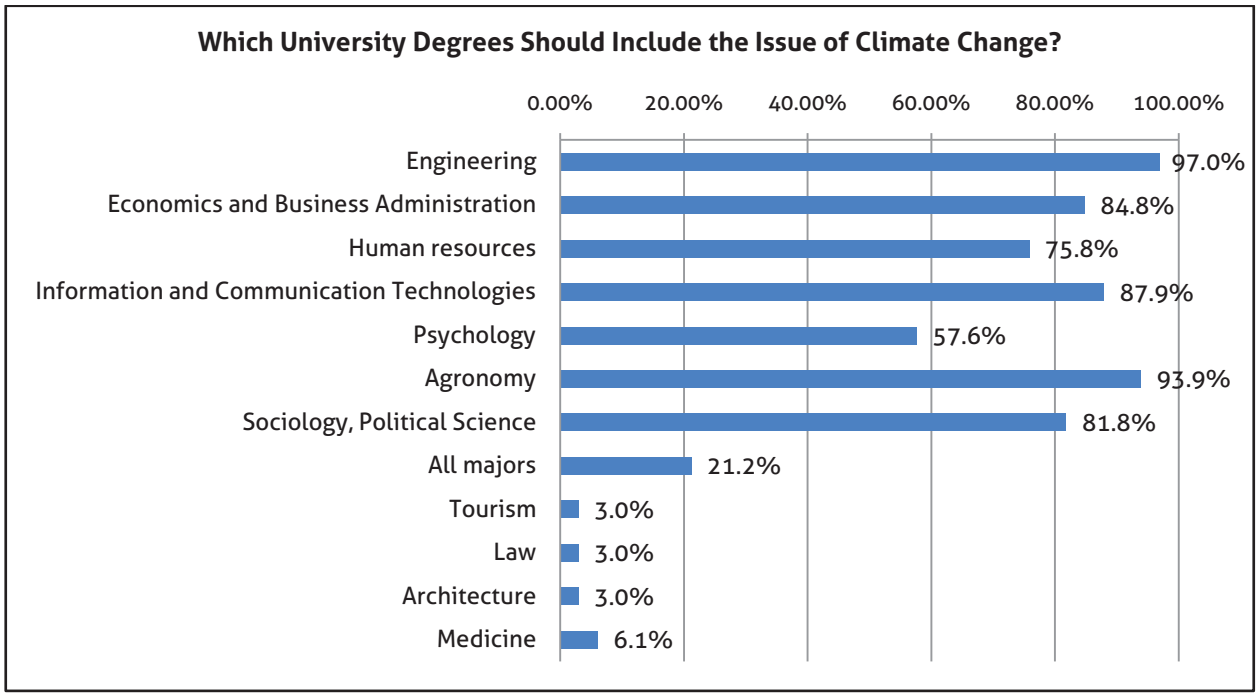
On the other hand, data not shown here, demostrate that 60.6% of respondents believe that it is moderately to very difficult finding qualified human resources to deal with climate change problems. Therefore, this is an opportunity area for training and career build-up by HEIs. When employers were asked about their opinion on university careers where climate change issues must be taught as shown in Graph 3.2.3, more than 80% of them responded, in order of importance: engineering, economics and business administration, human resources, information and communication technology, agriculture and human sciences such as sociology and political science. Between 50 and 70% of respondents felt that the issue of climate change should be taught in courses like psychology and human resources, while 21.2% said it should be taught in all degrees.

University–enterprises relationship. According to data not shown here, in developed countries there is a relatively tight relationship of cooperation among universities and businesses. In the case of Nicaragua, there is practically no formal relationship among them. However the survey results show companies are prone to establish different kinds of liaisons with HEIs. It is noticeable that 87.9% of respondents are open to establishing strategic alliances (university-business), another 74.2% thought about this issue and it must be done by procurement of services, and 69.7% declared that this relationship must be established through multiple agreements. A significant number of interviewees, 66.7%, consider that this liaison must look for mutual joint ventures combining entrepreneurship and research. Also 60.6% felt that there should be a strengthening of internships or apprenticeships to accomplish these goals and 51.5% mentioned supervised professional practices by which students do their thesis work accompanied by professors oriented toward companies and other sectors.

Climate change and the legal environment. When asked about their views regarding the importance and priority of climate change in the country, in data not shown here, 66.7% of employers responded that it is a priority and intrinsic to the national agenda and concerns to all. While only 12.1% said it's a priority but is only a concern for the government, NGOs, and some companies. Finally 21.2% consider climate change as an important issue but not a priority. This fact leads us to consider the need to integrate all national stakeholders to seek and develop joint actions for the effective adaptation to climate change. On the other hand, 100% of business

respondents expressed their agreement with legislation on climate change. Also considered among the most important measures that should be promoted by the government are raising public awareness, law enforcement, as well as training and dissemination in the field.

Graph 3.2.3



Centres of Research and Technology Transfer on Climate Change. On this issue 100% of employers surveyed agree with the establishment of Climate Change Research and Technology Transfer Centres at universities. Regarding the role of these Centres, respondents think they should develop the following actions, ordered by importance:

1. Encourage the use of appropriate technologies (27.3%);
2. Educate, teach and qualify human resources (24.2%);
3. Train companies (9.1%);
4. Keep people informed (9.1%);
5. Provide knowledge to society (6.1%);
6. Support businesses to develop strategies (3.0%);
7. Expansion and promulgation of knowledge (3.0%);
8. Minimize emissions (3.0%);

9. Did not respond (15%).

Impacts, opportunities, and adaptation strategies. As for the impacts, effects and opportunities for adaptation, a summary of survey results show that there is a low awareness level on the subject in the business sector, for the following reasons:

1. When asked about climate change threats in terms of rising temperature, floods, droughts, and other risks and menaces as well as adaptation measures. 90 to 93% of respondents did not answer this question;

2. When asked about the risk of climate change damage on infrastructure, 88.4% stated that they had little to no experience;

3. When asked about risk climate change damage on supply chains,87.4% responded there is little to no damage;

4. Finally 84.8% claimed to have little to no damage in the production process.

Businesses are minimally aware about climate change risks and threats, despite the fact that Nicaragua is considered one of the most affected countries by climate change. From 1982 to 2007, because of climate disasters, Nicaragua has lost 3,458 lives and has had damages estimated to be US$3.024 billion of which US$1,939 million have meant the destruction in whole or in part of stock or capital (CEPAL, 2007). Recent studies on future economic consequences of climate change in Central America, establish the following (CEPAL, 2011):

1. The projected water demand will increase 20-24% by the year 2100, with a decrease in total water availability ranging from 35-63%. Both ranges are higher than 20% of accepted water stress internationally.

2. The agricultural sector will be one of the most affected by climate change, with an estimated reduction of 9% (agriculture) and 13% in livestock by 2100, affecting the production of corn, beans, and rice.

3. Cumulative economic cost for 2100 range from US$44.000 million to US$73.000 million (according to different scenarios). In terms of gross domestic product (GDP) these losses represent a range of 32-54% of regional GDP, affected by climate change.

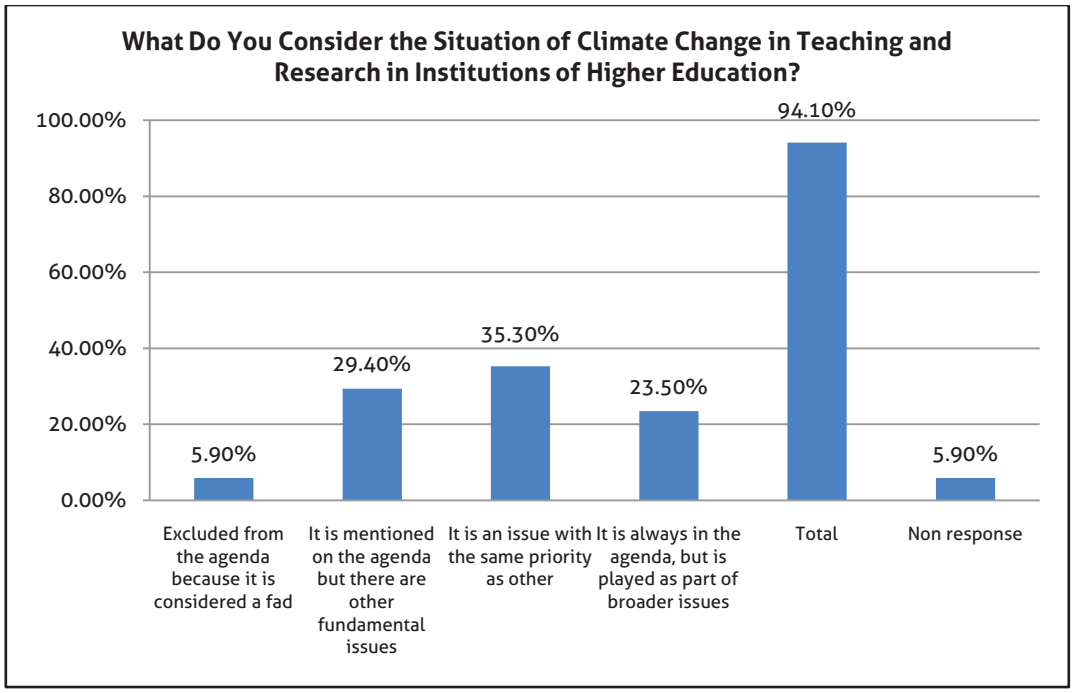
3.3. Survey Results Addressed to University Staff.

Regarding the background of university staff, 88.2% of respondents had master's degrees and 5.9% doctorates in sciences. However, when they were asked about their areas of expertise it was found that the respondents come from diverse areas of academia such as agriculture, environment, land development and environmental education, energy, risk assessment and disaster reduction, resource management, soil management, risk management and adaptation to climate change, sanitation engineering, business management, water resources, and environment management. From all professors interviewed, 82.9% are devoted to teaching,

5.9% are not engaged in teaching, and 11.8% did not respond. While 58.8% stated that they conducted research and 17.6% do; 23.5% had no response. Considering that this last figure is high compared to other countries and universities, a question was asked about how much they published. Concerning scientific publications 35.3% of professors wrote from 1 to 3 publications on climate change, while 64.7% did not respond to this question, which shows a different perspective. Also the absence of related patents affects this perception. When professors were asked about how many courses they had taught on climate change in the current academic year, 41.2% said they have taught from 1 to 3 three courses, while 58.8% did not answer.

Knowledge assessment regarding climate change. With respect to climate change knowledge assessment, looking at the data not shown here, 11.8% of professors considered themselves as an expert in the subject, 41.2% said they have enough knowledge, 11.8% said they neither had much or little knowledge on the subject, 29.4% said they had some knowledge on climate change,and finally 5.9% reported to have no idea or knowledge about the topic. On the other hand, when professors were asked what the situation is on the priority of teaching and research on the subject of climate change in Nicaragua's HEIs, 23.5% think that the issue is always on the HEIs agenda, but is part of broader issues, 35.3% considered it is an issue with the same priority as others on the agenda, while 29.4% said that the topic is mentioned on the agenda but there are other fundamental issues, 5.9% considered that climate change issues are excluded from the agenda because it is considered a fad, and a 5.9% had no answer (see Graph 3.3.1). Results show there is little concern about climate change in Nicaragua's HEIs contradicting all available data on the subject.

Graph 3.3.1



HEIs role on climate change. Regarding professors' perception about the role that HEIs have on climate change issues, in data not shown here, only 58.8% of them said they feel HEIs should focus on teaching, while 82.4% felt that HEIs role should focus on researching the effects of climate change in Nicaragua and Central America. On the other hand 58.8% of respondents said they have worked in research and development of technologies for mitigation and adaptation. Also 58.8% felt HEIs should focus on the elaboration of proposals for mitigation and the adaptation of laws and regulations, and 58.8% of them again thought HEIs should focus on technology transfer for mitigation and adaptation

Requirements for training and certification on climate change. As for the types of careers that should receive training on climate change there is some similarity in the results on the university staff's survey in relation to the position of the business sector. One hundred percent of respondents felt climate change issues should be included in engineering, 70.6% felt favorably in including the subject in economics and business administration, 41.2% felt favorably in including it in human resources training, 64.7% in information technology and communication. Moreover, 94.1% of professors answered that climate change issues should be included in agronomics and 58.8% in the humanities, sociology, and political science.

Institutional strengthening on climate change. With regard to the need of strengthening knowledge on climate change issues, 88.3% considered it as important to very important, while 12.7% considered it as a normal need. Similar to the previous responses, most professors interviewed considered the subject very important to keep up with regards to the generation of technological changes in the field of climate change. Regarding the need for broader and tighter collaboration on climate change between universities and businesses, 58.8% of respondents said it was a very important need, 23.5% said it was an important need, while 10.2% said it was unimportant, and 5.9% did not respond.

Feasibility of Research and Technology Transfer Centres. When professors were asked about their opinion regarding the operation of Climate Change Technology Transfer Centres, 86.4% of respondents qualified the proposal as a subject of their highest interest and just interest, while 5.9% said they had some interest, and 17.6% did not respond. According to the respondents the most important tasks for a Climate Change Technology Transfer Centre should be:

1. Applied Research on climate change issues;

2. Elaboration and proposal of codes and regulations related to climate change;

3. Exchange of professors for the increase in performance of subjects;

4. Development of specialized conferences on the subject.

3.4. Survey Results Addressed to Decision-makers.

Characteristics of the organizations. This survey was addressed to officials of public institutions, NGOs, and personnel of universities at the top of their respective bodies and programs directly related to climate change. In this group, 54.5% of respondents belong to

public institutions, 36.9% from non-governmental organizations, and 9.6% interviewed were Decision-makers from universities. With respect to respondents' academic backgrounds, 45% possess a master's degree, 45.5% a 5 year college degree (mainly bachelors), and 9% a doctoral degree.

When Decision-makers were asked about their activities, they answered as follows:

1. 27.3% of them performed teaching;

2. 72.7% of them undertake research;

3. 72.7% of them perform outreach, technical assistance and technology transfer;

4. 72.7% of them are involved in advocacy and lobbying in government and society;

5. 72% of them work in regulation and/or monitoring and enforcement of rules.

But as for the institutions interviewed:

1. Only 9.1% do work on climate change with the municipal governments;

2. Only 9.1% carry communication and project implementation;

3. Only 9.1% do awareness-raising activities, demonstrative actions in communities;

4. Only 9.1% perform program management or climate change projects;

5. Only 9.1% carry out climate change education and awareness.

These findings suggest that staff attached to universities that were interviewed do their work in outside institutions as independent agents. Therefore, their links to the university probably has a temporary character mainly depending on courses available in those HEIs, which according to them, is a minor task among the activities they perform. Regarding the extension of their initiatives, the institutions surveyed manifested that 18.2% only operate in the Capital City, while 81.8% have operations based in the countryside.

Behaviors and strategies towards climate change. In data not shown here, 91% of people interviewed consider the threat of climate change to people and assets resulting from extreme weather events as an issue of the most importance for their institution. While 54.6% said the highest priority is the interruption of the supply chain. Additionally, 63% thought that the demand for new products or services by consumers was an issue of minor importance. Concerning climate change knowledge, 27.3% of respondents considered themselves as very knowledgeable or experts in the field, while 54.5% said they had sufficient knowledge on the subject, and 18.2% claimed to be an apprentice in the subject. When interviewees were asked to qualify their institutions awareness in relation to climate change, 18.2% said they had a vague understanding and awareness of climate change, 45.5% replied they are aware of the key issues but still have a vague understanding, and 36.3% said they fully understand the issue and are aware of the carbon footprint and strategy of their institutions.

Organization's contributions. Respondents answer that 18.2% of institutions are planning to open undergraduate or graduate programs in climate change within the next 24 months, while 9.1% said they do not have plans now or in the future to do so, 18.2% don't know if they will create programs at any point, and 54.5% had no response. When asked about their experience on climate change issues, 54.5% of respondents said to have developed projects or interventions on climate change mitigation and adaptation earlier than the year 2007, while 36.4% have started projects after 2007, 9.1% of respondents plan to do it in the following 24 months, but 18.2% do not have any plan to do it in the future, and 9.1% did not respond. When interviewees were asked if their institutions promoted or granted scholarships on climate change issues, 9.1% said they do it occasionally, 72.7% responded to do it rarely, and 18.2% did not respond. Only 18.2% of respondents believed their institutions to be using experienced staff from different areas of knowledge to transfer their skills to students and faculty on climate change, while 81.2% said they are not doing so.

When asked if they access to external training to keep up with climate changes technological advances, 27.3% of them said they frequently did, 18.3% said they did periodically, 36.4% said they do once in a while, 9.1% said they rarely do, and 9.1% did not respond. Interviewees responded that their main source of knowledge on climate change was the Internet, 90.9% said they use it very often and 9.1% said they use it regularly but not so frequently. As a proof of interviewees commitment to the issue of climate change, Decision-makers were asked about their investments in the field of climate change, and 18.2% said they did regularly, while 45.5% said they did periodically but not as often as they would like, 18.2% said they did from time to time, and the remaining 18.2% responded to do it very rarely. When asked if their institutions supported or encouraged employees to participate in team projects (or conferences) with external experts in climate change, answers showed that 36.4% of respondents supported the frequent participation, while 36.4% said they did often, 18.2% expressed they did periodically, and the remaining 9.1% answered they did not know if their institutions supported such participation.

Investments in climate change. There is some contradiction on Decision-makers assignment of importance to climate change issues and the investment made by their institutions on the subject. It is very important to know that 90.9% of interviewees acknowledged that they were designing a strategy or planning to guide climate change activities. Regarding the question asked about their institutional investment budget on climate, 54.6% said they had one, while 36.4% said they did not have any, and 9.1% said they did not know if their institutions had a climate change investment budget. In terms of investment by institutions on climate change, 18.2% of interviewees considered they had a large budget, while 54.5% believed that their budget was average, and 27.3% did not know.

Technology Transfer Centres on Climate Change. When asked if they agreed with the idea of universities having a Climate Change Technology Transfer Centres, 100% of those interviewed were prone to support the existence of Climate ChangeTechnology Transfer Centres at universities. Concerning the most important tasks to be developed by such Centres, the interviewees declared the most important ones being the following:

1. Identify, validate, and implement technologies;

2. Provide information on climate change to implement at the national level;

3. Search for new technologies;

4. Creation of technical and specialized skills as it relates to energy professionals inserting the issue of climate change;

5. Strengthen the knowledge to consolidate and expand academic ties;

6. Development of technologies;

7. Validation of foreign technologies;

8. Training and dissemination.

3.5. General Conclusions and Recommendations

1. The business sector gives greater priority to cost reductions and efficiency increases to reach profitability and customer retention, in relation to responding effectively to threats and opportunities of climate change. This indicates that there is a gap in the urgency around the impacts and opportunities of climate change.

2. Another gap has to do with challenges derived from the growing threat to people and assets resulting from extreme weather events. For companies, it is a medium to high priority issue while for policymakers and professors this is an issue with the highest priority.

3. Companies believe that it is very difficult to find qualified human resources in the area of climate change, and they suggest including the subject of climate change in university degrees already available, prioritizing engineering, agriculture, and business studies, followed by human and social sciences. Decision-makers and university staff also shared this opinion.

4. Most businesses believe the issue of climate change is not a national priority and they envisage that there is a limited sectoral vision on climate change issues, which are handled by universities and NGOs. Meanwhile, university staff's results expressed that climate change is not a priority issue for their institutions.

5. Given the low rate of responses and their answers about awareness in the business survey, the CELA Nicaragua team considers that there is lack of information and awareness about the impact of climate change in this sector, confirming that this way of thinking increases their organizations' risks of present and future harm due to climatic events.

6. Although there is plenty of formation of master's degrees on environmental issues, climate change related programs taught by universities are scarce or are part of wider subjects related to environment in general.

7. There is a national program of postgraduate training on climate change in Nicaragua and only 58% of professors surveyed conduct some kind of research.

8. Most professors said they have sufficient knowledge about the issue of climate change, but there are a lack of experts in the field. Local publications on the subject are scarce and have outdated and insufficient data to reach different sectors of society.

9. All professors believe that climate change knowledge must be fostered and strengthened.

10. HEIs manifested their concern regarding the low access to scholarships for climate change learning.

11. In Nicaragua, the main source of knowledge on climate change used by professors and researchers is the Internet. There is little research in this field.

12. All institutions agreed on the importance of technology transfer to cope with climate change risks and threats. They all also agree that universities must develop Climate Change Technology Transfer Centres. There is also general consensus on the positive contribution these Centres can have in the climate change adaptation effort to be done in Nicaragua.

13. There is a need to create a mechanism for partnerships between universities, companies, governmental, and nongovernmental organizations for capacity building on climate change, because there is a clear lack of capacity to meet the enormous challenges of adaptation.

14. It is necessary to develop a capacity building program for business on the basis of climate change to allow each participating company to know and identify their risks of possible harm by the impact of climate change, but also to ponder opportunities.

15. The experience of the research centre and technology transfer on climate change sponsored by CELA project, should be extended to other national universities in order to enhance the national capacity building in climate change research in coordination and with support from the National Council of Universities.

16. Create a national capacity building program in climate change to raise the skill level for academics and promote joint research projects.

17. Promote and encourage the development of research projects on climate change in all universities to promote adaptation skills and technologies.

18. Suggest to the Nicaraguan National Council of Universities, CNU by its acronym in Spanish, and the Association of Private Universities (Nicaragua Chapter), to include the subject of climate change in their technology and humanities programs as a basis for having common curriculum content, but with enough flexibility to include the interests of each field of study.

PERU

3.1 Methodology

Sampling from selected groups was carried out from three different groups: private companies; university staff; and Decision-makers within NGOs, HEIs and public institutions. For each group, a different sampling strategy was implemented.

Sampling Procedure

Private companies. This group was based on the statistical information of the Top Peru Book 10,000 (Peru Top Publications S.A.C., 1999), which is equivalent to the Forbes 500 ranking in the United States. This book is considered a reliable statistical source regarding the 10,000 most important companies in Peru. Due to limitations in time and budget, it was decided to conduct a qualitative survey over a sample focused on the 80 most important companies registered in the Top Peru publication, selected from the following areas: Mining (19 interviewees), Oil (25 interviewees), Agriculture (30 interviewees) and Water & Energy (6 interviewees). The number of cases per sector is proportional to the total number of companies per sector shown in that publication. Only 38 companies answered the survey. Due to the qualitative nature of the research, interferential statistics were not intended to be executed.

University staff: professors, researchers, and administrators. The survey was based on a census on professors, taken from the top ten Peruvian universities (Piscoya, 2006), involved in environmental management and climate change. This census collected information from two main sources: university web pages and databases from the Andean Network of Universities for Risk Management and Climate Change (www.riesgoycambioclimatico.org, 2011). This group comprised of 283 individuals related to environmental and climate change issues. A probabilistic sample of 120 individuals was chosen, based on a normal distribution with 5% standard error and 95% confidence level. The survey was sent and 81 professors responded, with the remainder refusing to answer the questionnaire, mainly because of the lack of time and interest.

Decision-makers: universities, NGOs and government. This group was chosen from a Ministry of Environment, (Ministerio de Ambiente, 2010) database, which comprised of 190 Decision-makers' names and addresses from government, NGOs and universities[5] . This database included other institutions related to climate change, for example,cooperation agencies and research institutes, which were decided to be included in the survey. A probabilistic sample of 100 institutions was chosen, with 5% standard error and 95% confidence level, responses were obtained from 77 individuals.Concerning the fieldwork for data collection, the Peru CELA team decided to follow different strategies for each survey sample:

1. The businesses survey was done by personal interview;

2. The university staff survey was conducted by telephonic interview;

[5] This information was provided by Claudia Figallo and Anita Arrascue, expert officers from the Ministry of Environment of Peru.

3. The survey conducted with Decision-makers survey was done by telephonic interview.

Furthermore, three web forms were designed and they served as pollsters support, but in some cases it allowed some respondents to answer the questionnaire by themselves.

The online polls can be consulted in the following addresses:

1. Enterprises:
   https://docs.google.com/a/pucp.pe/spreadsheet/viewform?formkey=dDVwYkQtQnFMN1VWa2N5YVh4UURtekE6MA

2. Professors, administrators and researchers:
   https://docs.google.com/a/pucp.pe/spreadsheet/viewform?formkey=dGVEaGZsNWl2UDNSc0RmLWRZekJWaHc6MQ

3. Government, NGOs and Universities Decision-makers:
   https://docs.google.com/a/pucp.pe/spreadsheet/viewform?formkey=dHlrZFFMQWZQX1d6TnZCRjN1a3hWLVE6MQ

Table 3.1.1 Universe, Sample, and Returns

Group	Universe	Sample	Returns	Return %	Interviewing dates
Companies	10,000	80	38	47.5	October 6th to December 10th
University staff	283	120	77	64.1	October 17th to December 10th
Decision-makers	190	100	77	77.0	From October 6th to November 13th

Data collection. Interviews were conducted from October 6, 2011 until December 10, 2011, (see table 1). Administration and processing, started on December 15, 2011 and finished on January 17, 2012. The business sample included 38 interviews from the 80 companies contacted. This corresponds to a 47.5% answer rate. Because the sample was non probabilistic, these results cannot be generalized. However, the results are useful for exploratory purposes, especially considering that they represent the attitudes and perceptions of the biggest companies in Peru. Concerning the teaching staff at universities, the response rate was 64.10%, which allows for generalizations to be made regarding the attitudes and concerns of professors and researchers at universities about climate change. Regarding Decision-makers, the answer rate was 77%. This result allows for generalizations to be made about the positioning of Decision-makers in NGOs, HEIs, and public institutions regarding climate change issues in Peru.

3.2. Survey Results Adressed to Companies

Profiles of Companies and Respondents

Company profiles. Size was measured three different ways: number of employees, revenue, and geographical extension of the interviewed companies. Size represented by the number of employees: 44.8% of respondents were big companies (> 250 employees), 36.8% were medium sized businesses (51 to 250 employees) and 18.4% were small companies. (<50 employees).

Size represented by annual revenues, 15.2% percent of respondents were big companies (revenues> 200 million US dollars), 36.3% were medium size companies (revenues >35 and <200 million US dollars), and 48.5% were small to medium companies (revenues <35 million US dollars. It was observed that companies with less annual revenues corresponded to agricultural business. Size represented by operations extension: Most of the respondent companies (57.9%) focus exclusively on their local market, Peru. Whereas only 5.2% at the time of the survey were diversified in Latin American markets and 36.7% were doing business in global markets.

Profile of respondents. Forty two percent of interviewees were older than 45 years old, 42.2% of them were from 35 to 44 years old and 15.8% of respondents were less than 35 years old. Most of them, 58.8%, held a master's degree and 17.6% do not have a university diploma.

Attitudes towards climate change. In order to establish the importance of climate change in company strategy and understand the sustainability of the company over different periods of time (short, medium, and long term), the interviewees were questioned about their attitudes and opinions regarding climate change impact on the strategy and normal business of their companies. For 36.8% of respondents, climate change is essential for the sustainable development of their companies; meanwhile 44.7% of respondents stated that the topic was always in the agenda but was not fundamental to the strategy of the company. These results demonstrate that business directors are aware and concerned about the menaces of climate change.

When companies were asked their opinion about whether they take climate change into account for regular business, only 37.8% of respondents believe that climate change is taken into consideration prior to new investments. The majority, 52.6%, think that climate change is taken into consideration on marketing issues, and 52.6% in business strategy. The opinion of 50% of the respondents demonstrates that companies take climate change into full consideration only in environmental management. This means that even though companies are worried about environmental issues and the impact of climate change to their business, they still have not taken actions in accordance with their concern.

When asked about the importance of climate change in the board's agenda, Peruvian companies answered that this issue is very important, but 60% of the respondents rate climate change as an issue of medium high to high importance. This means climate change is one of the top issues for companies. It is significant, however, that 55.6% of Peruvian companies consider the search of cost reduction and the improvement of efficiency more important than climate change, rating it with the highest score. For 56.8% of companies, the most important issue is to hire the most talented people. For all respondents, innovation was not seen as the most important

challenge to overcome. In the long run (more than 5 years), Peruvian companies regard the main climate change risk as the interruption of the supply chain (71.1% rated it from medium high to high) but also important is the need for regulation on greenhouse gas emissions.

Upcoming challenges for businesses. Despite the fact that Peru ranks eighth in the world for the volume of renewable water available, the Peruvian Pacific Coast shows an extreme water scarcity, and it is precisely in this region where most industries and population are located, as determined by the Pacific Institute (Gleick, 2010). For example, SAB Miller owns five breweries in Peru, and the board of directors is deeply concerned about water availability for future growth. (SAB Miller Plc, GTZ, WWF-UK, 2010). Interviewees considered water and energy as extremely important resources, 76.3% and 71.1% respectively. To guarantee water supply, most companies, 21.1%, own water fountains. Others, 18.4% focus on reusing water or in using irrigation technologies, and further, a small percentage use technologies to desalinate sea water. This concern reflects the need to develop new technologies regarding water management.

Graph 3.2.1

To tackle energy challenges, 47.4% of companies consider first, the improvement of energy savings through a more rational use of it; second 21.1% of respondents consider the improvement of technology for energy management as important. Eighteen percent of companies said they have started or are planning to start an energy plan to reduce their costs (i.e. compressed natural

gas) and the future implantation of renewable energy sources. Concerning the companies' knowledge level on climate change, it was deemed as sufficient by half of respondents, but 26.3% considered themselves as beginners. However, when executives where asked about their appreciation of their employees' knowledge on climate change, 13.2% of them believed that they had full understanding of climate change issues and 47.4% considered their employees have average knowledge on the subject. In regard to carbon footprint, 10.8% of respondents said they measure carbon footprint within the whole value chain, meanwhile 32.4% of companies said they never have done this procedure before; but 21% of the companies said they are planning to do it very soon. This disregard by companies, concerning greenhouse gas emissions may be explained by two reasons, first, Peru's low carbon footprint impact and second the recent creation of the Ministry of Environment, which is just starting to work on clean energy policies (Ministerio de Ambiente, 2010).

Human resources management and the role of universities. According to respondents, only 20% of the companies have people working on climate change related issues. In those companies, the main climate change activities were focused on production activities (68%) for oil, mining, energy, and water companies. Meanwhile in agro-industrial companies the focus is mainly on quality assurance (63%). In both, corporate responsibility and marketing involved people working on climate change issues. Almost two-thirds (63.2%) of the interviewed companies declared that will need people trained in climate change in the near future. However, more than 80% of the interviewees expressed that it is difficult to find people qualified in climate change topics.

With regard to collaboration between companies and HEIs, companies preferred to have strategic partnerships (50% of agro-industries and 67% of other groups); the second is to develop mutual cooperation agreements (50% for agro-industries), and third, consulting services (44% for the other industries). Most of the interviewees suggested the aggregate climate change topics in careers such as: engineering (92.1%), economics and business administration (65.8%), agronomics (68.4%), political science (57.9%), and ICTs (52.6%).

Climate change and legal environment. For 52.6% of the respondents, climate change is a national priority, but 23.7% consider it as an important national issue but not a priority. This means that companies are prone to consider and support national initiatives concerning climate change. More than 70% of respondents believe that Peru is not ready to deal with the risks and menaces of climate change. Therefore, there is a significant potential demand for climate change adaptation and new mitigation technologies. The survey shows that over 40% of businesses are prone to support authorities to enact new legislation concerning climate change, immediately. However 47.4% of respondents consider it better to wait for 1 to 5 years until business are healthier and ready to enforce new rules on climate change. Agri-business entrepreneurs believe they should be given incentives to cope with the impact of climate change. Companies are prone to develop new financial instruments, such as the issue of domestic and international financial carbon or water bonds (80%), but most of them (60%) also believe that further steps are needed, such as the issue of new or revised standards and technical rules, taxes on greenhouse gas emissions, setting emissions limitations, and opening a carbon bond market.

For mining, oil, energy, and water companies; the most important policy is the creation of a carbon bond market (64% of respondents). Second, companies consider the emission or

actualization of standards and technical rules (61%).Regarding specific international climate policy instruments, 68.4% of respondents state some knowledge about the international carbon credit trading system, however only 11.5% have made use of it.

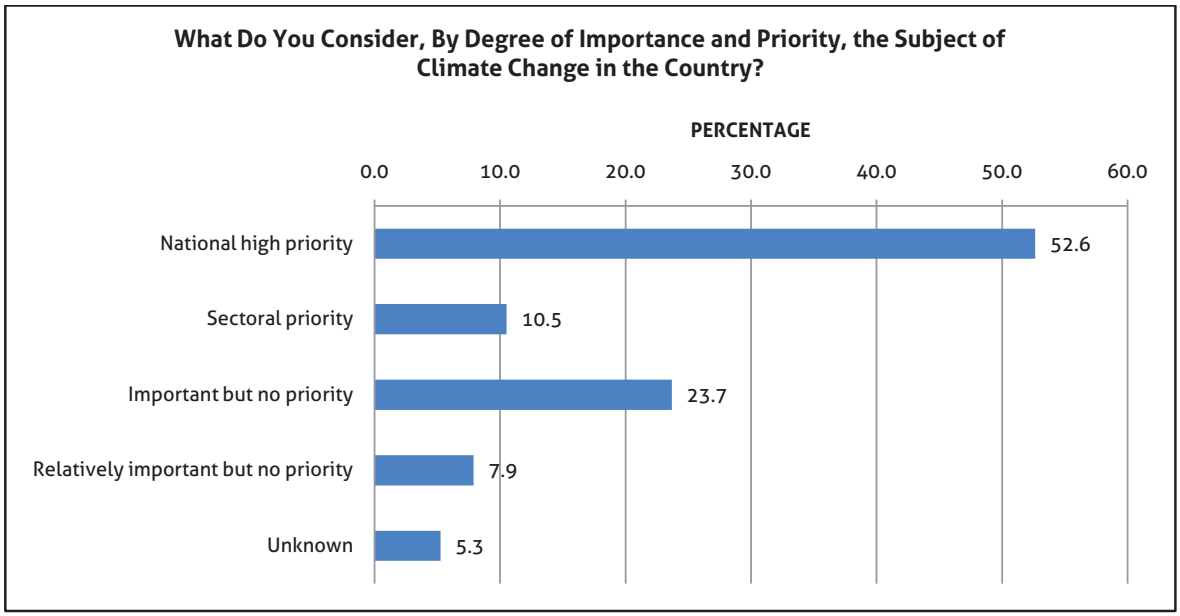
Climate Change Technology Transfer Centres. By far, the majority of respondents answered positively about setting up Technology Transfer Centres specialized on climate change issues by universities. Their main expectations include:

1. Having a place for developing innovations and technological transfers to cope with climate change challenges (57.8%);

2. Having a centre for public discussions on climate change issues. It must provide the proper understanding of the problems, risks, and menaces related to climate change challenges and opportunities (26.3%);

3. Having a place to foster networking on climate change issues, and a meeting point among different actors to develop a realistic and scientific approach of Peruvian reality.

Graph 3.2.2



Impacts, opportunities and adaptation strategies. Thirty two percent of mining, oil, energy, and water companies expect a 20% higher cost burden caused by the impact of climate change. Companies are already experiencing significant problems regarding communication interruption and isolation (22.2%) and supply disruption (11.1%). Companies report to have troubles due to climate change factors on production facilities (27.6%), supply chain (22.2%), and distribution channels (33.3%). Companies suggest that the best technological opportunities created by

climate change are the development of new technologies to improve energy efficiency (75%) and new clean technologies (50%).

Agricultural companies and climate change. Twenty-five percent of respondents believe climate change will have a detrimental effect on crops due to rising temperatures. Respondents declared flooding as the most frequent climate change menace (62.5%), followed by droughts, which were classified as high frequency by 37.5% of respondents. However, both flooding and drought are expected to happen more frequently in the coming years. Respondents believe that rising temperature will force people to change cultivation habits and there will be a need for new growth methodologies and technologies in order to control new pests and diseases (87.5%) and in addition warming will force people to cultivate in higher and cooler lands (62.5%). Warming will also create water scarcity; this will force people to change their irrigation systems and habits (50%). Nevertheless, agricultural companies see the biggest problem as lack of funding in introducing changes to their cultivation methods (25%).

3.3. Survey Results Addressed to University Staff

Background characteristics and attitudes toward climate change. Almost half of the interviewees work as associate lecturers; 19% work as administrative staff (directors of academic programs, project leaders, or deans). Additionally, 71.4% of respondents work on research, however most of them have not published in indexed journals. Seventy-four percent are male and 26% female. Regarding age, 86.7% of the interviewees are older than 40 years. All of interviewees have a university diploma (38.2% have a doctorate, 50% have a master's degree), and 89.6% of them have worked at HEIs for more than five years.

Regarding their knowledge of climate change, 55.8% of professors consider themselves as having sufficient understanding on climate change while 9.1% consider themselves as experts on the subject. Relative to the importance of climate change issues at their universities, 40.3% consider the topic always on the agenda but as part of broader issues and 37.7% consider it in the agenda but relegated for other concerns, as can be seen in table 3.3.1

Table 3.3.1 Climate Change Priority In the University Agenda

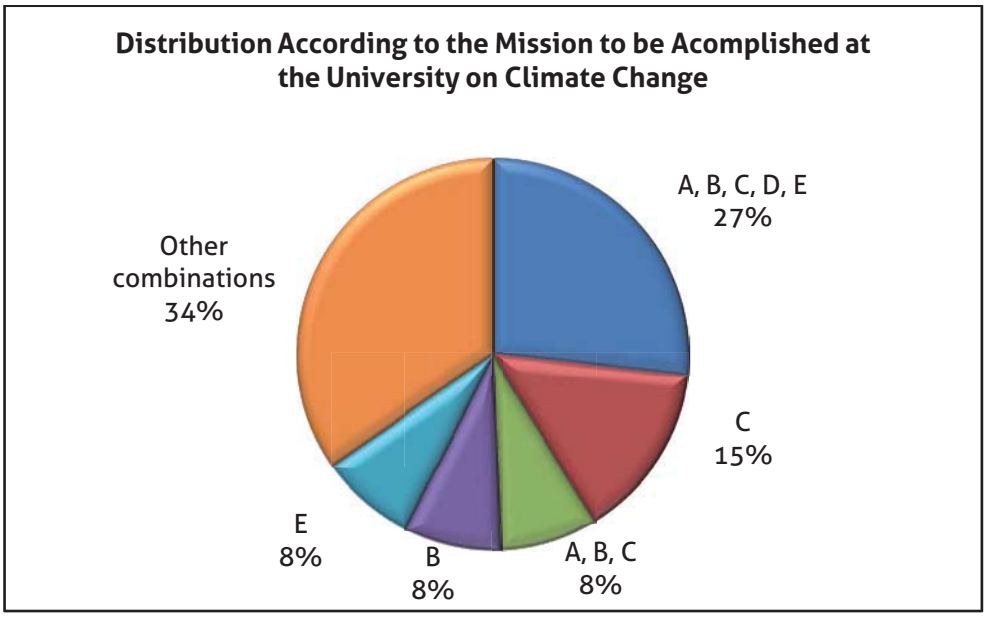
Answer Choices	*N*	*%*
It is always in the agenda, but discussed inside broader topics.	31	40.3
It is included in the agenda, but as a secondary topic.	29	37.7
It has the same priority as other topics.	11	14.3
It is always in the agenda and notably discussed within the academic curricula and research circles.	3	3.9
It is excluded from the agenda because it is considered just a fad	3	3.9
Total	**77**	**100.0**

According to the answers given in Graph 3.3.1 and Table 3.3.2, university staff believe it is necessary to change their universities' mission to introduce climate change on the board's agenda. Forty-nine percent of respondents suggest that the topic should be introduced as a subject in teaching and courses; 71% believe that climate change should be included in environmental research; 14.7% recommend that climate change be considered in the development of new technologies; 39% believe that the university should propose new laws and regulations on climate change; and finally, 55% of respondents believe that it is important to include mitigation and adaptation into the university's mission statement.

Table 3.3.2 Involvement of Universities in Climate Change Issues

Label	*Description*
A	Teaching
B	Research about the effects of climate change on Peru and South America
C	Research and development of mitigation and adaptation technologies on climate change
D	Law and regulation proposals on mitigation and adaptation to climate change
E	Transfer of mitigation and adaptation technologies to climate change

Graph 3.3.1



Training Interest on Climate Change

Training on climate change adaptation. Participants showed interest in training programs related to the following: water recycling (40.3%), energy efficiency improvement and renewable energies (37.5%), storage and water conservation techniques (29.17%), water use and irrigation efficiency and land management improvement (25%), and following finally desalination and diversification of energy sources (22.2% each one). The former data is not shown here.

Mitigation strategies. Respondents' main concerns are the following: heat and renewable energy (40.3%), mitigation research and development (32.8%), and carbon substitution and early applications to capture and store carbon dioxide (20.9%).

Curriculum development training. 67.1% of respondents showed interest in receiving training in curriculum development. The main subjects of interest are: certified training (55.1%), joint programs with international organizations (27.3%), master's degrees (23.1%), and doctoral degrees (20.8%). Most of interviewees are interested in receiving training in the development of teaching modules (69.3%). There is also great interest in receiving training on research direction (76%).

With regard to training on research management issues: 62.6% showed interest in receiving training on funding opportunities for knowledge, 51.8% research skills management, and 37.5% in funding administration training.

Requirements for training and certification on climate change. Regarding this issue, respondent's answers are as follows:

1. 32.9% believe that training should be required in order to improve their technical or professional skills in the area of teaching and research;

2. 43.4% feel that training should be required in order to keep up with the continous changes in climate change technology;

3. 31.2% believe that training should be required in order to develop skills in the topic climate change and curriculum development;

4. 62.3% would like their research facilities modernized including: laboratories, instruments, materials and equipment;

5. 50.6% would like access to scientific databases on climate change;

6. 39.5% feel is important to require attendance at teaching and scientific meetings on climate change;

7. 62.3% believe that collaboration should be required between universities and businesses in the area of climate change.

Institutional strengthening on climate change. All respondents determined that climate change issues need to be strengthened at HEIs. They considered the following should be strengthened:

1. Research and development in mitigation technologies, focused mainly on improving energy and water efficiency (54.7%);

2. Research and development in adaptation technologies focused mainly on how to cope with climate change risks and menaces (54.7%);

3. Develop exchange programs and educational cooperation between universities, businesses, and public institutions (46.7%);

4. Enhance networking and partnerships between universities, companies, and public institutions (46.7%);

5. Climate change internship opportunities for students (37.7%);

6. Academic programs dedicated to focusing on the market impact of climate change (24.7%).

Feasibility of Research and Technology Transfer Centres. According to the Graph more than 48% of respondents consider it 'feasible' to start up Technology Transfer Centres at their own HEIs; 22.1% qualified it as 'absolutely feasible'. However, around 30% are skeptical about the sustainability of such Centres. Respondents believe that these Transfer Centres should include:

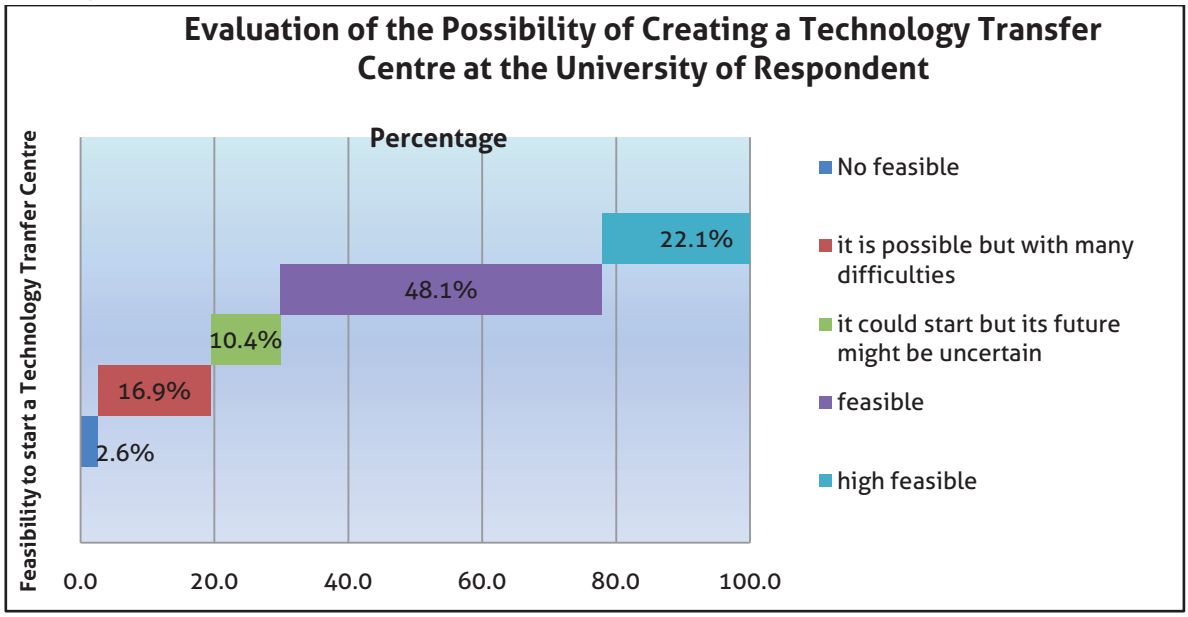
1. Training in the technical aspects of climate change (58.6%);

2. Training in curricula development and producing content for public, private, and non governmental organizations (46.7%);

3. Contribution to codes and regulations related to climate change (4.6%);

4. Generation of patents with access to derived royalties (29.3%).

Graph 3.3.2

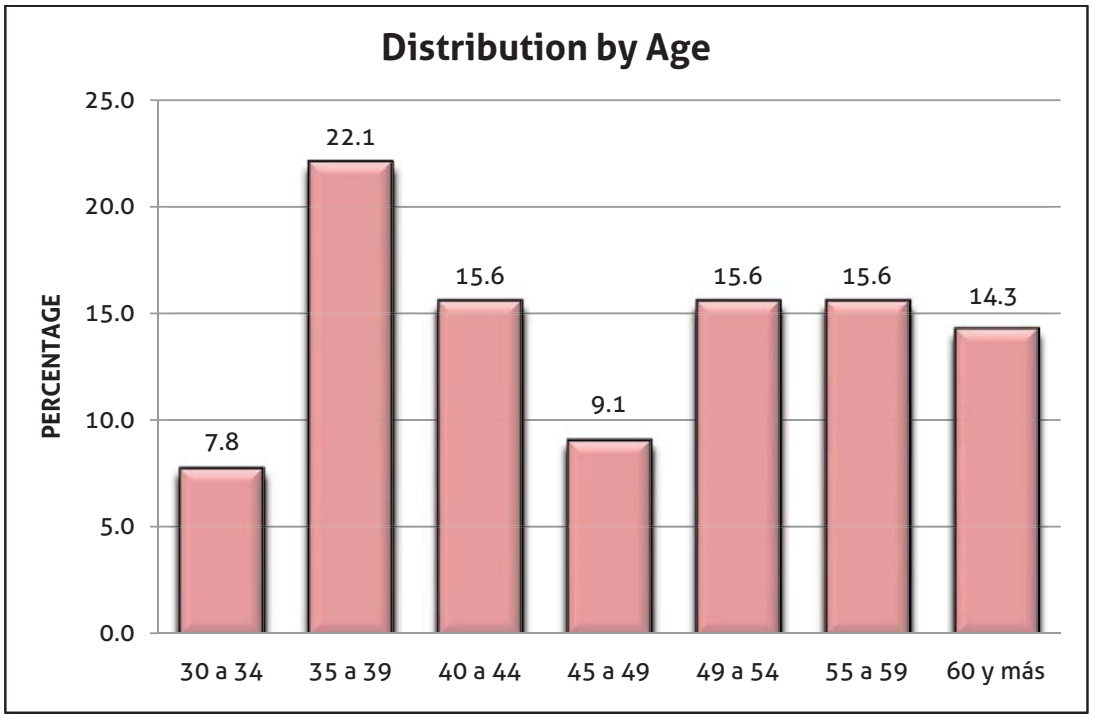


3.4. Survey Results Addressed to Decision-makers.

Characteristics of the organizations. This sample was composed of 42 government agencies, 11 NGOs, 10 cooperation agencies and foreign consulates, 8 universities, and 6 research institutes. Seventy seven interviews were conducted with Decision-makers for these organizations. This sample contained 31.2% females and 68.8% males. Seventy five percent of them had management positions as coordinators, directors, or advisors. Respondents'age was evenly distributed, but there is a slight concentration around 35 to 39 years old. Sixty percent of respondents had graduate degrees as can be seen in Graph 3.4.1.

Graph 3.4.2 shows that fifty five percent of respondents believe that their organizations mission regarding climate change should be fostering understanding and promoting public policy. Around 60% of respondents believe they have a sufficient knowledge on climate change issues as described in Table 3.4.1. Moreover, water and energy are perceived as very important topics within the discussion of climate change, with 84.4% and 51.9% respectively. For 87% (21 women and 46 men) of respondents, climate change affects both genders equally and the remaining 13% (3 women and 7 men) believe that women are most affected by climate change.

Graph 3.4.1



Graph 3.4.2

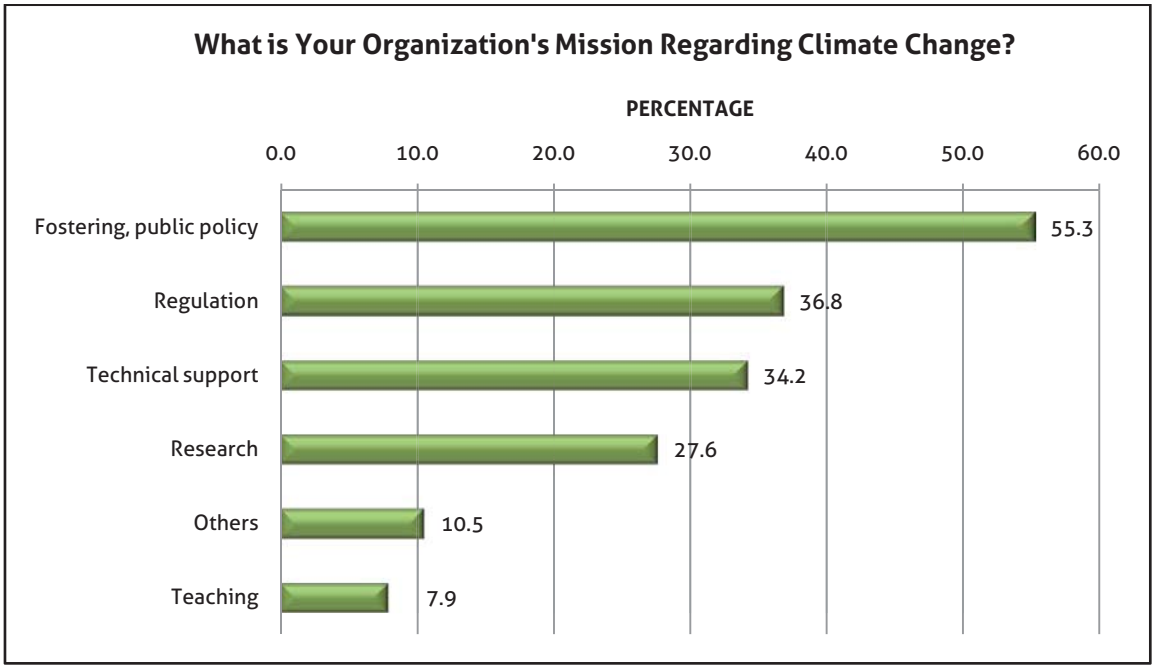


Table 3.4.1 Knowledge of Climate Change Issues

Which one is the level that describes best your knowledge and work on the climatic change and its effects?		
	Frequency	Percentage
I am an expert on the subject	14	18.2
I know enough about the subject	48	62.3
I am learning about the subject	10	13.0
I have a few ideas about the subject	4	5.2
I do not know anything about the climatic change and its effects	1	1.3
Total	77	100.0

Table 3.4.2

Awareness on Climate Change		
	Frequency	Percentage
Strong understanding of the subject and the effects of the carbon footprint on the planet	24	31.2
Weak understanding of certain subjects but awareness of main effects	30	39.0
Vague knowledge about the subject	20	26.0
Skepticism about the theory of climatic change	1	1.3
No understanding of the climate change and the effects on our activity	2	2.6
Total	77	100.0

Behaviors and strategies toward climate change. The survey asked Decision-makers about their experiences in research of climate change; data not shown here say that 40.3% of interviewees answered that their institutions had experience in research with external financing before 2007. Whereas 31.2% indicated that they are projecting new ventures over the next 24 months. However, 11.7% answered that they have not implemented any plans nor will conduct any project regarding climate change in the near future.

Concerning Decision-makers' past experiences in mitigation or adaptation, 36.4% reported to have started actions before 2007, 42.9% reported doing it since 2007, and 11.7% have projected new ventures over the next 24 months. In the field of research networking in climate change, results show that 39% started activities before 2007, 36.4 started after 2007, and 5.2% will execute this activity over the next 24 months. Additionally, 9% of respondents have never implemented or have no plans to take action on this issue.

Concerning virtual collaboration, 39.0% began activities before 2007, 33.8% after 2007, and 9.1% will execute this over the next 24 months. Moreover, 10.4% have never implemented or have plans to take action on this issue. These institutions have collaborated or are planning to collaborate in climate change projects with other organizations promoting interdisciplinary programs and/or external training. Unfortunately, scholarships have not been promoted concerning the topic of climate change; even worse they are planning to reduce them. With regard to climate change knowledge acquisition by these institutions, answers show that before 2007 the main source of knowledge was the Internet and ICTs. After 2007, knowledge acquisition has shifted to interaction with experts. Additionally, projections show that university investment in external knowledge as well as interaction amongst NGOs, the international market, research institutions, and universities is constant.

Organization's contributions. Most organizations stated that their main contribution is the generation of public policies on climate change. This was an unexpected result considering that 63% of respondents were from governmental institutions. In addition many respondents stated that their organizations have made contributions in technical assistance, such as land

management, solid waste management, disaster prevention and risk management, glaciers, water resources management, watershed management, and energy efficiency. Further, interviewees reported to have conducted research on the effects of climate change and finally, interviewees mentioned that they were working actively to bring awareness to the public about the risks of climate change and further, promoting a behavioral change amongst individuals and businesses regarding climate change.

Investments on climate change. Results show that 48.1% of Decision-makers reported that their institutions have assigned a portion of the budget to investment on climate change issues; meanwhile 49.4% declared no budget allocation. Investment on climate change is perceived positively by more than 40% of Decision-makers or they consider their investment being high or very high.

Technology Transfer Centres on Climate Change. Results support the idea that universities must have their own Technology Transfer Centres on Climate Change, 98.7% of consulted Decision-makers supported this idea. It was also mentioned that these Centres will not only be helpful to spread the technological knowledge on climate change, but will also serve to identify and overcome bottlenecks in the relationship between universities, enterprises, and government stakeholders. It will also be useful to create a bridge between reality and the academic world for innovation promotion. The main outcomes desired from Technology Transfer Centres are: capacity building in technical and practical knowledge on climate change, as well as training programs in curriculum development and content programming for universities, public, private organizations and NGOs. Respondents strongly believe that these Centres will be encouraged and supported in order to facilitate technology transfer and to promote innovation.

3.5. General Conclusions and Recommendations

This survey looked for insightful information about the three research objectives of the transnational needs assessment:

1. Almost 60% of surveyed companies established that universities should be the main source for technology for climate change adaptation and mitigation. This is very relevant since Peru is a net importer of all types of technology. It is important to mention that companies showed a positive attitude with regards to mutual cooperation with universities. Traditionally, universities are just providers of qualified workers. This is a turning point and an excellent opportunity to build a bridge between universities and businesses. Interviewees held that climate change is an essential subject and should be taught in all academic areas, especially in engineering (90%) and business administration (60%). Mining and oil companies focused more in TICs (54%), meanwhile agro-industrial companies focused on agronomy (80%).

2. In terms of educational content to be included at universities, companies would like a clear conceptual framework for climate change taught, as companies are aware the various market opportunities such as carbon credit markets, product and process certification, etc. Companies would also like required courses on climate change, environmental conservation, clean development mechanism (CDMs), developing innovations for clean industrial processes, and better management of water and energy.

3. Of note is the interest by university professors to cooperate in projects with companies; however 30% of them find serious difficulties with Technology Transfer Centres and they believe that there is a small chance for obtaining significant outcomes. They also show interest in receiving training and/or information regarding financial opportunities on climate change projects. Professors identified the reuse of water and renewable energy as adaptation climate change topics they should know better. Research and development were mentioned as sensible needs, especially on mitigation climate change topics. This can be interpreted as mitigation is a less known topic than adaptation.

4. Decision-makers are looking for better, more reliable, and impartial information about climate change risks and menaces in order to make better decisions, especially when there are environmental conflicts; they considered it more important even than training for their employees. They urge Lima universities to pay more attention on supporting and helping to solve climate change problems in other regions, such as the Andes and the Amazon jungle, where there is lack of qualified human resources. This group of interviewees stated that Lima universities should support regional governments to produce public investment projects and to organize capacity building seminars and programs with other universities within Peru. Decision-makers also mentioned that universities need to develop their own technology in order to help solve some problems in Peru.

5. An important finding was that 20% of the public sector and/or NGOs have significant financial resources that could cover the costs for training programs on climate change. This finding was endorsed by the former Minister of Environment, Antonio Brack, who disclosed this information during the first public presentation of CELA project meeting, held in December, 2011. He said the Ministry of Environment had a wide line of credit to carry out many climate change projects.

6. Regarding what role the government should play in climate change issues, businessmen sustained that the government should regulate and ensure the compliance of law. The government must also strengthen the Ministry of Environment as well as increase the proportion of investments, especially on research in this topic. People expect the dissemination and discussion of climate change issues from the Ministry of Environment.

7. Concerning interviewees' gender, 20%, 25%, and 33% of companies, universities and public administration respectively, were women. Regardless of gender, almost all interviewees believed that climate change affects both men and women equally. There were a few who sustained that climate change affects women more than men. This situation may exist in rural communities where women must deal directly with food sustainability, may suffer from lack of water and/or contamination by proximity to mining areas and/or oil exploration.

CHAPTER IV

MAIN FINDINGS FROM A COMPARATIVE PERSPECTIVE

MAIN FINDINGS FROM A COMPARATIVE PERSPECTIVE

1. This study is based on the experiences had by the CELA Project, which includes universities in Bolivia, Estonia, Germany, Guatemala, Nicaragua and Perú. Furthermore, this study is focused on network and technology transfer between Latin America and Europe and how the HEIs of these countries might contribute to the sustainable development of Latin America.

2. The theoretical framework, which guided the research, argues that despite climate change adaptation is a priority in many Latin American countries, however, these countries often have neither the technology nor the resources necessary to adapt successfully. However, to cope with the challenges that climate change events present, the role of HEIs were analyzed, especially in the field of research, technical assistance, and the impact of a qualified human capital. Finally, this study introduces a new scheme in the university-industry network in light of government policy scenarios. These conclusions offer some outstanding points that might contribute to create resilience in the Latin American region.

3. Methodologies, sample design, and fieldwork were a combination of quantitative and qualitative approaches which targeted three groups: companies, university staff and Decision-makers in key bodies and programs such as universities, government entities, and NGOs. All countries prepared surveys addressed to these groups, although different methodologies were applied to gather data derived from these structured (some having slight differences) questionnaires. Translation efforts, local influences, and specific needs of each country, also created differences amongst the countries.These differences created limitations for the ability to make generalizations about cross-national survey results.

4. Problems of access affected the validity, reliability, and the capacity to generalize any sample or census. Data quality should constantly be checked in the analysis because biases might distort any statement when there are differences across samples and countries.

5. Deficits in gender were detected in many sub-samples that were analyzed, regardless of country and level of development. Two notable examples include Estonia and Perú. In the Estonian sample addressed to companies 75% men versus 25% of women were represented. In Perú, it was found that in the groups representing university staff and Decision-makers, 30% of respondents were female versus 70% male.

6. This finding justifies a special approach to gender in the subject of climate change, as CELA proposes in its project design.

7. If it is true that there is a consensus that climate change should be a priority, there has been little progress or resources allotted to cope with its impact. A crucial issue,

however, is to reach the needed external and internal convergence and coordination among all stakeholders that could make a difference.

8. This convergence and coordination is becoming a priority for all targeted groups within this study. Moreover, this convergence and coordination has increased since the year 2007, the date when the oil crisis emerged and new ideas about the social responsibility of businesses were disseminated elsewhere, particularly in developing countries.

9. Interviewees were concerned about the impact of climate change on the population and infrastructure and their focus was centered mainly on disasters such as excessive rain or hail, inundations, and change of temperature. Other subjects that were a common concern among the interviewees include lack of knowledge about climate change as well as appropriate and current climate change technology. Furthermore, there was a common desire among interviewees for a greater emphasis on laws and regulations capable of improving current standards.

10. Companies are hesitant, despite the consensus mentioned, about environmental laws and regulations, as they are concerned about costs.

11. Capacity building was also a dimension that was mentioned with a high degree of consensus and it was aimed to enhance the levels of certification through associate degrees, college degrees, master's degrees, and doctorates. Capacity building could improve prevention and control the effects of climate change.

12. University Staff expressed the need of capacity building and qualification and infrastructure construction such as laboratories endowed with instruments, materials and equipment, systematically fed by adequate administration and funds at the universities.

13. The degree of awareness within the stakeholders varies depending on experience. The clearest case is Guatemala. Here agricultural enterprises present a greater awareness about the threat of climate change, particularly disasters, while industries see these threats with less urgency. In general, companies in Estonia and Germany that belong to more industrialized countries tend to feel less threatened by these kinds of dangers than Bolivia, Guatemala, Perú and Nicaragua.

14. Low educational levels prevail more in the agricultural sector than in industrial sector. And there are lower educational levels in developing countries versus developed countries. This creates a limitation for the introduction of new technologies, innovation, and the creation of better regulation.

15. In addition, it is possible to find a higher level of acknowledgment for social responsibility within the industrial sector and in developed countries than in the agricultural sector or in the majority of developing countries.

16. Priorities differ depending on the entity involved. Companies set their priorities around the chain of production; university staff according to research and teaching activities; and Decision-makers mainly around national problems. However, there are limitations. For example, Decision-makers mention that they are guided by strategic plans elaborated

by universities, government, and NGOs, but they face serious problems in adoption, implementation and evaluation. In addition, university Decision-makers acknowledge that they hardly have anything budgeted for these goals. Budget limitations are a common problem and concern in every country and sector. Therefore, this aspect will need a lot of effort before climate change is adopted as a priority.

17. The future impact of climate change varied according to the nature and experience of the stakeholder groups. Some agricultural firms were very specific about the changes they consider necessary for the development of new technologies. To note, however, that few samples considered breakdowns by this sector. This group suggests the development of new technologies and control methods to combat plagues and diseases in sowing and crop programs. Further, changes that could alter planting and harvesting crops during different seasons, moving crops to different altitudes, and the introduction of new irrigation systems with a better and more efficient use of water were also suggestions.

18. Interviewees belonging to industry expressed their concern with regard to interruptions in the supply and distribution chains. The ability to keep operational the available infrastructure is crucial to avoid interruption. Nevertheless, industry is more resilient and adapt better to climatic problems. The industrial sector also has suggestions in how to cope with future threats of climate change. Technologies that increase capacity, construction of green buildings, the development and establishment of clean development mechanisms (CDMs), access to carbon markets, technologies for the reduction of greenhouse gas emissions, risks management and improvements in energy efficiency, were some to name a few.

19. In all sectors and countries, a concern for water management was paramount but while the agricultural sector put emphasis on irrigation problems, industries highlighted the importance of an efficient use of water and the preservation of its water sources.

20. Decision-makers at universities had a wider vision, but were still limited in their ability to project themselves and the HEIs and have an impact, as they belong into society at large. For example, this group places little emphasis in examining or proposing laws and regulations for the country. On the other hand, Decision-makers in the public sector and NGOs, are concerned about their country as a whole. On the contrary, companies as well as universities were more concerned about their own organizations. This difference can be explained by the thought that government and NGOs usually have sites all over the country and deal to a larger extent with public and citizen concerns more related to the common good.

21. Data was very clear, however, that in each country studied, activities in all areas intensified after 2007, when the oil crisis emerged.

22. Decision-makers belonging to the public sector and NGOs have similarities. Both groups focus on problems related to the public. This explains the frequent association between state entities that finance programs to be implemented by NGOS. This alliance runs the risk of transparency issues, by mixing public and private interests.

23. It was also found that there is a generalized openness to capacity building.

24. According to the opinions expressed by their directors, businesses in general find that their employees had an insufficient awareness of the risks and problems that climate change brings. They ask for a greater effort in capacity building around methods oriented toward reducing risks and vulnerabilities. Further, directors stated that logistics management must be improved in order to limit possible interruptions inflicted by climatic change to the supply and distribution chains. All these suggestions imply a need to raise the qualifications of present human resources. One way to do so is by way of e-learning and informal education methodologies.

25. The survey made by Bolivia to students, included in this study, highlights the importance of the role the Internet plays in the dissemination of knowledge.

26. Reform is suggested for HEIs' curricula to include the subject of climate change. Engineering for example should pay greater attention to risk analysis, contingency plans, clean technology, efficient use and recycling of water energy, and "green building" design. Agronomy should engage in the development of new crops and varieties with greater resiliency to droughts and diseases. These innovations should be accompanied by contents related to crops adaptation, reforestation and irrigation technologies. As for economics and business administration, changes should go in the same direction of engineering. With regard to information technology and communication, subjects suggested include data protection systems and early alert systems. Finally, human sciences should include early alert systems, improvement of social organization, and risk planning.

27. Centres for Research and Technology Transfer on Climate Change seem to enjoy a great consensus.

28. This study gives definite suggestions about the role and scope of these Centres. According to respondents:

    a) Joint research ventures creating collaboration among the business, university, public, and NGO sectors;

    b) Strategic alliances with common objectives that could build real networks in fields of common interest;

    c) Internships that could place students in practical jobs capable of giving them professional experience;

    d) Stimulus to systems by which students with teachers' supervision develop their thesis and course practices, in all interested entities that ask and develop activities related to university workload;

    e) Strengthening the role of the universities in offering expertise and technical services in order to help businesses, government, other universities, and NGOs;

f) Concerted efforts to develop patents on the basis of research done by participating organizations active in the network;

The above demonstrates that through the survey findings a system should be built that could put all the issues raised into a short, medium, and long time framework with responsibilities assigned to all involved stakeholders. This system will seek collaboration of all key sectors: mainly universities, private, public, and NGO sectors. An additional step is to link local, regional and national goals. This system might constitute the basis for the precise identification of strengths, opportunities, weaknesses, and threats to share a strategic plan derived from the logical framework of the Project. These outcomes, if accomplished properly, might orient all activities of the system constituted by key actors in specific time periods.

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Climate Change is a concern for all countries; however, for Latin America, the impact of climate change is especially acute as the population is vulnerable to a decrease in their qualify of life. Due to this fact, the CELA (Network of Climate Change Technology Transfer Centre in Europe and Latin America Project) was initiated in order to look at these issues and foster greater cooperation between countries in Latin America and Europe. CELA is being undertaken as part of the ALFA III Programme of the European Commission and involves countries from both Latin America (Bolivia, Guatemala, Nicaragua and Peru) and Europe (Germany and Estonia).

This report presents the results of a transnational survey, which was coordinated by Galileo University on behalf of the project partnership. Its results show that while there is a great potential for the inclusion and dissemination of matters related to climate change in curriculum as well as in the research and extension activities undertaken by Latin American and European universities, much of this potential remains dormant. It also points out the need for action at the institutional level and the relevance of international cooperation in order to reverse this trend.

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Summer 2012

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Guatemala, C. A.

ALFA
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Impreso por:
Kamar