



Enhancing Scientific Cooperation between the European Union and Central America

Fortaleciendo la cooperación científica entre la Unión Europea y América Central



"Towards a Caribbean & Central American Knowledge Based Bio-Economy: Visions, Pathways and Priorities"

Setting up the S&T dialogue through a continuous exchange of knowledge and flow of information (proceedings)



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1. EXECUTIVE SUMMARY

The report presents a first approach to the discussion of a Bio Economy program for the Central American Region. The general characteristics of the region are presented in the first part of this report, stressing the similarities and the deep differences among the seven countries considered. For some of the variables examined, a clear grouping of the two “southern” countries, Panamá and Costa Rica, and the “northern” group comprising Guatemala, El Salvador, Honduras and Nicaragua is perceived. Belize is a special case, because of its small population. It is to some extent associated with the “northern” countries and in other cases associated the “southern” countries. A SWOT analysis among some of the ENLACE partners in order to obtain not only their points of view but we asked them to work in a small discussion groups in their own countries is also included.

The consensus reached in the Dominican Republic Dialogue, has set the basis for further discussing the topics identified as potential themes of mutual interest during the first ENLACE-ECUARINET dialogue workshop on April 2010: 1) Research on biodiversity to “optimize ecological services”, 2) Use of microorganisms, for food and non-food use, 3) Food and food chain related issues, 4) Optimization of the use of biomass for energy and industrial uses.

These four areas are discussed in a general framework of transversal issues in the second part of this report: 1) Capacity building, 2) Humans resources and mobility of researchers, 3) Weaknesses in the relationship between academy and industry, 4) Access to knowledge through regional models and databases, 5) Knowledge exchange among EU and CAC countries.¹ They give account of the dialogue discussions taken place between Central American experts in Brussels, Belgium the 17th and 18th October 2012. A set of conclusions and recommendations stemming from this dialogue are presented in the last part of the report.

¹ The original formulation talked about “knowledge transfer from EU to CAC countries”. The discussion groups agreed that the pertinent action is of knowledge exchange, recognizing that there is knowledge on both sides that should be shared.



2. CONTEXT

In the last ten years, several joint initiatives from the European Union (EU) and the Latin American and Caribbean (LAC) region have been launched. The proposal of an “EU-Latin American & Caribbean (LAC) Knowledge Area,” was first mentioned in the Guadalajara Declaration of 2004. A key initiative in support of the building of an EU-LAC Knowledge Area has been the ALCUE Common Area in Higher Education LAC-EU, an initiative of the LAC countries and the EU to create an environment of interaction and bilateral and multilateral cooperation of the regions' systems of higher education. The issue of the EU-LAC knowledge area was further addressed in the EU-LAC Summit in Madrid in 2010. In this meeting, Innovation and technology for sustainable development and social inclusion was proposed as a central theme, and a new “Joint Initiative for Research and Innovation (JIRI)” for the LAC region has been developed. Broad thematic priority areas of EU-LAC S&T collaboration have been identified and bi-regional working groups have been established accordingly:

1. Biodiversity and climate change.
2. Bio-economy, including food security.
3. Energy.
4. ICT for meeting societal challenges.
5. Horizontal activities on S&T policy with emphasis on human and institutional capacity building.

2.1. The EU-LAC bio-economy: global challenges, regional bio-economies

In addition, the European Commission announced a strategy for a sustainable bio-economy to ensure smart green growth in Europe. The strategy and action plan were called “Innovating for Sustainable Growth: a Bio economy for Europe”. The plan focuses on three key aspects: developing new technologies and processes for the bio-economy; developing markets and competitiveness in bio-economy sectors; and pushing policymakers and stakeholders to work more closely together.²

As the challenges driving the BE (food security and climate change) are global, its development should be based on a global view. The European Commission and the European Technology Platforms organized in 2010-2011 several conferences on the concept of bio-economy.

“The result of these activities appears in the Commission’s February 2012 communication entitled «innovating for Sustainable Growth: a Bio economy for Europe».”³ In this communication, the Bioeconomy Action Plan rests on three main pillars:

- a. - Investments in research, innovation and skills aimed at ensuring substantial EU and national funding.
- b. - Reinforced policy interaction and stakeholder’s engagement.
- c. - Enhancement of markets and competitiveness in bio-economy sectors by a sustainable intensification of primary production, a cascading use of biomass and waste streams as well as mutual learning mechanisms for improved resource efficiency.

Regardless all these initiatives, the BE understanding, relevance and strategic implications remain quite different depending on regional perspectives. There have been ample discussions on the bio-

2 Schmid, O. Padel, S. and Levidow, L. (2012) The Bio-Economy Concept and Knowledge Base in a Public Goods and Farmer Perspective. *Bio-based and Applied Economics* 1(1): 47-63

3 Schmid et al. (2012) Op. cit, p. 49.



economy concept. According to Schmidt et al., there are basically two main views: the industrial perspective and the public goods perspective, each promoting different features for agricultural systems and farmers' roles.⁴

The ENLACE Second Bi-regional Dialogue held in the "Universidad Iberoamericana" (UNIBE), in Santo Domingo, Dominican Republic on 7 and 8, March, 2011, states that "The term "bio-economy" includes all industries and economic sectors that produce, manage and otherwise exploit biological resources (e.g. agriculture, food, forestry, fisheries and other bio-based industries)"⁵

The FP7 ALCUE-KBBE project was conceived as a process directed to help the Latin American Countries of the LAC region to develop their perspective/vision objectives and challenges for realizing their bio economy based on their comparative advantages.

Central American countries should take part on this process by identifying their proper visions, objectives and challenges for their BE economy as part of the larger LAC BE concept. Institutional setting, policy and research agendas should be defined and implemented to move in the development of a Central American bio-economy.

The ENLACE project, aiming at enhancing the EU-Central America dialogue, wishes to build on these initiatives and contribute to the JIRI by identifying and envisioning the BE pathways for Central America. This has to come from an analysis of the BE current situation and potential at large for the Central American region is necessary.

4 Schmid et al. (2012) Op. cit,

5 CSUCA (2011): Proceedings of the CA S&T expert dialogue events, ENLACE-D2.5 v1.3, June 26, 2011.



3. BACKGROUND

The report on the State of the Region⁶ gives every three years a broad and comprehensive view of the Central American Region, covering issues from demography, social equity, economics, environment, politics, regional integration and climatic change. The fourth report, covering the 2008-2011 trienniums, highlights the convergence of three strategic risks to which it devotes special attention because of its importance for the future of Central America.

The first risk identified is institutional: there is a kind of state, present in several countries in the region, particularly hostile to democracy. Those States are characterized by having small institutional apparatuses, precarious institutional networks, dominant Executives without political counterbalances, elusive transparency and policies penetrated by special interests. This configuration converges with an acute infrastructural weakness: a reduced tax basis which prevents the basic tutelage for human rights -such as the right to life- and a meagre base of financial and human resources, which makes difficult the State's presence in the territories of the countries. These states, small and weak, are not only unable to leverage democracy, but from inside undermine and limit their ability to anticipate and respond to the problems that beset their development.

The second risk is linked to climate change. Even the most optimistic experts, with contrasts between sub regions and countries, said the Isthmus has to live with rising temperatures and increased frequency and intensity of weather phenomena, a situation that will exacerbate the problems that already experience the region. These new conditions, combined with the social vulnerability and the expansion of the "ecological footprint", become risk triggers for infrastructure, production and the survival of the species and persons in particularly those living in fragile ecosystems. That is why environmental management, mainly in the areas of adaptation and mitigation, is considered a top priority. While there is greater regional political deliberation on the subject, a common position in the global context, as well as strategies, plans and policy and institutional adjustments, much remains to be done to achieve effective risk management.

The third risk relates to the political blockade that prevents combat of social exclusion. The report states that over a third of Central Americans live in social exclusion, having precarious employment and deprived from social programs. This problem is more pronounced in the central and northern countries of the Isthmus, which also have strong barriers to the implementation of public policies to -reduce this problem. By interacting with other variables such as high social violence, weak institutions, the demographic transition and the development style, these blockages threaten the future stability of the region.⁷

The Fourth Report on the State of the Region considers that "Central America, after going through a very difficult period from 2008 to 2010, faces internal threats and other derived from its geopolitical situation. These ask for a clear change of route: more of the same would lead to more complex situations. There is time, capacities and vision to do something different. In essence, there is room for regional and local policies. In view of the analysis presented in this report, a sustained advancement in the levels of human development, requires a combination of national tasks, as the strengthening of institutional capacities of the States and the removal of political blockages to overcome social problems on the one side, and enabling mechanisms that favour a joint action of the different countries, on the other. In the national realm, long term and inclusive agreement could lead the way to reducing social exclusion. In the regional realm, it is necessary to identify and take

6 Programa Estado de la Nación (2011) Cuarto informe del Estado de la Región. San José, Costa Rica.

7 Programa Estado de la Nación (2011) Cuarto informe del Estado de la Región. Capítulo 1, Sinopsis. San José, Costa Rica, pg. 362



advantage of available opportunities of inter-State collective action. There are at least three areas of opportunity to articulate efforts: reversion of the insecurity climate prevailing in the region, risk management and climatic change, and building a common logistics and infrastructure platform that fosters regional interconnection.”⁸

Most of these issues define the context of the KBBE actions that we propose, and that we should discuss to agree on common action fostering the development of the region through the establishment of a solid Bio-Economy initiative.

3.1. The region

In the following section we present a series of data and analysis that provide an adequate framework for the discussion of the strategies for a KBBE initiative in the Central American region. The analysis involves basic demographic, economic and social development data. We also included more detailed analysis of issues related to human resources, biodiversity and marine resources, because of their central character for the regional proposal.

3.1.1. Demography

Table 1: Basic demographic data, 2010

Country	Total population 1000 inhabitants	Gender ratio Men per 100 women	%	Years	Births for 1000 inhabitants
Belize	303	99,9	51,9	76,2	23,0
Costa Rica	4.564	102,9	59,0	79,1	16,3
El Salvador	6.183	89,8	63,2	72,2	21,2
Guatemala	14.362	95,2	40,8	70,2	30,5
Honduras	8.046	97,2	50,8	73,6	27,8
Nicaragua	5.816	98,1	57,0	72,9	23,2
Panamá	3.504	101,6	64,4	76,0	19,1

Source: Cuarto Informe del Estado de la Región

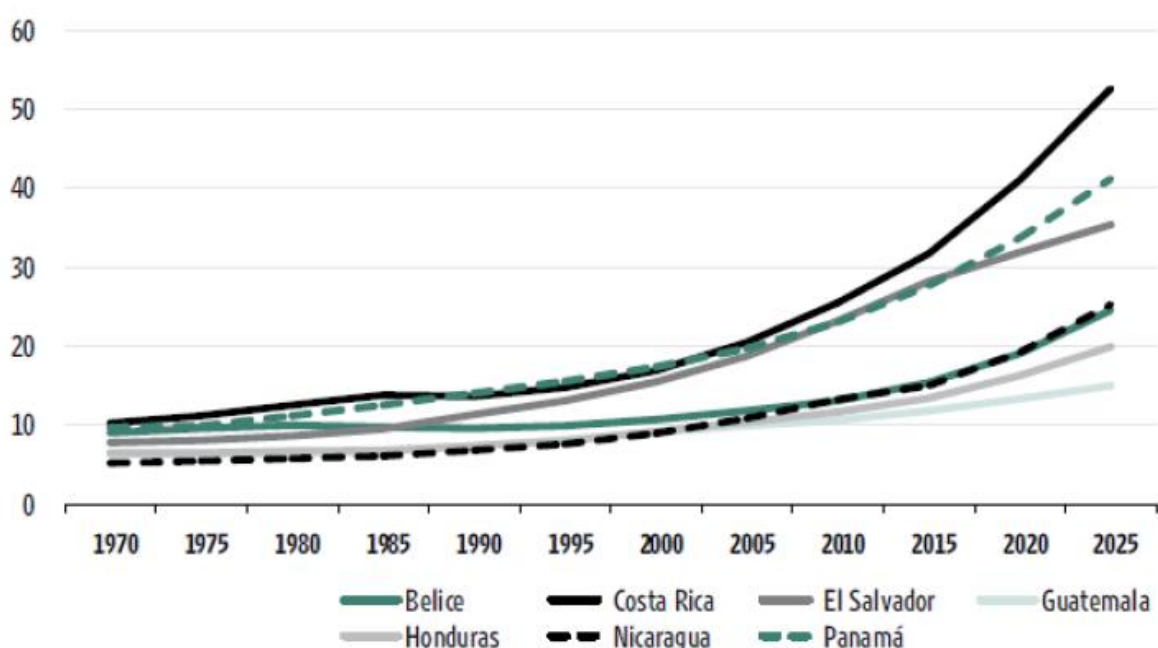
The ratio of population sizes is 47 times between Guatemala, the most populated country and Belize, the least. But other differences are also striking: most countries, except Guatemala, are mostly urban, with extreme values in Panamá and El Salvador. Life expectancy at birth shows important differences, with Costa Rica having the longest. Birth rate is another variable with extreme values, very high for Guatemala, and low for Costa Rica and Panamá. During the last sixty years, life expectancy increased in all countries but with different rates. In the 2000’s differences widened

⁸ *ibid*, pgs 362-363

considerably: El Salvador, Guatemala and Honduras have a life expectancy rate similar to what Costa Rica had thirty years ago.

A major concern for three countries in the region is the very rapid ageing of their populations. The population over 65 is the fastest growing in the region. It is expected that population will increase at an average rate of nearly 20% every five years in all countries except El Salvador and Belize during the period 1970-2025. In 2025, Costa Rica and Panama will have more than forty elderly inhabitants per each hundred under 15. From the data in Table 1, it is clearly the product of an elevated life expectancy and a low birth ratio. This is a major concern for Costa Rica, as it will have a big impact on available workforce and cost of the health system.

Figure 1: Ageing index (persons >65 years per 100 persons <15 years,) 1970-2025



Source: Cuarto Informe del Estado de la Región, Capítulo 1, (2011)

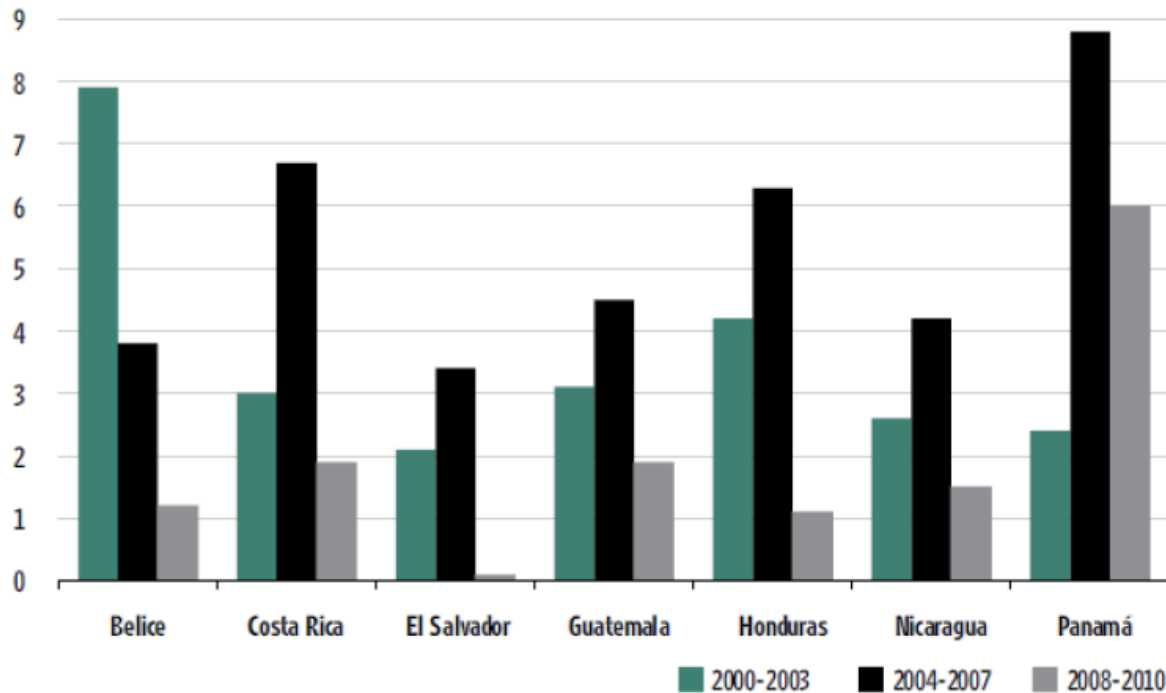
3.1.2. The economics of the region

Table 2: Gross national product 2010

Country	GNP real GNP real Millions of 2000 US\$	GNP nominal Millions of US\$	GNP real per capita US\$ per inhabitant	Growth GNP real %	Growth GNP per capita %
Belize	1.212	1.383	3.995	2,0	12,0
Costa Rica	24.203	34.346	5.304	4,0	2,8
El Salvador	15.970	21.512	2.583	1,0	0,5
Guatemala	23.792	40.624	1.657	2,5	0,0
Honduras	10.685	15.361	1.328	2,5	0,3
Nicaragua	5.151	6.433	886	3,0	1,7
Panamá	21.090	26.473	6.018	6,3	4,7

Source: Cuarto Informe del Estado de la Región (2011)

Figure 2: Average growth of GNP (real) 2000-2010 (percentages)



Source: Cuarto Informe del Estado de la Región, Capítulo 1, (2011)

In 2009, the crisis had a very important economic impact in the region, where all Central American economies contracted, except Panamá (3.2%) and Guatemala (0.6%). The internal demand in both countries helped them to minimize the effects of the economic crisis. In fact, Panama invested in the Canal as a counterweight measure.

El Salvador's economy was the most affected by the crisis (-3.5%), both in breadth and depth. The country entered the recession earlier than other nations and remained in that condition for longer. In 2010 there were signs of recovery, as all the economies of the region showed a moderate growth. Between 2004 and 2007 the growth rate of the region exceeded by about 50% the average for the decade. However, the international economic downturn (2008-2009) led to production fell by 0.5% regionally. The determinants of economic boom were also factors of transmission of the crisis. In 2008 and 2009, private capital flows fell by 21.4%, remittances 2.4% and exports of goods by 1.5%, while tourism did not grow (just increased 0.3%). In years 2004-2007 fiscal imbalances in the region decreased by an amount equal to 2.8% of GDP. The crisis reversed this result: the fiscal deficit increased by 2.8% of GDP in 2008 and 2009. Almost half (49%) of the increase recorded in 2009 was due to a higher public spending.⁹

⁹ Programa Estado de la Nación (2011) Cuarto informe del Estado de la Región. San José, Costa Rica, chapters 1 and 4.

3.1.3. Poverty issues

Although poverty increased during the 2008-2009 economic crises in nearly all the countries (poverty had diminished in the 2003-2007 period), this phenomenon was most notable in the three largest countries (Guatemala, Honduras, Nicaragua), home to two of every three Central Americans. Comparatively speaking, while in Latin America one-third of the population lives in poverty, in Central America one in every two inhabitants is poor. Costa Rica and Panama are the only Central American countries where poverty is below the Latin American average.

The inequalities affecting the region are also reflected inside the countries. This is evident in the gaps between rural and urban areas, between different social classes and groups, but it mostly affects women, young people, indigenous communities, and Afro-descendant groups, as well as persons with some form of disability. Poverty affects indigenous peoples more than any other group; in Panama this problem is acute, since nine out of ten indigenous rural inhabitants live in poverty, while in Guatemala, for every poor non-indigenous person there are two poor indigenous people. In synthesis, in the balance of social equity, Central America continues to be a region with elevated levels of poverty and inequality, but they are not immovable.¹⁰

Table 3: Incidence of poverty

Year Estimates from	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
income (% of households)											
<u>Costa Rica</u>											
General Poverty	20.6	20.3	20.6	18.5	21.7	21.2	20.2	16.7	17.7	18.5	21.3
Extreme Poverty	6.1	5.9	5.7	5.1	5.6	5.6	5.3	3.3	3.5	4.2	6.0
<u>El Salvador</u>											
General Poverty	38.5	38.8	36.8	36.1	34.6	35.2	30.7	34.6	40.0	37.8	
Extreme Poverty	16.0	16.1	15.8	14.4	12.6	12.3	9.6	10.8	12.4	12.0	
<u>Honduras</u>											
General Poverty		63.7	64.8	65.3	64.6	63.7	59.9	58.2	59.2	58.8	60.0
Extreme Poverty		44.2	45.6	46.7	46.2	46.0	40.4	37.5	36.2	36.4	39.1
Estimates from Consumption (% of population)											

¹⁰ Programa Estado de la Nación (2011) Cuarto informe del Estado de la Región. San José, Costa Rica.



<u>Guatemala</u>			
General Poverty	56.2		51.0
Extreme Poverty	15.7		15.2
<u>Nicaragua</u>			
General Poverty	45.8	48.3	42.5 ^a
Extreme Poverty	15.1	17.2	14.6 ^a
<u>Panamá</u>			
General Poverty		36.8	32.7
Extreme Poverty		16.6	14.4

a/ Preliminary figures Source: Cuarto Informe del Estado de la Región (2011)

Inequality in income distribution in Central America is high, although in recent years have been reductions in El Salvador and Panama. Measuring income inequity through the Gini Coefficient (Table 4), all countries are near or above 0.500, an internationally accepted limit of inequality. Three countries in the region (Panama, El Salvador and Nicaragua) experienced significant reductions in inequality of income. In them the Gini coefficient diminished during the last decade and fell significantly. In Guatemala and Honduras, countries most unequal in the Isthmus (and between most unequal in Latin America), no progress was made.¹¹

Table 4: Income inequity

Country and Year	Gini Coefficient
Costa Rica	
2002	0.488
2006	0.482
2008	0.473
2009	0.501
El Salvador	
2001	0.525
2004	0.493
2009	0.478
Guatemala	

¹¹ Programa Estado de la Nación (2011) Cuarto informe del Estado de la Región. San José, Costa Rica, chapter 3.

2002	0.542
2006	0.585
Honduras	
2002	0.588
2006	0.605
2007	0.580
Nicaragua	
2001	0.579
2005	0.532
Panamá	
2002	0.567
2006	0.540
2008	0.524
2009	0.523

Source: Cuarto Informe del Estado de la Región, Chapter 3 (2011)

3.1.4. Human development

The human development index presented in Table 5, shows the two Central Americas discussed above, the southern countries, Panama and Costa Rica with high human development and the Northern countries, Guatemala, El Salvador, Honduras and Nicaragua, with medium human development.

Table 5: Human Development Index (HDI) and relative Positions (2010)

Country	HDI	Relative position
Belize	0.694	78 (High)
Costa Rica	0.725	62 (High)
El Salvador	0.659	90 (Medium)
Guatemala	0.560	116 (Medium)
Honduras	0.604	106 (Medium)
Nicaragua	0.565	115 (Medium)
Panamá	0.755	54 (High)

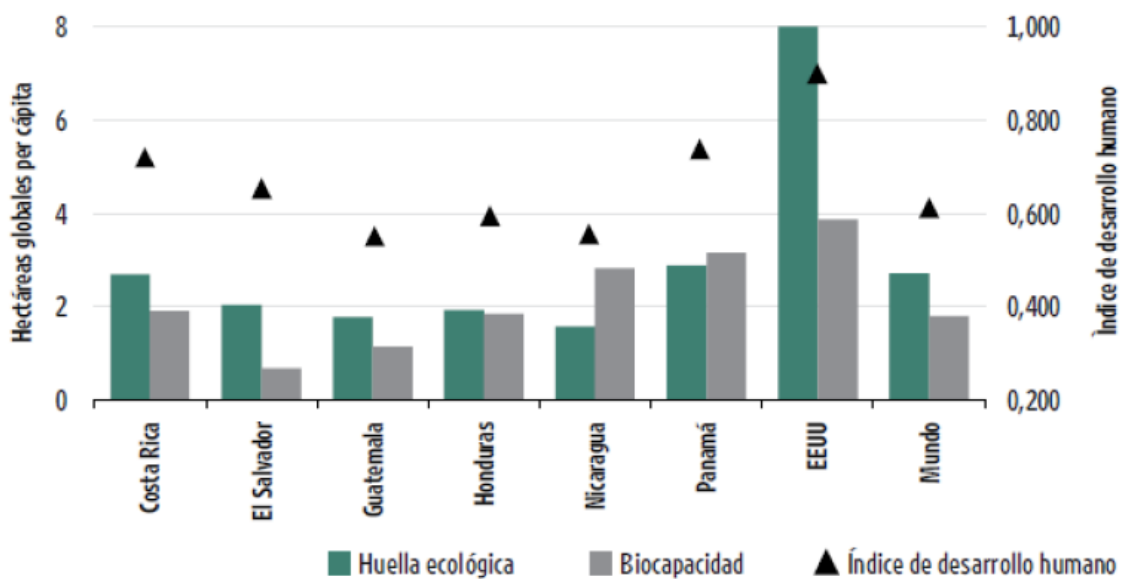
Source: Cuarto Informe del Estado de la Región, Chapter 3 (2011)

3.1.5. Environmental issues

In the last decade regional initiatives in various fields of environmental management were launched: fisheries and aquaculture, agro-environment and health agenda, an agricultural policy, forest ecosystem management, environmental sustainability, biodiversity, prevention and control of pollution and climate change, among others.

Central America has a negative ecological footprint: each person requires 10% more land they have available to meet their consumption. The higher the human development index (HDI) in Central American countries, the greater its ecological footprint. This shows that development has not incorporated sustainable patterns of land use.

Figure 3: Ecological footprint, Bio-capacity and Human Development Index (2007).

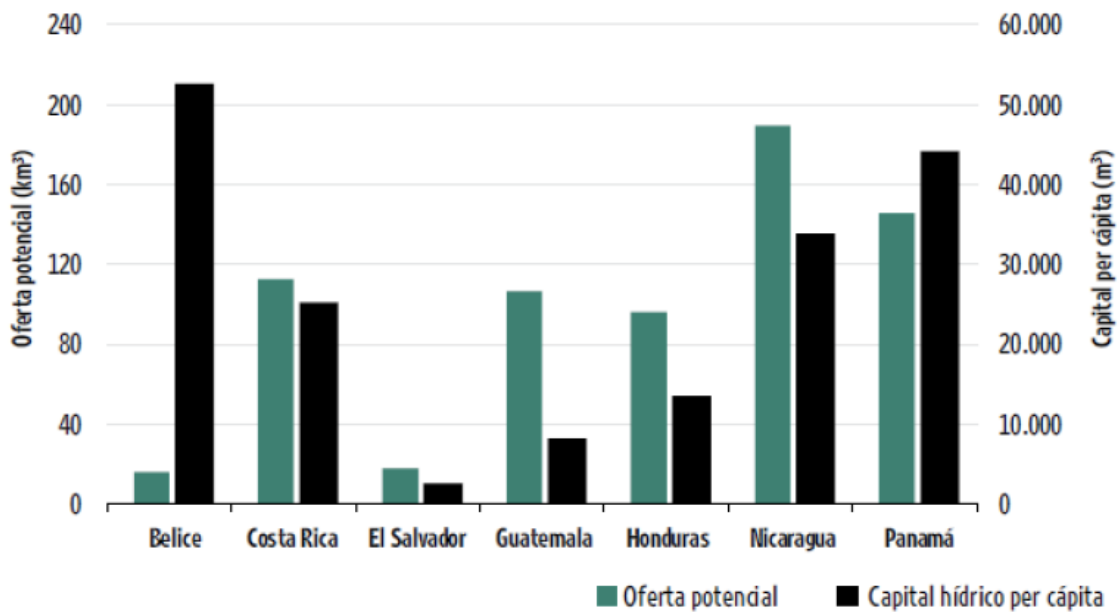


Source: Cuarto Informe del Estado de la Región, Capítulo 5, (2011)

Water availability is a major regional issue. Service coverage of drinking water increased from 86.7% in 2000 to 91.6% in 2008; in rural areas this percentage is lower (80%) and still about 4.5 billion people lack access to this liquid. Hydric potential and Hydric Capital is critical for El Salvador.

An important consideration, stressing the need for regional cooperation and policies is that 35% of regional territory is in shared basins. Border protected areas have been identified, representing 48% of the areas under conservation or management in the Isthmus.

Figure 4: Hydric potential and hydric capital (per capita)

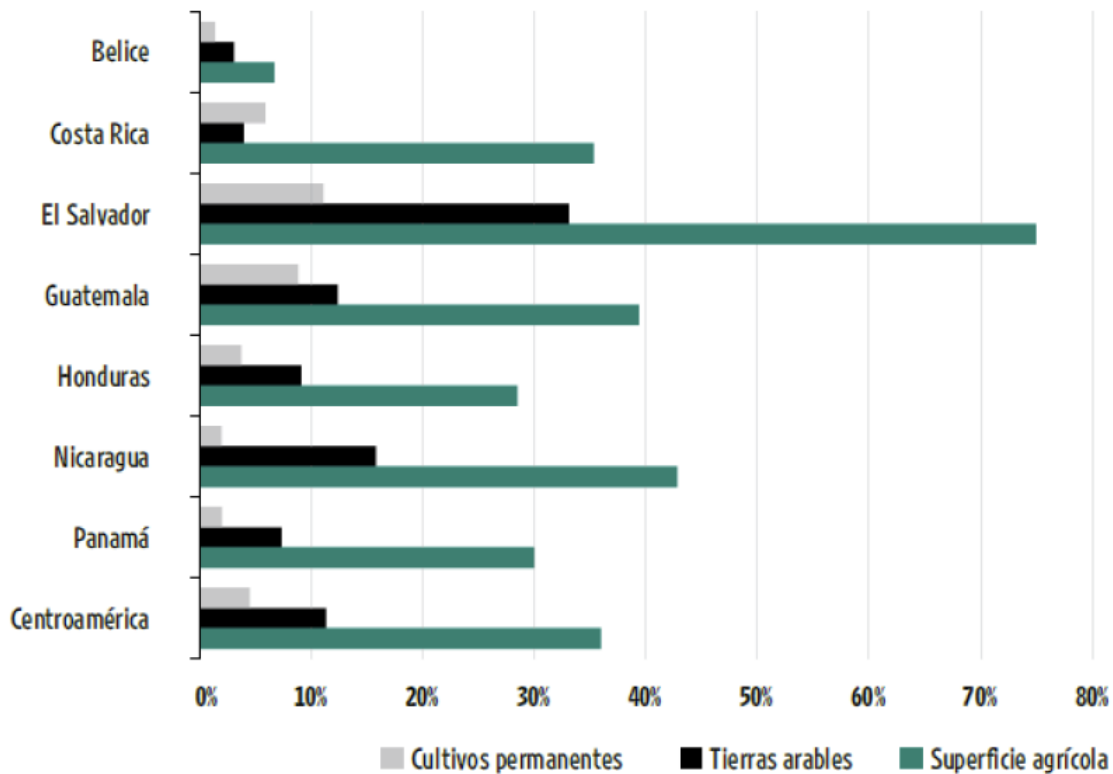


Source: Cuarto Informe del Estado de la Región, Chapter 5, (2011)

Between 2005 and 2008, there was a decrease of 7.4% of the agricultural area of the region. An estimated 14% of the Central America territory is used for marine exploitations; about 25 conflicts are reported regarding this activity.

Between 2005 and 2010 the wooded area was reduced in 1.246.000 hectares. This loss trend; however, was reduced; between 1990 and 2000 the rate was -1.6%, and between 2000 and 2010 was -1.2%.

Figure 5: Agricultural land as a percentage of total land. (2008)



Source: Cuarto Estado de la Región, Capítulo 5, (2011)

3.1.6. Fishing and aquaculture

As noted by Fargier (2012), “artisanal fisheries in Developing Countries Tropical coastal employ the majority of fishermen worldwide. It therefore has a considerable socio-economic importance. The dynamics and structure of these fisheries are mainly determined by their human component. This feature justifies the integration on the one hand, the social sciences to the study of the artisanal fisheries and on the other hand, stakeholders, and primarily fishermen to manage their fisheries, including through process of co-management for sustainable marine renewable natural resources.”¹²

The Central America's Pacific at the level of Costa Rica and Panama is among the most complex region of the isthmus. It has its own variable stream regime during the year with the presence of a seasonal upwelling. It also shows an assembly of diverse habitats: sandy-muddy coasts, rocks, coral reefs, mangroves, estuaries, and coastal islands. This is also the area that presents in the Eastern Pacific, the highest species richness, and certainly the most productive sea area of Central America.

Artisanal fisheries in Central America are complex and difficult to define; their characteristics vary by country. Although it appears that the landings of the artisanal fisheries are more important than industrial fishing (except Panama), these values should be taken with caution because of the blurred distinction between these two types of fishing in the region. Bean fishing the “last frontier” for the rural unemployed, the number of fishermen has been growing for thirty years. Thus this area,

¹² Fargier, L. (2012) Doctoral dissertation. La participation des pêcheurs artisanaux à la gestion des activités halieutiques artisanales tropicales. Etude de cas dans le Golfo Dulce, Costa Rica. Université de la Rochelle, France.

concentrated on the Pacific coast, takes on considerable socio-economic importance in the region. Marginalized sector organizes itself around since the 1980s, cooperatives, associations and federations.

Table 6 presents a broad view of fisheries and aquaculture in Central America. Fisheries and aquaculture activities show large differences depending on the source: in the Pacific there is a more productive fishing than on the Caribbean coast. In the Pacific fishing focuses mainly on shrimp, shark, shallow water estuarine species (snapper, sea bass, grouper, smooth, *Scombridae*, herring and shellfish). In the Atlantic, fishing focuses in lobster, shrimp and other species of local importance. The main aquatic resources are: in Costa Rica, Belize and El Salvador, tuna fishing flake and cultures of tilapia and shrimp, in Guatemala, tuna, shrimp farming and tilapia, inland fisheries, fishing flake and shrimp catch; in Panama, anchovy, herring, shrimp, scale fishing, tuna and culture shrimp, in Nicaragua, culture scale shrimp fishing, shrimp and lobster, and Honduras, shrimp and tilapia farming, fishing lobster, shrimp, fish flake and snails. Although of not significant tonnages: sea cucumber, sea shells, shellfish and crabs.

Based on an evaluation with incomplete and limited financial, technical and human resources, State fisheries management is ineffective or even counterproductive. To remedy this problem, user participation in management through fisheries co-management has been developed since the 1990s in different countries of the region and in various ways. Costa Rica being one of the countries where civil participation in environmental management is not representative comparatively with other CA countries appears to be much more interested to study the modalities of participation of artisanal fishermen in the management of their fisheries in Costa Rica.¹³

Fargier (2012) analyses the main threats on coastal marine resources of Central America: both to habitats and populations. In the tropics, habitat loss is the most significant in terms of productivity, biodiversity and ecosystem functions, and concerns mainly coral reefs and mangroves. Concerning menaces to populations, shrimp fisheries in shallow tropical waters are among the fisheries producing the most waste, often composed of a large diversity of species of juvenile fish.

These individuals are often caught and released to the target species of artisanal fisheries operating in the same areas and may therefore, be subject to conflicts.¹⁴

Fishing and aquaculture are important economic activities in the region. Five of the 7 countries of the region have access to two oceans (Atlantic and Pacific). Nevertheless, traditional artisanal fishing is linked to low-income groups, and to subsistence economic activity. Panama Costa Rica and El Salvador are the countries with highest level of fishing production; Panamá alone represented 70% of total fishing production in 2007. El Salvador has shown a marked increase in both activities between 2000 and 2007 (See Table 7).

¹³ Fargier, L. (2012) Op. cit.

¹⁴ Fargier, L. (2012) Op. cit.



Table 6: Basic information on fisheries and aquaculture in Central America

Item	1995	2009	% Change 1995-2009
Artisanal Fishing ^a			
Number of fishermen	92.876	140.920	51,7
Number of artisanal vessels	38.743	62.513	61,4
Artisanal production (in metric tons per year)	162.659	179.893	10,6
Production value (in dollars per year)	179.400.000	620.630.850 ^b	245,9
Industrial fishing			
Number of industrial vessels	985	1.020	3,6
Production volume	158.129	239.367 ^c	51,4
Production value	281.400.000	478.734.000	70,1
Aquaculture			
Hectares of crops	28.275	65.000 ^c	129,9
Volume of production (in metric tons per year)	27.582	110.994	302,4
Production value (in dollars per year)	171.600.000	445.000.000 ^d	159,3
Total			
Volume of global production (metric tons)	348.370	530.254	52,2
Overall production value (dollars)	632.400.000	1.544.364.85	144,2

Notes:

a: 1995 values does not include Belize. In 2009 Honduras is included with 1995 data.

b: Price per Kilogram is US\$ 3.45.

c: Estimate includes Honduras with data from 1995.

d: Figures from FAO.

Source: Cuarto Informe del Estado de la Región, Chapter 5, 2011, with data from OSPESCA-SICA (2010)

There are several regional and international fisheries management organizations in which at least one of the seven Central American countries is a member. However, there is one organization bringing together all of these countries, the Central American Organization of the Fisheries and Aquaculture Sector (OSPESCA).

The countries are now aware that most of the exploited marine resources are common to all Central American countries. The purpose of this organization is to encourage the development and coordinated management of fisheries and aquaculture in the region and strengthen the Central American integration process. In recent years, important regional efforts on the sector through OSPESCA approved new regulations on the use of marine resources: Regulation OSP 03-10, which creates a regional satellite system for the monitoring and control of fishing vessels; OSP 01-09, which establishes a Central American fisheries registry system; and OSP 02-09, to regulate lobster fisheries in the Caribbean, which mandates a common region-wide closed season.



Table 7: Volume of fishing and aquaculture production, 2000-2007 (in metric tons)

Country	Sea fishing		Aquaculture	
	2000	2007	2000	2007
Belize	620,7	635,7	3.637,3	2.637,4
Costa Rica	44.907,8	27.122,2	9.500,0	25.299,0
El Salvador	6.757,0	35.681,0	260,0	3.729,7
Guatemala	31.902,0	15.227,4	3.963,0	16.400,0
Honduras	5.343,8	2.520,2	13.602,4	43.187,0
Nicaragua	8.576,7	11.075,0	5.422,0	11.431,1
Panamá	246.904,2	224.548,8	1,347,0	8.309,0

Source: Cuarto Estado de la Región, Capítulo 5 (2011), with data from OSPESCA-SICA, 2010

3.1.7. Biodiversity in Central America

As a region, Central America is among the first ranks of the world in terms of number of species if compared to some of the great mega-diverse countries (Australia, Brazil, Colombia, Indonesia and Mexico) (Table 8). It ranks second in plant density and first place for groups of birds and mammals.

Table 8: Diversity of known species in Central America

	Central America	Belize	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panamá	México
Plants	20.000 (aprox)	3.750	11.451	3.411	7.754	7.525	9.000	12.178	23.232
Amphibian	n.d.	41	183	32	142	121	92	179	290
Birds	1.714 (aprox.)	574	862	542	722	715	673	957	1054
Mammals	350 (aprox)	152	239	147	192	229	187	259	491
Reptiles	n.d.	126	226	98	245	212	170	229	704
Fresh water fishes	n.d.	116	135	40	220	130	157	190	506
Total	21.524	4.607	13.096	4.270	9.275	8.932	10.279	13.992	26.747

Source: INBio, 2010



Costa Rica, Panama and Guatemala are ranked in the first 32 places in terms of number of species of vertebrates and plants in the world, on a list of 228 countries (Table 9).

Table 9: Ranking of 3 Central American countries among 228 countries in terms of number of species.

Group/Country	Guatemala	Panamá	Costa Rica
Plants		N° 16	N° 17
Amphibians		N° 14	N° 13
Reptiles	N° 18	N° 19	N° 20
Mammals	N° 27	N° 30	N° 32
Birds		N° 17	N° 23

Source: INBio, 2010

Panama is the country in the region that has the highest number of known species of vertebrates and plants (Table 7), closely followed by Costa Rica. However, when you consider the density of species, Costa Rica ranks first place in the Central American region, followed by El Salvador and Belize. All Central American countries have greater density of species than some mega diverse countries in Latin America and the world, such as Mexico and Colombia

The numbers of protected areas in the region accounts in 2011 to 813, for a total of more than 17 million hectares. All countries, except El Salvador, for obvious reason, have important reserves and protected areas.

Table 7: Protected areas, including continental and marine territories. 2011

Country	Total area (hectares)	Number of areas
Belize	1.052.983	104
Costa Rica	2.826.000	170
El Salvador	17.000	77
Guatemala	3.516.854	250
Honduras	3.999.196	91
Nicaragua	2.208.957	72
Panamá	3.578.480	49
Total	17.199.470	813

Source: Cuarto Estado de la Región, Capítulo 5. (2011).

The Central American countries have national lists of threatened and endangered species, but there is a general lack of recent studies to substantiate these lists and effective update mechanisms. Because of the rise in the building of infrastructure in most countries and tourism-related urbanization, among others, the wildlife (especially vertebrates) is being displaced. The countries with the highest number of threatened and at risk species, in order from highest to lowest, are Panama, Costa Rica and Guatemala (see Table 8)



Table 8. Number of threatened and endangered species, and percentage of the total number of reported species of vertebrates and plants.

Country	Total number of threatened and endangered species	% of the total number of plant and vertebrate species
Belize	140	3,0
Guatemala	1.639	17,7
Honduras	299	3,3
El Salvador	720	16,9
Panamá	2.141	15,3
Costa Rica	1.828	14,0
Nicaragua	73	0,7

Source: INBio, 2010

As complement of public efforts, joint conservation initiatives with and of the private sphere are recognized. In addition, there are private reserves combining protection with income generating activities such as eco-tourism and agro-tourism, which work with private and non-governmental organizations. These reserves are organized into national networks.

In preparation for the International Year of Biodiversity (2010), UNDP/UNEP launched a series of consultations for the LAC region. Noteworthy is the Regional Initiative Biodiversity and Ecosystems: Why these are Important for Sustained Growth and Equity in Latin America and the Caribbean, a stakeholder consultation held in Guatemala in December 2009. This consultation discussed paradigmatic cases of biodiversity conservation and ecosystems services in Central America and their impact on development and equity. "Central American countries occupy 769,000 km² only 0.5% of global land area; but they have approximately 7% of the world's terrestrial species including 210 endemic mammals and 24,000 plants.

The region has already taken steps towards conserving its remarkable biodiversity, by establishing approximately 600 protected areas and over 100 marine protected areas so that about 12% of Mesoamerica is now under some form of protection. Regional co-operation has helped create innovative programs such as the Mesoamerican Biological Corridor (MBC) which links protected areas, biodiversity-friendly plantations, agro-forestry systems and private reserves throughout the region."... "Undoubtedly, one of the most significant challenges that Central America is still facing is the conservation and sustainable use of biodiversity. The richness and abundance existence of natural resources represent an opportunity window for economic growth and poverty reduction in Central America. Currently, some countries of the region obtain large economic gains from activities related to biodiversity and ecosystems, such as tourism or fisheries, thus, the sustainable management and protection should be key elements in the national development strategies. While other countries are aware of the potentiality of biodiversity as source of economic growth, thus exploring activities related to ecosystems should become a public policy priority."

During the last decade, the Central American countries have advanced in the review, adjustment and creation of different legal tools for conservation and use of biodiversity. Each country has laws,



regulations and decrees related to the topic, and have created or reorganized the government institutions responsible for its application. However, there are limitations to implementing the actions and penalties established, such as the lack of human and financial resources and lack of coordination between governmental offices and between these and other sectors of society. The following institutions are each country's main governmental enforcement legal instruments related to biodiversity, and the number of relevant laws:¹⁵

Belize: The Ministry of Natural Resources and Environment, through its Department of Forestry, and the Ministry of Agriculture, Fisheries and Cooperatives, through the Department of Fisheries. There are five acts.

Costa Rica: The Ministry of Environment and Energy (MINAE), through the National System of Conservation Areas (SINAC) and the National Commission for Biodiversity Management (CONAGEBIO). There are six laws.

El Salvador: The Ministry of Environment and Natural Resources (MARN) and the Ministry of Agriculture (MAG). There are seven laws.

Guatemala: The National Council of Protected Areas (CONAP), the National Forest Institute (INAB), the Ministry of Environment and Natural Resources (MARN) and The Special Unit for Fisheries and Aquaculture (UNIPESCA). There are five laws.

Honduras: The Ministry of Natural Resources and Environment (SERNA), the State Forestry Administration, the Secretary of Agriculture and Livestock (SAG) and the Justice Department. There are 15 laws.

Nicaragua: The Ministry of Environment and Natural Resources (MARENA). There are six laws.

Panama: The National Environmental Authority (ANAM) and Aquatic Resources Authority (ARAP). There are 12 conservation laws.

The consultation examined several success cases, among them the creation in 1989 of the Central American Commission for Environment and Development (CCAD), the Regional Biodiversity Monitoring and Evaluation Program (PROME BIO), the Mesoamerican Biological Corridor initiative, the Trevino Plan, the Maya Biosphere Reserve (MBR) in Petén Guatemala, the Coastal Zone Management Strategy of Belize, the Ecomarkets project in Costa Rica, the National Fund for Forestry Financing (FONAFIFO) in Costa Rica, the National Biodiversity Institute (INBio) in Costa Rica, the Water Canon proposal in Costa Rica and the NATURA experience in Panamá.

¹⁵ INBio (2010): Conocimiento y Conservación de la Biodiversidad en Centroamérica, Vilma Obando and Álvaro Herrera, compilers. INBio, 88 pgs.



3.2. The KBBE concept: development and reviews¹⁶

KBBE stands for “Knowledge Based Bio Economy”. It covers issues related to Food, Agriculture and Fisheries, and Biotechnology.

The term “bio-economy” includes all industries and economic sectors that produce, manage and otherwise exploit biological resources (e.g. agriculture, food, forestry, fisheries and other bio-based industries)

3.2.1. KBBE objectives

Building a European Knowledge Based Bio-Economy by bringing together science, industry and other stakeholders, to exploit new and emerging research opportunities that address social, environmental and economic challenges: the growing demand for safer, healthier, higher quality food and for sustainable use and production of renewable bio-resources, the increasing risk of epizootic and zoonotic diseases and food related disorders; threats to the sustainability and security of agricultural, aquaculture and fisheries production; and the increasing demand for high quality food, taking into account animal welfare and rural and coastal context and response to specific dietary needs of consumers.

3.2.2. KBBE Activities

Three main activities are considered in the KBBE proposal: 1) Sustainable production and management of biological resources from land, forest and aquatic environment; 2) Fork to farm: Food (including seafood), health and well-being and 3) Life sciences, biotechnology and biochemistry for sustainable non-food products and processes.

3.2.3. KBBE and International Cooperation

International cooperation with participants from third countries is supported and encouraged for all the areas of KBBE.

Specific International cooperation Activities” or “SICAs” are identified, for which international cooperation is mandatory. Such activities aim to foster research both for and with developing countries. Involvement of local stakeholders/users is an important aspect of these topics.

Cooperation with industrialized countries in general focuses on emerging new scientific fields.

Cooperation with Latin America and the Caribbean: In 2010, EU-Latin America and Caribbean (LAC) Summit focused on bi-regional cooperation on "Innovation and technology for sustainable development and social inclusion". The Summit's Action Plan calls for boosting science and technology cooperation between the EU and LAC countries. In KBBE WP2011, a number of topics contribute to sustainability as advocated by the Summit and could, therefore, be of strong interest to LAC countries. In these topics, special attention was paid to environmental, economic and social dimensions and the uptake and use of the new knowledge generated.

Twinning of projects: With a view to promoting international cooperation with third countries that have signed bilateral S&T agreements with the European Union, initiatives for collaboration between

¹⁶ The material presented in this Section is from CSUCA (2011): Proceedings of the CA S&T expert dialogue events, ENLACE-D2.5 v1.3, June 26, 2011.



projects under Theme 2 of FP7 and related research programs in these third countries are encouraged on the basis of mutual benefit and reciprocity.

3.2.4. Other horizontal issues and KBBE

Three horizontal issues should be considered in the KBBE proposals: The innovation dimension, socio-economic dimension of research and gender dimension in research.



4. RESULTS OF THE DOMINICAN REPUBLIC DIALOGUE-CA

A Bi-regional Dialogue was held in the “*Universidad Iberoamericana*” (UNIBE), in Santo Domingo, Dominican Republic on 7 and 8, March, 2011.

4.1. Identification of relevant topics for EU-CA cooperation

A group of topics of importance for potential cooperation, reflecting the strengths and weaknesses of each region was agreed: the greatest potential for future cooperation are mostly related to the exploitation of advances in the area of biotechnology for the better use of the CAC’s region great biodiversity resources for production of better food and energy, and to meet the challenges posted by the impacts of climate change.

4.2. Thematic priorities

The following specific topics were identified and discussed as potential topics of mutual interest: 1) Research on biodiversity to “optimize ecological services”, 2) Use of microorganisms, for food and non-food use, 3) Food and food chain related issues, 4) Optimization of the use of biomass for energy and industrial uses. These four thematic priorities should be developed and proposals implemented in the October 2012 Brussels meeting.

4.3. Cross-cutting issues:

Several cross-cutting issues were identified in the Santo Domingo meeting, and they should be considered in the Brussels discussion: 1) Capacity building, 2) Humans resources and mobility of researchers, 3) Weaknesses in the relationship between academy and industry, 4) Access to knowledge through regional models and databases, 5) Knowledge transfer from EU to CAC countries.

4.4. Human resources

Assessing the quality and quantity of human resources available in the CA region for the KBBE field is an impossible task today. Databases are not available, or if data is available, it is incomplete.

4.4.1. Higher education data

An approach to estimate the pool of human resources is through the university graduates data. As they are real people, with enabling degrees, its distribution could give an idea useful for our purposes. But these data neglects graduates in foreign countries, and a group of tertiary education graduates key for development, those graduating from technical and vocational careers. In general, it could be said that in Central America, as in the rest of Latin America, there is a strong negative bias for graduates in science and engineering. A large majority of graduates come from the social sciences and education areas.

4.4.2. Research capacity



In the region, most of the research capacity is found in the universities, mainly in public universities. Research groups in the private sector are slowly emerging.

Macaya and Santos (2010)¹⁷ notes that, “in general, the structure of Nation Science and Technology System in Central America, is very complex, following an all included attitude, but given the small size of the local scientific communities is more rhetoric than operative. It is necessary to identify key institutions of the System, give them proper recognition and support them, more with selective rather than all-included criteria. The region systems of science and technology must accept the factual evidence that in CA, the production of scientific and technological results, publications, patents, prototypes or technological solutions, comes from the universities, mainly public. The local demand from enterprises for scientific and technological results is still meagre, and the academy offer is not linked to the needs of the productive sector.

4.4.3. Regional mobility

The regional mobility of higher education students and graduates (professionals) has been a goal for the CA countries since 1921. Different efforts have been translated into regional agreements, ratified by the countries but never put into practice. Formal barriers, mainly from professional unions, make difficult the professional practice of foreigners in CA. The Consejo Universitario Centroamericano (CSUCA), has a permanent program to attain the goal of students and professional mobility.

¹⁷ Macaya, G. & Santos, M. (2010) El Caso de Centroméica, in El rol de las universidades en el desarrollo científico y tecnológico. Educación Superior en Iberoamérica, Santelices, B. Editor. CINDA, Santiago de Chile, p143-1522011.



5. CENTERS OF EXCELLENCE AND REGIONAL COOPERATION:

5.1. Examples of regional cooperation with Central America

In the past 20 years, several successful examples of regional cooperation had a positive impact in the development of academic and S&T capacities in the region.

5.1.1. Program ANUIES CSUCA

This is a collaborative program of the Asociación de Universidades e Instituciones de Educación Superior de la República Mexicana (ANUIES) and The Consejo Superior Universitario Centroamericano (CSUCA). The program seeks to broaden and consolidate the knowledge generation, transmission and application in Science and Technology, favouring the development of human resources in priority areas for regional development and the study of strategic problems. Priority areas are education, health, disaster prevention, tourism, environment, agriculture and animal production.

The program developed activities strengthening academic networks in climate change, volcano monitoring, recycling, agricultural technology, health and education. It also strengthened universities' publishing houses, and develop processes of technology transfer to small enterprises. It also helped the development of national education systems, and plans to rescue, conserve, restore and sustainable use of the biodiversity. Joint projects, bases on a call for proposals, were developed with Mexican and CA universities.¹⁸

5.1.2. DAAD CSUCA

For several decades, the German Academic Exchange Service (Deutscher Akademischer Austausch Dienst DAAD) and the Consejo Superior Universitario Centroamericano (CSUCA), developed a joint program to develop human resources for the Central American Region. Fellowships were awarded for students from the CA countries to follow masters' degree studies in selected programs (considered regional programs) in the Central American universities. It also awarded fellowships to allow successful master graduates to continue doctoral studies in Germany. The program recognized CA masters program considered of excellence and supported its development.

5.1.3. Sweden

Jointly with the Karolinska Institute, and funded by the Swedish International Cooperation Agency, a very successful joint/sandwich program in biosciences was developed. Students in a masters degree program, granted by the Karolinska Instituted, develop their studies in a three part arrangement, involving initial training at the University of Costa Rica, further training at the Karolinska Institute in Sweden, research worth in collaboration of a CA University Researcher and a Karolinska researcher. Successful students were granted a fellowship to continue doctoral studies in Sweden. In this program, the University of Costa Rica acted as a pivotal institution for the development of the program, through "triangulation" activities.

¹⁸ SSC in the Context of Aid Effectiveness: Telling the Story of Partners in South-South and Triangular Cooperation Produced for the Task Team on South-South Cooperation (March 2010) Explore 110+ cases at: www.southsouthcases.info

5.2. Centers of Excellence (Examples from Costa Rica)

In this section, as examples, we present 6 research groups from the University of Costa Rica, that have acted as regional centers of excellence, not only in the programs noted in the previous paragraph, but also developing region bilateral and multilateral research activities. The 6 groups are internationally recognized leaders in their field of expertise. We present them as the basis for a broader discussion aiming at the recognition of other excellence groups in other CA countries.

(INBIO) National Biodiversity Institute: www.inbio.ac.cr

(CENIBiot) National Center for Biotechnological Innovatio: www.cenibiot.go.cr

(CITA) National Center for Food Science and Technology: www.cita.ucr.ac.cr

(CIMAR) Marine Sciences and Limnology Research Center: www.cimar.ucr.ac.cr

(CIGEFI) Geophysics Research Center: www.cigefi.ucr.ac.cr

(ICP) Instituto Clodomiro Picado: www.icp.ucr.ac.cr

(CIGEO) Centro de Investigación Geocientíficas: www.cies.edu.ni

(CIRA) Centro de Investigaciones para los Recursos Acuáticos: www.cira-unan.edu.ni

(CBM) Centro de Biología Molecular: www.uca.edu.ni/cbm/

(CIES) Centro de Investigaciones y Estudios de la Salud: www.cies.edu.ni

(INDICASAT) Instituto de Investigaciones Avanzadas y Servicios de Alta Tecnología: www.indicasat.org.pa

(LEA) Laboratorio Especializado de Análisis de la Universidad de Panamá: www.up.ac.pa

(STRI) Instituto Smithsonian de Investigaciones Tropicales: www.stri.si.edu

(ICGES) Instituto Conmemorativo Gorgas para estudios en Salud: www.gorgas.gob.pa

(LASEF) Laboratorio de Análisis de Aguas y Servicios Físico Químicos de la UNACHI. www.unachi.ac.pa

(OAP) Observatorio Astronómico de Panam: www.cc.utp.ac.pa

Laboratorio de Física de la Atmósfera de la Universidad de Panamá: www.igc.up.ac.pa

Herbario de la Universidad de Panamá: <http://herbario.up.ac.pa/>

Herbario de la Universidad Autónoma de Chiriquí: <http://www.unachi.ac.pa>

Instituto Nacional de Geociencias

(INCAP) Instituto de Nutrición de Centroamérica y Panamá: www.incap.org.gt

6. SWOT ANALYSIS ¹⁹

Due to the lack of relevant information regarding the Central America region, it occurs to us to do a SWOT analysis among some of the ENLACE partners in order to obtain not only their points of view but we asked them to work in a small discussion groups in their own countries. The topics we selected were: Geographical situation, Political situation, Research and Innovation, Human Resources, Institutional support, Infrastructure, Investment. These topics were considered relevant indicators that would reflect on the issues interested to KBBE.

STRENGTHS	WEAKNESSES
<p><u>Geographical situation</u> Geographical position with maritime access on two coasts that contributes to diverse ecological zones.</p> <p><u>Political situation</u> Level of human development Availability of standardized data from the “State of the Region” Recognition of the value of education Tradition on regional networking Products exportation experience Competitive prices and high product quality Good integration between productive and industry sectors applying technological know-how to new businesses. Main legal framework and regulations related to ecosystem services Openness to foreign direct investment</p> <p><u>Research and Innovation</u> Regional tradition in natural resources research Sector sensibility to innovation, diversification and appropriate production technology of products with higher added value</p>	<p><u>Geographical situation</u> In general, the regional geography renders high vulnerability to natural disasters (seismic, hurricanes, oceanographic)</p> <p><u>Political situation</u> Indifference towards political integration and coordination of regional organisms Lack of regional funding and development to support science and technology Lack of coordination between policy makers Lack of regional legal mechanisms Lack of fiscal incentives related to R&D&I Low use of communication and information technologies in business management Lack of formal activities of technological surveillance Deficient information available for decision makers at local level due to restricted ITC technology availability Biotechnology regulation is politically biased rather than science-based Insufficient technical development in agriculture, forestry and agro-forestry areas in some countries</p> <p><u>Research and Innovation</u> Lack of regional interdisciplinary research and collaboration among research institutions. Lack of economic and academic incentives for researchers Insufficient communication and knowledge transfer of the research capabilities of higher education institutions</p> <p><u>Human Resources</u></p>

¹⁹ This SWOT was compiled from proposals presented by: Gabriel Macaya, Filiberto Vega, Helena Molina, Marianela Cortés, Costa Rica; Eddi Vanegas, Guatemala; Gusmán Catari. Honduras; Freddy Alemán, Nicaragua

<p><u>Human Resources</u> Availability of human capital: professional, academic and technical</p> <p><u>Institutional Support</u> Existence of universities with research units in all areas of knowledge with the correspondent undergraduate and graduate programs</p> <p><u>Infrastructure</u> Good public services (water, electricity, telecommunications) & health services Agricultural tradition</p> <p><u>Investment</u> Important levels of Direct foreign Investment</p>	<p>Insufficient human capital in R&D&I</p> <p><u>Institutional support</u> Lack of regional mechanisms for labour and professional mobility</p> <p><u>Infrastructure</u> Lack of infrastructure and edge equipment for R&D&I Small farmer's production of staple food is inefficient. Lack of appropriate infrastructure: cold storage facilities, roads, airports and so on.</p> <p><u>Investment</u> Capital concentration in industry & commercialization Difficulties to commercialize products due to international market ignorance and lack of certifications of quality and environmental management (ISO). The economy depends on a narrow range of exports, some company's focus on a single product, which makes it highly vulnerable to natural disasters and shifts in commodity prices. Lack of long-term vision particularly within fishing sectors Marketing, budget & strategic plans do not exist or are not formalized Post-harvest losses are considered to be high and access to markets for small farmers is difficult. Lack of value added to agricultural goods</p>
<p>OPPORTUNITIES</p> <p><u>Geographical situation</u> MBC (Mesoamerican Biological Corridor) Initiative (www.biomeso.net) MBRS (Mesoamerican Barrier Reef System) ETPS (Eastern Tropical Pacific Seascape)</p> <p><u>Political situation</u> Opening of the European Cooperation towards the region (Macro Programs) Regional Integration in Education Signature of Free Trade Agreements, specifically the agreement between EU and CA (agricultural sector and market access for exports) Promote biotechnology-based products (e.g. through preferential taxation) in order to mainstream them.</p>	<p>THREATS</p> <p><u>Geographical situation</u> Global change effects on climate variability Issues with land tenure Research and</p> <p><u>Political situation</u> Civil insecurity, drug trafficking and corruption Political instability and inequality Regional bodies could break down because of external political forces Economic crisis Excess of legal regulations, sometimes counteracting each other Unfair competition derived of Free Trade Agreements Subsidies with little or inexistent control Agricultural subsidies and tariffs in rich countries could undermine achievements (the later could be solved through the recent EU-Central America Association</p>

<p><u>Research and Innovation</u> Implementation of better production techniques to assure quality New agricultural approaches more compatible with the environment and the biodiversity (e.g. conservation agriculture, development of crops resistant to climate stresses).</p> <p><u>Human Resources</u> University graduates in areas of interest Number of Ph.D. graduates working the region. Number of scholarships supporting Graduate Students in and out the region.</p> <p><u>Institutional Support</u> Existence of Central American organisms to develop joint initiatives (CETECAP, SICA, CSUCA, OSPESCA) Programs of academic mobility and regional networking International agencies interested in conserving regional ecosystem services</p> <p><u>Infrastructure</u> Producers' empowerment through their association and incorporation in other parts of the food chain Export and innovation support Improvement of suppliers' development programs</p> <p><u>Investment</u> Adequate environment for FDI New local and international markets</p>	<p>Agreement in trade, when it is fully complied).</p> <p><u>Research and Innovation</u></p> <p><u>Human Resources</u> Brain drain</p> <p><u>Institutional Support</u> Fragility of regional institutions</p> <p><u>Infrastructure</u> Increase of raw materials' prices High cost of organic production Introduction of substitute products and changes in consumers' behaviour A few transnational agro-businesses dominate the production and marketing (banana, oil palm, melon) Natural resources could be depleted, leaving the communities without any chance for their future</p> <p><u>Investment</u> Bargaining power of higher distribution chains Increase of competition based in low prices Export decrease</p>
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7. KBBE EXPERTS DIALOGUE OUTCOMES

The ENLACE project, aiming at enhancing respectively the EU-Central American S&T dialogue, has tackled the BE theme in two previous occasions:

A first expert meeting on KBBE has taken place in Dominican Republic in March 2011, identifying priority themes for EU – Caribbean and Central American collaboration in R&D. **In April 2012, a preparatory workshop has been organized in Curaçao**, which identified 4 potential priorities on the BE R&D themes / pathways :

- Sustainable management of marine biodiversity (in particular reefs and coastal areas, biodiversity exploitation);
- Food Chain efficiencies (zero waste);
- Eco-intensification and Eco-systems services.

The Experts' Dialogue workshop organized by the EUCARINET and ENLACE projects in October 2012, wished to share and validate the first findings of the study with respectively Caribbean and Central American experts and further **proceed to the establishment of a roadmap per subtheme** identifying and prioritizing the interventions points to make the Bio-economy a reality.

The purpose of the proceedings resulting from the event will be to feed the discussion and help push the agenda of the BE working group, as well as serving other relevant groups such as the JIRI by identifying/developing/envisioning the BE pathways for their region.

7.1. Eco-intensification and ecosystem services pathway (bioeconomy and biodiversity working group)

7.1.1. Background

Ecosystem services

Ecosystem services include the processes by which the environment produces resources utilized by humans such as clean air, water, food and materials. Given the special nature of the relationship and interactions implied between natural resources and economic and social activities in a bio economy approach an ecosystem perspective becomes a strategic component of any sustainable bioeconomy strategy. The bioeconomy is a response to a long period of resource over utilization and an attempt to readapt behaviors in the light of anticipated global challenges, accordingly implementation strategies can only succeed if the integrity of the natural environment is recognized throughout the decision making processes and the value of the different flows are appropriately accounted for. Within this general context the development of carbon credit system, eco-tourism strategies and water management pricing and management mechanisms, are three specific entry points that should be considered in relation to ecosystems services in the framework of a bioeconomy approach.

Eco-intensification

Relates to agronomic practices directed to improving environmental performance of agricultural activities without sacrificing existing production/productivity levels. Eco-intensification covers a broad and evolving set of concepts having in common their departure from "business as usual" behavior usually over-focusing on maximizing yields. Eco-intensification aims to achieve a balance of

agricultural, environmental, economic and social benefits, seeking more efficient use of energy resources and targeting at reduced use of fossil fuels, pesticides and other pollutants. Examples of specific eco-intensification strategies include no-till agricultural practices, precision agriculture strategies, integrated pest and nutrient management, at the more “production oriented” end of the spectrum and more socially oriented concepts such as that of sustainable land management where a greater emphasis on environmental functions is made. Beyond primary production the eco-intensification pathway is associated to the early concept of the clean technologies, particularly those aspects related to the use of biological processes in support of industrial and other activities (waste waters treatments), although the mere use of biological resources of processes should not be enough, and effective environmental “goods” should be associated to deserve the link.

7.1.2. Results of the dialogue on eco-intensification and ecosystem services

Rapporteur: Gabriel Macaya

Participant experts

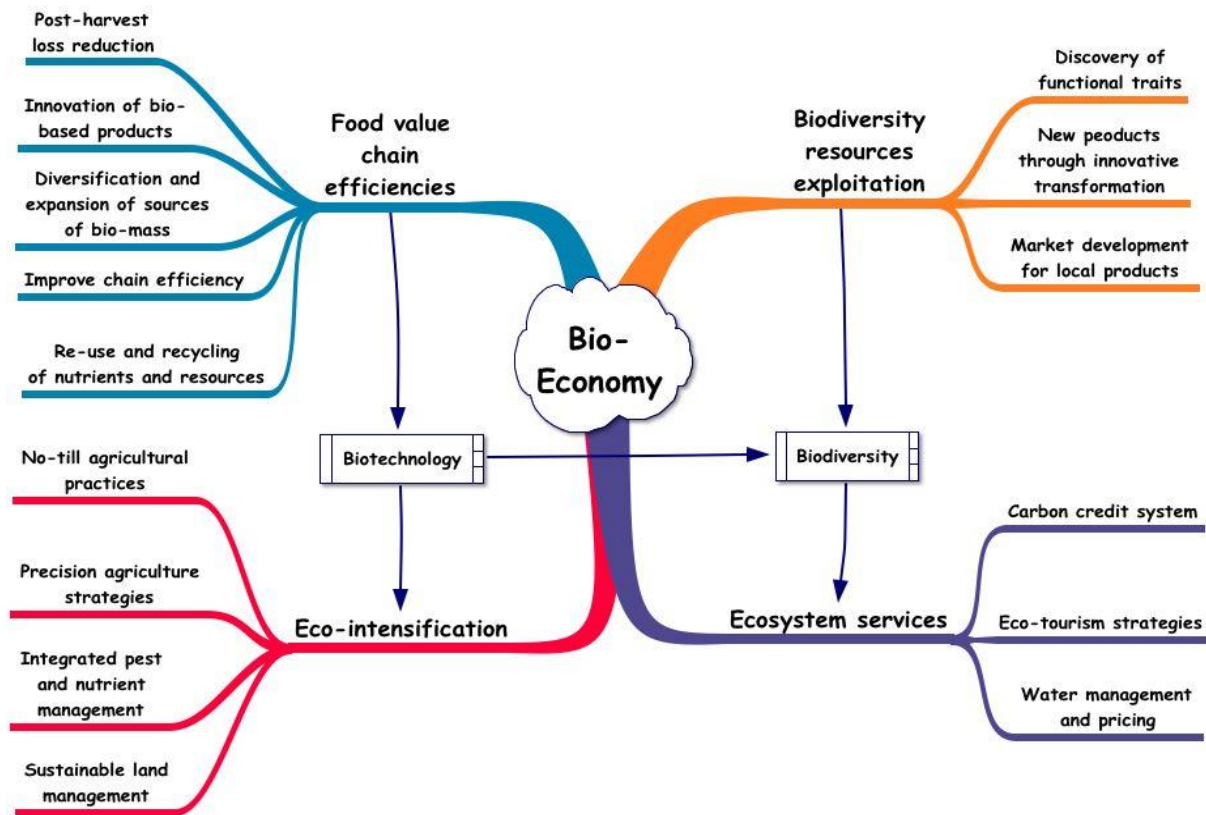
Freddy Sebastián Alemán Zeledón	Nicaragua, Universidad Agraria
Luisa E. Castillo	Costa Rica, Universidad Nacional
Yenny Eigure,	Honduras, Universidad Pedagógica Nacional
Alfonso Fuentes Soria	Guatemala, Consejo Superior Universitario Centroamericano (CSUCA)
Moisés Gómez	Nicaragua, Consejo Nicaragüense de Ciencia y Tecnología (CONICYT)
Jorge Mendoza	México, Colegio de la Frontera Sur (EcoSur)
Miguel Rojas-Chaves,	Costa Rica, Instituto Tecnológico de Costa Rica
Manfred Szerencsits,	Austria, Öko Cluster and University of Kassel

7.1.3. Generalities of the session

The session was organized as a discussion panel to provide comments on the draft report and to organize the discussion on the sub-pathways, constraints and opportunities. On a first stage an open discussion was promoted to not only discuss the content of the Foresight document, but to introduce new concepts and proposals that deemed suit for the final report. A long discussion was devoted to a document presented by Manfred Szerencsits on “Transdisciplinary development of sustainable and resilient solution”. Another important input for the discussion was a series of comments presented by Freddy Alemán. The time for discussion was too restricted, and the discussion on specific sub-pathways was insufficient, and the Rapporteur had to “fill the voids” from the recording of the session.

From the discussions, the following diagram depicting the sub-pathways was generated, and used as a general guideline.

Figure 6: Bioeconomy pathway and sub-pathways.



7.1.4. Main outcomes/suggestions about the report.

This section includes suggestions for improving the Foresight report, lines of research and other consideration that were debated during the session. Two specific contributions represent the main body of the discussion, and an extensive transcription is given below.

Freddy Alemán:

There is clearly a need for joint initiatives. Problems in the region are common, it is compulsory to develop strategies that allow joint efforts oriented to solve regional problems. It is not only important to talk about food security but also of food sovereignty, regarding quality and safety of agricultural production, either for external and internal markets. On transversal issues, it is important to develop knowledge that helps to solve technological problems but, not to forge the creation of capacities in the people (Emerging subjects). It is paramount to foster the regional mobility of researchers, but also with EU countries. Countries that have developed expertise in some specific areas should lead to initiatives in these areas and give facilities for expanding the knowledge. We also need to share what we have in terms of knowledge, there have been many efforts that have not been shared with others, and we need mechanisms that make available what we are producing. There is a need to integrate key actors in the process: academia, government, and private sector to work very close if we want to have impact on the results of the process.

Common areas where we can have common initiatives are: Increase productivity and competitiveness to generate welfare. Nicaraguan agriculture is facing an improvement, the rising

prices of agricultural commodities as well as the high international demand on agricultural commodities has led to an increase in incomes, nevertheless, we have the challenge to increase productivity, something that could be done throughout research.

Concerning common areas where we can have common initiatives: Adaptability to Climatic change to assure food security and sobering. We are facing uncertainty in agriculture, nobody knows what will be tomorrow, one day we have the Niña phenomenon, and later on we have the Niño. Variation in temperature, irregularities in rain patterns, so we have to work hard on developing strategies for adaptation and mitigation of climatic change. Adaptation and mitigation of climatic change. We are facing Insufficient management capacities to concrete agroecological strategies that permit adaptation and mitigation of climatic change. Central American countries are vulnerable to climatic change (natural phenomenon especially those from geological and hydrological origin). Around 17 to 20 percent of land area is located in sectors of high to extremely high sensibility to climatic change.

A series of major problems to be faced: High poverty indexes, high dependency on the agricultural sector, low diversification and productive technical advancement, high dependency on local production and the use of natural ecosystems.

Concerning areas where we can have common initiatives: Food security and sovereign; we need to assure that rural families diversify their productive systems and their channels of commercialization, transform their agricultural products, manage efficiently their agro-ecosystems and improve their quality of life with agro chains approach and adaptation to climatic change. Foster capacity building at different levels, farmers, technicians, academics, etc.

Concerning the draft report, there are there several missing contextual elements. An issue that was not covered was the role of the government in the initiatives, it is crucial that the government play an active role in the process. Central American governments need to be sensible to the importance of S & T for the development

The Central American Confederation of Universities (CSUCA) plays an important role in merging more than 20 Universities in Central America, so it could be an institution that could foster research or exchange initiatives in Central America. Other institutions that could be of major support for CA initiatives are: CIGEO (geological research center), CIRA (Aquatic resources research center), FHIA (Honduran foundation for agricultural Research), is also working with stapled crops with success), FUNICA (Nicaragua foundation for agricultural development), who have been managing external resources for agriculture value chain, Molecular biology lab, Central American University, CIDEA (Research center for aquatic ecosystems), Central American University, Nicaragua.

Sub-pathways: Eco-intensification: Integrated crop production (industrial crops and stapled crops), seed production, integrated pest management, nutrient cycling, local genetic resources, water management, quality and safety of primary production, crop diversification, adaptability to climatic change, seeds adapted and resistant to climate variations, innovations on production systems to reduce effects of climatic change.

Sub-pathways constraints: The use and dependency on conventional agriculture, to increase productivity in systems of low inputs (with stapled crops). Poor added value to primary production. The tendency to continue production using high amounts of external inputs, many key actors and farmers rely on conventional agriculture. There is a need of to produce safety products for internal of external consumption (common for North countries in CA In CA there are cash crops that rely on imported technology, so farmers or organization that work with those crops (sugar cane, oil crops, etc.), have their own research systems, and scarcely ask for support. So, systems that could be of interest are those based on stapled crops that have been unattended in the pass.

Opportunities for developing the proposed pathways: High international demand on safety products, agricultural sector crucial to ensure food security and sovereignty, international concern



about management and conservation of natural resources. The application of good agricultural practices for food production (mainly fruits and vegetables to be consumed fresh) is a task of responsibility with consumers who wish to eat food with no contamination. Agriculture is a sector where different key actors involved in development could converge: academia, government and civil society, each one has to take responsibility of its role in the agriculture value chain, in order to be additive in a common purpose. There is a tendency at the international level about degradation of natural resources, so any initiative oriented to protect environments should be seen as an activity to fulfil.

Actions to implement the program: To create knowledge by means of implementation of research projects according to family needs, to develop competences and capacities in the rural family in the management of his or her farming systems, to promote ways of rural associative and organizational structure of the family that aims to articulate the agro feeding chain, to foster an entrepreneur culture in youngsters that permit generation of quality and sustainable employment, to establish educative modules of GAP that permit diffusion (TT) of knowledge amongst farmers and technicians, to promote efficient productive systems that guarantee food sovereignty and security in the rural family.

Manfred Szerencsits:

Thematic priorities from the Dominican Republic meeting: Food and food chain related issues; Optimization of the use of biomass for energy and industrial uses; Research on biodiversity to “optimize ecological services” Use of microorganisms for food and non-food use

Cross-cutting issues in the Dominican Republic: Capacity building; Human resources and mobility of researchers; Weaknesses in the relationship between academy and industry; Access to knowledge through regional models and databases; Knowledge transfer from EU to CAC countries

Reflection on motivations: Why do people apply ineffective solutions? What are current reasons for every day practice? What can be done to introduce immediate improvements regarding sustainability and resilience?

Research with people for people: If research shall contribute to sustainable societal and economic changes, it is not sufficient to be of high scientific quality. Research has to be practically oriented and convince those, who should introduce research results in every day practice

Trans disciplinary research: Development of local solutions with those, who can/want to apply them, solutions that work and are of benefit for local communities; solutions that are most convincing

Pilot projects – Inspiring examples: Pilot projects, inspiring sustainable regional development and introduction of bio-economy in other regions; points of departure for further innovation - identification of communities / organizations with high potential for innovative practice or already engaged in successful sustainable action; it is easier to initiate changes in local systems than in states - changes from grass roots. Nevertheless changes of states should also be aimed at

Motivations - drivers for sustainable action: motivation of women and men to contribute to a sustainable development; give people a perspective for good living, cheerfulness and joie de vivre; people must be given the opportunities to involve themselves in local business and agriculture, they should have the impression that it makes sense to be active for local development

Food, food chain, agriculture: Agricultural production with a minimum of vulnerabilities and dependencies on goods and products from abroad (e. g. fossil energy; fertilizer and pesticides; agricultural machinery); maximum food supply from regional production; low outflow of regional income

Cash-crop production and Bio-Energy: combination of regional supply of food and energy with cash-crop production; biogas, in comparison with other biofuels, allows relatively small production units, that require low efforts for transport, value added can remain in rural areas, can be used for electricity, heat and as fuel for cars and agricultural machinery and can complement energy from wind and sun.

Synergy instead of competition: Identification of synergies example: Biogas from catch crops in Central Europe; compile local inventories of all kinds of biomass usable for biogas production and not in competition with food and cash-crop supply and reduction of the risk of nitrate leaching, nitrous gas emissions and erosion e.g. growing of intercrops/under sown crops to reduce need for pesticides and fertilizer and supply biomass for feedstock for animals and biogas

Organic farming: agriculture with relatively low risk for farmers and the environment, lower dependence of products from outside. Inspiring conventional production. Growing of (fodder) legumes in conventional agriculture e.g. as under sown crop in maize; N-fixation. Weed suppression. Phosphor mobilisation. Erosion protection

7.1.5. Cross cutting issues

A group of three fundamental cross cutting issues were discussed, and agreed on its importance: Clean production, social responsibility and energy efficiency

7.1.6. Pathway: eco intensification

SUB-PATHWAY A: Integrated pest, waste and nutrient management

CONSTRAINTS	DOMAINS OF INTERVENTION				
<p>Crops in a complex tropical ecosystem</p> <p>Excessive dependence on agrochemicals</p> <p>OPPORTUNITIES</p> <p>Improve staple food production</p> <p>Lower agrochemical residues on foodstuff.</p>	<p>Research & Innovation</p> <p>Mapping good practices and innovations on mixed crops systems in the tropics.</p> <p>More systematic research and innovation on organic production</p>	<p>Policy</p> <p>Incentives for good practices on mixed crops.</p> <p>Improve and enforce regional regulations on agrochemicals' use.</p>	<p>Human Resources</p> <p>Organize available field researchers on crop production in the region.</p> <p>Promote exchanges and training with European researchers in the field.</p>	<p>Institutional support</p> <p>Improve connectivity of local and regional organisms</p>	<p>Investment</p> <p>Finance research, development and innovation.</p> <p>Promote credit lines for producers following good practices.</p>

SUB-PATHWAY B: Organic farming and sustainable land management

CONSTRAINTS	DOMAINS OF INTERVENTION
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Organic crops as niche products Large state farming vs. small scale farming OPPORTUNITIES a. Export organic agricultural products to high value niche markets.	Research & Innovation More systematic research and innovation on organic production Develop information systems on organic products' markets.	Policy Incentives for healthy and organic crop production Foreign promotion of organic foods.	Human Resources Organize available field researchers on crop production in the region. Promote exchanges and training with European researchers in the field.	Institutional support Promote linkages with agricultural chambers in the region.	Investment Finance research, development and innovation. Promote credit lines for producers following good practices.
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SUB-PATHWAY C: No-till and conservation tillage agriculture

CONSTRAINTS Erosion, soil conservation and nutrient depletion Innovating cropping OPPORTUNITIES Reduce erosion rates on vulnerable areas. Reduce fertilizers use	DOMAINS OF INTERVENTION				
	Research & Innovation Improve regional networks on soil science. Develop research and innovation on new crops	Policy Update and improve land use and soil type maps of the region	Human Resources Network soil scientists of the region	Institutional support Improve local and regional research groups on cropping systems and soil use and management.	Investment Finance research, development and innovation.

7.1.7. Pathway: ecosystem services

SUB-PATHWAY A: Water Management and Value

CONSTRAINTS Water availability and water waste Crops under irrigation vs. desertification OPPORTUNITIES Improve water use and conservation	DOMAINS OF INTERVENTION				
	Research & Innovation Improve research of crops under irrigation and water use for agricultural purposes. Map water availability, usage and dynamics.	Policy Incentives for good practices on water management. Improve and enforce regional regulations on water management.	Human Resources Organize available field researchers on water management in the region. Promote exchanges and training with European researchers in the field.	Institutional support Improve connectivity of local and regional organisms.	Investment Finance research, development and innovation.

SUB-PATHWAY B: Biodiversity conservation and sustainable management of ecosystems

CONSTRAINTS	DOMAINS OF INTERVENTION				
	Research & Innovation	Policy	Human Resources	Institutional support	Investment
<p>Knowledge, management and sustainable use of biodiversity</p> <p>Need for regional policies on biodiversity conservation</p> <p>OPPORTUNITIES</p> <p>Better management of protected areas for knowledge and use of existing biodiversity</p> <p>Develop new crops and products issued from biodiversity</p> <p>Find new and innovative genes for crop and foodstuff improvement.</p>	<p>Develop, cataloguing, knowledge and characterization of regional biodiversity</p> <p>Improve good practices on protected area management.</p> <p>Develop research on bioprospecting.</p>	<p>Regional harmonization of biodiversity protection policies</p>	<p>Organize available field researchers on biodiversity management in the region.</p> <p>Promote exchanges and training with European researchers in the field.</p> <p>Train regional experts on taxonomy of diverse biological groups.</p>	<p>Networks on biodiversity conservation institutions in the region.</p>	<p>Finance research, development and innovation.</p> <p>Promote development of private groups to transfer knowledge of research institutions to commercial products.</p>

SUB-PATHWAY C: Synergetic production (agro-ecology)

CONSTRAINTS	DOMAINS OF INTERVENTION				
	Research & Innovation	Policy	Human Resources	Institutional support	Investment
<p>Increased land productivity through intercrops and under swan crops</p> <p>reduction of nitrate leaching, nitrous gas emissions and erosion</p> <p>OPPORTUNITIES</p> <p>Improve the economic cycle of small farmers.</p> <p>Reduce impact of agricultural waste.</p>					

SUB-PATHWAY D: Eco tourism strategies

CONSTRAINTS	DOMAINS OF INTERVENTION				
	Research & Innovation	Policy	Human Resources	Institutional support	Investment
<p>Certification of good ecotourism practices</p> <p>High value</p>	<p>Develop research of</p>	<p>Promote certification of</p>	<p>Train on good</p>	<p>Fiscal Incentives</p>	<p>Improve credit support for</p>

<p>ecotourism and sustainable conservation OPPORTUNITIES</p> <p>Link tourism to conservation strategies.</p> <p>Improve ecological awareness on the citizen</p> <p>New sources of income for SMEs.</p>	<p>visitation impact on protected areas.</p>	<p>ecotourism initiatives.</p> <p>Develop regional visitation policies for protected areas.</p>	<p>practices small ecotourism entrepreneurs.</p> <p>Promote scientific exchange on biodiversity and ecotourism.</p>	<p>for ecotourism entrepreneurs</p>	<p>ecotourism entrepreneurs.</p> <p>Increase investment for infrastructure access to ecotourism areas.</p>
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SUB-PATHWAY E: Carbon Credit Systems

<p>CONSTRAINTS</p> <p>Lack of policies of Carbon Credit Systems in the region</p> <p>Competition between countries of the region for credit allocations</p>	<p>DOMAINS OF INTERVENTION</p>				
	<p>Research & Innovation</p>	<p>Policy</p>	<p>Human Resources</p>	<p>Institutional support</p>	<p>Investment</p>

7.1.8. Conclusions

Clean production, social responsibility and energy efficiency are reflected on the discussion leading to the preparation of the pathway and sub-pathways. All this points take into account the concerns of the panel regarding regional and global climate change impact.

7.2. Food chain efficiencies working group

7.2.1. Background

Food value chain efficiencies include activities that (i) reduce post-harvest losses at whatever level they are occurring, and (ii) aim at developing the need market links for innovative bio-based products. There is a common mistake in equating the bio economy with sustainability concepts. It must be made clear that bio-based options are not per se more sustainable.

Resource over-use is always a latent issue and resource efficiency is of no lesser importance in the bio economy than in conventional approaches. But the most important issue is related to the potential conflict in achieving the objectives of the bio economy to meet increased global food/feed/fuel demands (50-70% over present levels) without further encroachment of forest and marginal lands and at the same time using part of the biomass production efforts to replace present use of fossil resources.

How to reconcile these seemingly conflictive tendencies is one of the key challenges in the transition to the bio economy, for which there are neither unique nor simple solutions. The final equilibriums will certainly be a complex mix of many new strategies. These will involve, among others, aspects such as the diversifications and expansion of sources of biomass, and more efficient use and processing strategies. Within the latter an immediate challenge in the transition is a more efficient value chain.

At present over 40% of what is actually produced is wasted before it reaches its final use (UNEP, 2011). This represents a huge opportunity to start moving into bio economy strategies without creating additional conflicts and pressures on the natural resources base. What are the technological, logistical and policy options to improve chain efficiency are questions that need to be addressed. In addition, an aspect, which is often neglected, is the recycling and reuse of nutrients and other resources in agricultural production that have to be regenerated during processing as well as from the bio-based products in the end.

7.2.2. Results of the dialogue on food chain efficiencies

Rapporteurs: Davide Viaggi and Marianela Cortés Muñoz

Participant experts

Davide Viaggi and Marianela Cortés Muñoz (Rapporteurs)	Agricultural economist, Department of Agricultural Science, University of Bologna, Italy
Marianela Cortés Muñoz	Food specialist, University of Costa Rica
Gusman Catari Yujra	Agricultural engineer, Honduras
Eddi Alejandro Vanegas Chacon	Environment, Guatemala
Tarsilia Eldiney Silva De Carranza	Food industry, Nicaragua

7.2.3. Generalities of the session

The session aimed to provide comments on the draft report and to provide structured ideas about sub-pathways and domains of intervention.

The session was organized in line with the others around three main steps:

- a) Comments to the draft document “Foresight for Central American Bio-economy related research in the context of the EU-LAC Joint Initiative on Research and Innovation”.
- b) Identification of a list of sub-pathways for the pathway food value chain efficiency.
- c) Identification of Constraints, opportunities, domains of intervention.

Step a) was managed through a roundtable of comments. In step b, each participant was firstly asked to provide 3 suggestions; the outcome was collected on a board and a list of suggested sub-pathways was negotiated after discussing overlapping and potential merging/splitting of initial proposed topics.

Step c) started with some discussion, but basically only provided an exercise of understanding of the table provided by the organizers, applied to food processing.

It was agreed that the latest step would be more practicable if the form is circulated and session members would react in writing.

7.2.4. Main outcomes/suggestions about the report

The report presents the general aspects of CA countries and the content found the agreement of most participants.

However, it was also agreed that, in order to allow for a better interpretation and better use, more information should be added. In particular the following should be added/integrated/expanded:

- Food chain structure / organization and distribution of benefits
- Distribution of importation and exportation
- Food waste : more relevant at the farm level
- Infrastructure (access to production, cold chain availability...)
- Land tenure
- Legal system: enforcement and policy implementation
- Taxes and trade regime, fair trade policies
- Certification and labelling
- Financial/credit policies
- Consumers
- Access to markets by small producers, e.g. local markets
- Use of information and communication technologies
- Relevance of energy biomass production
- Information on the topography of each country
- Climate change impact > reduction of yields -> all report agree CA is very vulnerable

A key important issue concerns the identification of Centers of Excellence in each of the countries of the area, which is presently only focused on one of the countries.

7.2.5. Main research lines

In this section, the following sub-pathways were identified (in rough order of decreasing relevance):

- Food processing (including small scale).
- Food quality and safety.
- Increase production (yield).
- Conservation of native genotypes.
- Sustainable production systems.
- Post-harvest management and losses.
- Market for primary products/access to markets.
- Labelling and product certification.
- Consumer education.
- Property rights: patenting/land.

For food processing, the exercise was made to identify constraints and opportunities and how they interact with the domain of intervention. The main results were the following:

Constraints:

- Lack of financial resources/research.
- lack of info about the effect of processing
- lack of qualified human resources
- poor enforcement/control of policies related to sanitary conditions, pesticides
- Opportunities:
 - consumers being aware of healthy food
 - promote consumption of native plants

The difficult part was with connecting such constraints and opportunities with individual domain of intervention. On the one hand for some cases there are straightforward solution (e.g. lack of financial resources need financial investment); on the other hand in some cases all domains could be relevant to solve a specific constraint.

PATHWAY: <i>Food value chain efficiency</i>	
SUB-PATHWAY: Food Processing	
CONSTRAINTS (C)	DOMAINS OF INTERVENTION

& OPPORTUNITIES (O) Describe the C or the O;	Research & Innovation (Describe R&I needs + indicate what are the priority research axes in the context of collaboration with EU)	Policy (Indicate policy area + what is needed e.g. laws; incentives, ...)	Institutional support (organizational bodies)	Human resources	Investment (e.g. infrastructure requirements)
C1: Lack of information about bioactives compounds present in fruits and vegetables of the Central American region and the effects on processing. All countries.	Need for studying the composition of fruits and vegetables and identifying the compounds of interest and the effects of traditional technologies on these compounds.	Incentives to research	Research laboratories equipped appropriate analytical methods	Scientific and technical support	Need for public and private investment in infrastructure
O1: To perform investigation concerning the use of new technologies in food processing. All countries.	Need to study the effects of the new technologies (non-thermal) on bioactive compounds in order to develop functional foods.	Regulation concerning the application of new technologies	Research laboratories equipped with appropriate technologies	Scientific and technical support	Public and private partnerships to enhance collaboration and investment infrastructure (laboratories, pilot plants)

7.2.6. Conclusions

The main conclusions of the panel were:

- Enrich the draft report by addressing the issue listed above;
- Circulate and collect written reactions to the constraints/opportunities table.

7.3. Sustainable management of marine biodiversity working group

7.3.1. Background

The Knowledge based bio economy covers issues related to Food, Agriculture and Fisheries, and Bio-technology. It includes all industries and economic sectors that produce, manage and otherwise exploit biological resources (e.g. agriculture, food, forestry, fisheries and other bio-based industries).

It aims to build a Knowledge Based Bio-Economy by bringing together science, industry and other stakeholders, to exploit new and emerging research opportunities that address social, environmental and economic challenges such as:

- *The growing demand for safer, healthier, higher quality food and for sustainable use and production of renewable bio-resources;*
- *The increasing risk of epizootic and zoonotic diseases and food related disorders;*
- *Threats to the sustainability and security of agricultural, aquaculture and fisheries production and the increasing demand for high quality food, taking into account animal welfare and rural and coastal context and response to specific dietary needs of consumers.*

For more information see:

<http://www.bio-economy.net/> and http://ec.europa.eu/research/biosociety/index_en.htm

7.3.2. Biodiversity resources exploitation

Includes those situations where the differentiating element is the valorisation (domestication, transformation, linking to market, etc.) of distinctive biodiversity (discovery of functional traits related to specific uses and sectors, development of new products through innovative transformation, market development for local products, etc. examples in this could be specific gene discovery phytoterapeutics, cosmetics, tropical fruits, etc.;

7.3.3. Results of the EXPERT dialogue on sustainable management of marine biodiversity

Rapporteur: Hans J. Hartmann

Participant experts:

Hans J. Hartmann (Rapporteur)	Université de LaRochelle, France, ULR
Rosa Elena Caballero	Universidad Autónoma de Chiriquí, Panamá, UNACHI
Luc Fargier	Université de LaRochelle, France, ULR
Helena Molina Ureña	Universidad de Costa Rica, UCR
Raúl Salguero	Consejo Superior Universitario Centroamericano, CSUCA
Matilde Sommariba Chang	Universidad Nacional Agraria, Nicaragua, UNA



Filiberto Vega	Universidad de Costa Rica, UCR
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7.3.4. Generalities of the session

The group decided not to go through specific interventions by panel members, but to treat the entire work in a group-dynamic process. First, critiques and suggestions for improvement of the Bioeconomic Foresight Study for Central America were identified and classified. Second, sub-pathways were suggested through a brainstorming process, then regrouped and narrowed down to three main topics for which task matrices were developed.

7.3.5. Discussion of the bio-economic foresight study for Central America

Findings and orientations.

The definition of the term 'Bio-economy' has been questioned. Several panel members agreed that it must be well defined and clarified in the report as not to produce unreachable expectations. Areas of uncertainty include: (i) its distinction from "primary sector", as the current definition obviously does not equate with sustainability concepts. (ii) Emphasis or not on "non-fossil-fuel economy" (e.g. pay for environmental services), importance and use of biotechnology, as well as inclusion of socio-economic and environmental factors and (iii) the inclusion of agro-tourism and ecotourism. It was emphasized that a definition considering the specificities of the region should be included.

There was a rather large consensus that the orientations of the report reflect a terrestrial point of view. Marine-related background data are essentially missing. Information such as the extent and importance of the Exclusive Economic Zones and their use or potential for sustainable use, existence of marine protected areas and areas of exemplary biodiversity, hot spots, coastal pollution, threats and risks, etc. are needed to balance the approach.

The presentation of statistical data by countries emphasizes differences and trends by countries. Notwithstanding this information, there was consensus that the findings should better reflect the state and characteristics of the region as a whole, such as: its contrasts between Pacific and Caribbean coastal areas (geographic, climatological, oceanographic, primary-productivity base, ecosystemic, biodiversity, socio-economic, cultural, and political comparisons), the importance of indigenous people and presence of autonomous areas, as well as regional corridor initiatives (e.g. for conservation and economic purposes), such as the Eastern Tropical Pacific and the Mesoamerican Barrier Reef System (MBRS on the Caribbean coast).

The five transversal issues identified in the executive summary are of particular relevance to the EU. However, two of these are inadequately defined: Weaknesses exist not only in relationship between academy and industry, but also in relation with **society** (civil-society sector). The expression "*knowledge transfer from EU to CAC countries*" must be replaced by the more appropriate term **knowledge exchange between EU and CA**, which reflects reality, as there is knowledge flowing in both directions.

Finally, the SWOT analysis appears incomplete as presented; it needs topical grouping and a more structured presentation opposing cause and effect.



Missing contextual elements.

There is no mention of the CELAC (Community of Latin American and Caribbean States) created in 2010. Some general sources of information have been overlooked, particularly the recent ENLACE report *Landscape of research, technology and development in Central America*²⁰. The Central American members of the panel emphasized that human resources data may be obtained through databases from the different National Science Councils and from CSUCA²¹, as well as from several universities, which are participating in accreditation and on bodies such as the former SICEVAES²² within CSUCA.

Given the terrestrial bias of the report, all panel members agreed on the lack of marine and coastal information in two categories: Cooperative agreements and existing regional bodies concerning the marine and coastal environment, and marine/coastal data and information on **resources, socio-economy, coastal issues, biodiversity and integrated coastal management**. Data and reports are available from diverse regional and international organizations, in particular FAO, IUCN, BID, OSPESCA and diverse relevant publications and recent PhD theses (see Annex for a short list provided by some panel members). The panel finally recommended the inclusion of exemplary relevant regional projects concerning the coastal and marine areas, such as the Eastern Tropical Pacific Seascape Convention, the Mesoamerican Barrier Reef System Project, former successful EU ALFA projects (such as the ALFA projects COSTA and GIAC), the IBERMAR ICZM network, and other international research projects funded through the World Bank, GEF-UNDP and OSPESCA.

7.3.6. Main lines of research

The panel identified 19 important lines of necessary research, which were regrouped by topics into three sub-pathway categories concerning in particular data gaps, governance and stakeholder participation, resource valuation and integrated coastal zone management (Table 1).

Table 7.1. Necessary research topics group under three major research lines (sub-pathways) identified by the marine biodiversity panel.

A: Scientific data collection	B: Natural-resource-governance and socio-economic studies	C: Integrated Coastal Zone Management
Natural Resources data: - Biota diversity, taxonomy and identification (e.g. fish species diversity in mangrove areas) - Habitat diversity and characterization (<i>mangroves, reefs, sea grass beds, mudflats, island rises, CR dome,</i>	Ecological Economics: - Socio-economic valuation of coastal and marine habitats	Habitats: - Management and conservation of habitats (inshore and offshore): mangrove, sea grass beds, reefs, lagoons) Watersheds: - Geological/ geographic features for risk management (tectonically active areas,

²⁰ http://www.enlace-project.eu/ENLACE_Regional_report.pdf

²¹ Consejo Superior Universitario Centroamericano (<http://www.csuca.org/>)

²² Sistema Centroamericano de Evaluación y Armonización de la Educación Superior (Central American System of Validation and Evaluation of Higher Education)

<p><i>canyons, etc.)</i></p> <ul style="list-style-type: none"> - Mapping of major ecosystems and habitat types (location & extension, monitoring changes, etc.) - Fishery-independent data surveys (fish and invertebrates) - Dynamic processes (food web structure and dynamics, migratory species) <p>Social, economic, anthropological data:</p> <ul style="list-style-type: none"> - Reliable fishery statistics (in particular small-scale), socio-economic data of coastal communities and coastal rural and Amerindian areas <p>Institutional data:</p> <ul style="list-style-type: none"> - Mapping of national coordination units for partner search (including an updating mechanism) 	<p>Governance and Legal Issues:</p> <ul style="list-style-type: none"> - Regional Legal framework for ICZM - Legal frameworks with respect to international cooperation (intellectual property, species exchange for research) <p>Stakeholders:</p> <ul style="list-style-type: none"> - Stakeholder participation for sustainable coastal resource use - Sociological/anthropological studies of coastal communities and rural areas (processes, links, dynamics...) - Sport fishery biological, socioeconomic, social impacts 	<p>erosional features, etc.)</p> <ul style="list-style-type: none"> - Watershed management and conservation (often trans boundary) <p>Economic alternatives:</p> <ul style="list-style-type: none"> - Economic alternatives for wild fish stock and invertebrate taking (harvesting; fishing = hunting...) - Aquaculture impacts
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Concerning the actions suggested for each sub pathway, **human resources** development was added as a fifth domain of intervention in the ‘roadmap structure’ matrix (Tables 2 and 3).

With reference to **scientific data collection** (Table 2), the panel stressed that in the face of some serious regional constraints pertaining to policy, institutional support and investment, opportunities existed due to the relative closeness of both Central American coasts to major population and academic centers, which in turn would facilitate tasks such as investment for sustainable infrastructures for research and for coastal access. Furthermore, the closeness of the national boundaries in CA would give opportunities for facilitating cross-boundary and external alliances, the latter being particularly relevant to the EU- CA collaboration.

Weak laws and regulations for developing sustainable harvest concepts and lacks of ecosystem services compensation were identified as the major constraints for developing **natural resources governance** (Table 3A). The panel stressed in particular needs for human resources to foster governance-related research in the region and needs to develop appropriate methodologies for social and economic valuation for sustainable bio-diversity management. This would be facilitated by the opportunities to work with existing data and experiences to identify major socio-economic and anthropological issues (Table 3B). The actually scarce existing funds should first be re-allocated to



define projects and quantify needs, so that sound long-term research investment strategies can then be developed in cooperation with international partners.

Concerning Integrated Coastal Zone Management (ICZM), there was insufficient time to develop the constraints / opportunities matrix during the allocated time. Nevertheless, the panel stressed that the research priorities identified (cf. Table 1) were particularly relevant for developing necessary changes in human/society behaviour in the face of on-going loss of coastal habitat and continuous re-structuration of coastal societies. Thus, the development of economic and environmentally sustainable alternatives for wild stock exploitation (such as fishing) can only be solved in a context of integrated coastal management. A number of the constraints and opportunities already listed in the previous two sub pathways also apply to ICZM, in particular concerning human resources and policy. Furthermore, a lack of dedicated institutional investment in this issue, related to inadequate academic formation on a regional level was mentioned, while re-allocation of funds towards favouring coastal and watershed management was seen as an opportunity.

7.3.7. Conclusions

Despite the closeness to two very different coastlines, much of Central America has developed during the twentieth Century by turning its back away from the coasts. The terrestrial bias of the bio-economic foresight study identified by the panel is a manifestation of this evolution. A reverse of this trend has been undergoing over the last two decades, thanks to recent regional efforts in cooperation with international bodies (with NGO tending to be on the leading edge in fields related to stakeholder involvement for conservation). However, great long-term efforts for strategic prioritization are required to develop an economically and ecologically balanced approach for coastal zone sustainable development, as coastal biodiversity conservation is indispensable for such activities.

Given the time constraints of the workshop, issues related to research in ICZM in particular must be further developed before definite strategy goals are established for research cooperation between CA and the EU concerning the bio-economy issue.

Table 7.2. Constraints and opportunities for action on **Scientific Data Collection**, suggested by the CA marine biodiversity panel. Opportunities are listed in italics.

PATHWAY: <i>Marine Biodiversity</i>					
SUB-PATHWAY A: <u>Scientific Data Collection</u>					
CONSTRAINTS OPPORTUNITIES	DOMAINS OF INTERVENTION				
	Research & Innovation	Policy	Human Resources	Institutional support	Investment



C1: Information Gap on: Natural, Socio-economic, and institutional situations	Need for information on: • Biota &habitat, • Socio- economics • Anthropolog y • Institutions	Need of sufficient data for appropriate laws and regulations	Few qualified scientists with local experience	• Few and u equipped c institutions • Lack of co- ordination	• Insufficient national/internatio nal funds for basic research. • Lack of database management
O1: Relative closeness to the coast from main cities	Coastal Research Consortia/ Networks	Incentives for private sector and consortia to invest on Research stations and facilities	Re- allocation of human resources for long/term strategy	Strategic alliances: cross- boundary and international	Re-prioritizing coastal investment for <u>sustainable</u> : - Infrastructures - Access to coasts - Transport

Table 7.3.A. Constraints impeding action on **Natural resources governance and socio-economic studies**, suggested by the CA marine biodiversity panel.

PATHWAY: Marine Biodiversity					
SUB-PATHWAY B: <u>Natural Resources governance and socioeconomic studies</u>					
CONSTRAINTS	DOMAINS OF INTERVENTION				
	Research Innovation	& Policy	Human Resources	Institutional support	Investment
C1: Weak law and regulations enforcement for a sustainable harvest and conservation of marine resources	Need for understanding social, political, cultural and economic driving forces among the different coastal areas in the region	Need for appropriate information to develop regulations for a sustainable use and for conservation	Few experience on governance- related research in the region	Need for an institutional co- ordination mechanisms to improve local governance capacity	Need for communication services and coordination to promote local participation



C2:	Low potential to implement compensation mechanisms for ecosystem services of coastal marine zones	Lack of information on socioeconomic values of coastal marine resources	Need to develop incentive mechanisms to promote coastal zones conservation	Some, but not broad scientific experience on socioeconomic valuation of other natural resources and ecosystems	Need to develop institutional awareness	Need to develop appropriate methodologies and tools to carry out the social and economic valuation of the coastal and marine resources
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Table 7.3.B. Opportunities for action on **Natural resources governance and socio-economic studies**, suggested by the CA marine biodiversity panel.

PATHWAY: Marine Biodiversity						
SUB-PATHWAY B: <u>Natural Resources governance and socioeconomic studies</u>						
OPPORTUNITIES	DOMAINS OF INTERVENTION					
	Research Innovation	&	Policy	Human Resources	Institutional support	Investment
<u>O1:</u> Regional agenda for adaptation to climate change	Possibility to identify major socioeconomic and anthropological issues related to the adaptation to coastal zone changes		Possibility to identify major issues to develop mechanisms for adaptation to coastal zone changes	Possibility to re-allocate human resources for medium and long-term strategy	Possibility to form strategic alliances across the Region	Funds can be re-allocated to first define projects and quantify resources, for then developing a sound transnational and international investment strategy



8. GENERAL CONCLUSIONS

The workshop allowed fruitful knowledge exchange and the identification of common areas of interest of European and Central American research groups on BE. Understandings of similar problems and different perception of various BE concepts emerged. It was the case for topics such as Food Chain efficiencies (zero waste) and Eco-intensification and Eco-systems services.

It is clear that Central American nations, despite the political difficulties faced from 2008 to 2010, still have room to grow together in order to advance our human development in a sustainable way. It is a major joint endeavour that requires a combination of national tasks and the removal of political blockages. Likewise, each country has to devote strong efforts to reduce social exclusion and by doing so, they will be able to strengthen institutional capacities both nationally and regionally.

There are at least three areas of opportunity to articulate efforts: reversion of the insecurity climate prevailing in the region, risk management and climatic change, and building a common logistics and infrastructure platform that fosters regional interconnection. Any proposal to foster a Bio Economy initiative, should take into account the social and political context of the region.

As was concluded in the workshop, there are two main aspects that, once tackled, will contribute to the realization of a vision of Central America as an integrated region, clearly aware of their common goals, capabilities and resources. These are: the development of a broad regional communication infrastructure, both physical, (roads) and digital (Central American fiber optics backbone for data exchange), and new mechanisms to exchange knowledge, experiences, failures and aspiring goals.

Central American region has “Centers of Excellence”, groups of high level scientific and technological expertise with a longstanding experience in collaborating through international networks, mainly in bilateral terms. This is why, it is time for our countries to expand this bilateral accomplishments regionally.

The consensus reached in the Dominican Republic Dialogue Workshop, sets the basis for further discussing the topics that were identified and discussed as potential topics of mutual interest: 1) Research on biodiversity to “optimize ecological services”, 2) Use of microorganisms, for food and non-food use, 3) Food and food chain related issues, 4) Optimization of the use of biomass for energy and industrial uses.

In terms of Marine Biodiversity the dialogue workshop panel evidenced that a great long-term efforts for strategic prioritization are required to develop an economically and ecologically balanced approach for coastal zone. A sustainable development is necessary, as coastal biodiversity conservation is indispensable for such activities. More time would have been necessary to develop pathways in a deeper way. ICZM in particular must be further developed before definite strategy goals are established for research cooperation between CA and the EU concerning the bio-economy issue.

In terms of Food efficiencies, the group agreed that more issues should be discussed. In particular in areas related to food chain structure, distribution of import and export of food products, generation of food waste (access to production, cold chain availability), land tenure legal systems, taxes and trade regime, fair trade policies, certification and labelling financial and credit policies, access to



markets by small producers, use of information and communication technologies, relevance of energy biomass production and effects of climate change.

In terms of Eco-intensification and Eco-services, clean production, social responsibility and energy efficiency were reflected on the discussion as a cross cutting issues. All this points take into account the worries of the panel regarding regional and global climate change impact.

9. RECOMMENDATIONS

Although there was evident need to deepen on the pathway analysis during the workshop panels, some initial recommendations stemming from the dialogue have been identified. These can be taken as critical inflection points that could guide policymakers and researchers on a smoother cooperation for an active development of R&D&I.

Trans disciplinary research: Development of local solutions with those, who can/want to apply them, solutions that work, are of benefit for local communities and that are most convincing. Create knowledge by means of implementation of research projects according to family needs.

Scientific data collection: Overcome constraints pertaining to policy and weak institutional support by facilitating investment for sustainable research infrastructures and data access. This would facilitate the opportunities to work with existing data and experiences to identify major socio-economic and anthropological issues.

Community empowerment: Develop competences and capacities in the rural family in the management of his or her farming systems, to promote ways of rural associative and organizational structure of the family that aims to articulate the agro feeding chain. Foster an entrepreneur culture in youngsters that permit generation of quality and sustainable employment, to establish educative modules of GAP that permit diffusion (TT) of knowledge amongst farmers and technician. Promote efficient productive systems that guarantee food sovereigns and security in the rural family.

Improving governance and sensibilisation: Develop necessary changes in human/society behaviour in the face of the on-going loss of coastal and wild habitat and continue the re-structuration of these societies. Focus on particular needs for human resources to foster governance-related research in the region and needs to develop appropriate methodologies for social and economic valuation for sustainable bio-diversity management.



10. APPENDIX

10.1.1. Publications and Reports suggested by the Panel (a non-exhaustive list):

ECLAC (2011) Statistical Yearbook for Latin America and the Caribbean 2010. (ed U. N. publication), pp. 310. United Nations, Santiago, Chile

<http://www.eclac.cl/cgi-bin/getProd.asp?xml=/publicaciones/xml/7/42167/P42167.xml&xsl=/deype/tpl-i/p9f.xsl>.

FAO (2011c) Latin America and Caribbean Regional Consultative Meeting on Securing Sustainable Small-scale Fisheries: Bringing together responsible fisheries and social development. FAO Fisheries and Aquaculture Report (ed FAO), pp. 75. San José, Costa Rica. (<http://www.fao.org/docrep/012/i1227t/i1227t00.htm>).

FAO & OSPESCA. 2010. Taller regional FAO/OSPESCA sobre el mejoramiento de Los sistemas de información y recolección de datos pesqueros para América Central y el Caribe. San Salvador, El Salvador, 23–26 de enero de 2006. FAO Informe de Pesca y Acuicultura No. 919. Roma, FAO. 41p. (<http://www.fao.org/docrep/012/i1418s/i1418s00.pdf>).

Fargier, L. 2012. *Coastal Marine resources of Central America*. In: The participation of small scale fishers in the management of tropical coastal marine resources. Case study of Golfo Dulce, Costa Rica. PhD thesis, Université de La Rochelle, France. Vol 2 Chapter 1. Final copy available December 2012. U. La Rochelle Doctoral School, 17000 La Rochelle, France or directly from the author (lfargier@univ-lr.fr).

Gréboval, D. F. (2007) Ordenación de la capacidad pesquera: panorama general. *Capacidad de pesca y manejo pesquero en América Latina y el Caribe*. (ed M. Agüero), pp. 3-17. FAO, Roma. (<http://www.fao.org/docrep/010/a0236s/a0236s00.htm>).

Hernández, F. R. (2010) Encuesta estructural de la pesca artesanal y la acuicultura en Centroamérica - 2009 - Informe final preliminar. (ed OSPESCA), 126 pp. La Libertad, El Salvador. (<http://www.scribd.com/doc/52720583/Centroamerica-en-Cifras-pesca-y-acuicultura>).

Rodríguez J.J., Windevoxhel N.J. 1998. Análisis regional de la situación de la zona marina costera centroamericana. BID Report ENV-121

[http://www.infoiarna.org.gt/media/file/areas/marino/documentos/interna/\(3\)%20An%C3%A1lisis%20de%20la%20situaci%C3%B3n%20marina%20costera.pdf](http://www.infoiarna.org.gt/media/file/areas/marino/documentos/interna/(3)%20An%C3%A1lisis%20de%20la%20situaci%C3%B3n%20marina%20costera.pdf).

Salas, S., Chuenpagdee, R., Charles, A. & Seijo, J. C. (2011) Coastal fisheries of Latin America and the Caribbean. FAO Fisheries and Aquaculture Technical Paper (eds S. Salas, R. Chuenpagdee, A. Charles & J. C. Seijo), pp. 430. FAO, Rome. (<http://www.fao.org/docrep/014/i1926e/i1926e00.htm>).



Salas, S., Chuenpagdee, R., Seijo, J. C. & Charles, A. (2007) Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. Fisheries Research 87, 5-16. (http://husky1.stmarys.ca/~charles/PDFS_2005/007.pdf).

Windevoxhel, NJ. 2012. Manejo Costero y su gobernanza en Centroamérica. El futuro desde el Pasado. Keynote speaker, I Congreso Iberoamericano de Gestión Integrada de Áreas Litorales; Cádiz, Spain, January 2012. Copy of lecture presentation (2 parts) is available through the GIAL website: (<http://www.gestioncostera.es/congresoGIAL/descargas>).

10.1.2. Exemplary Regional Coastal Zone Projects:

Eastern Tropical Pacific Seascape

Triangle of Submarine Rises between Galapagos, Isla de Coco and coasts from Costa Rica to Ecuador
4 country convention with substantial NGO research funding (e.g. Conservation International), since 2002 (migratory species, marine resource management)

Mesoamerican Barrier Reef System Project (Caribbean)

GEF projects: Caribbean Large Marine Ecosystem Transboundary Coastal Water Management (artisanal fisheries)

OSPESCA projects:

SIRPAC (American Fisheries and Aquaculture Integrated Record System),

PAPCA (Plan de apoyo para la pesca),

MASPLESCA (Spiny Lobster management in the Caribbean)

IBERMAR Network Initiatives on ICZM (see e.g. GIAL Congress and IBERMAR Publications in the IBERMAR website: www.gestioncostera.es/ibermar/)

EU -ALFA Projects relevant to Central American Coastal research and management, which emphasized a link between research and post-graduate education for ICZM for Mesoamerica:

ALFA- COSTA (Coastal Ecosystems of Tropical America)

ALFA GIACT (Gestión Integrada de Areas Costeras Tropicales): Initiated in 2001, this Master project and the related research it has generated continues to live on through the University of Costa Rica's GIACT Academic Master Program.



11. LIST OF ABBREVIATIONS

ANAM:	National Environmental Authority of Panamá
ARAP:	Aquatic Resources Authority of Panamá
CAC:	Central American Countries
CCAD:	Central American Commission for Environment and Development
CELAC:	Community of Latin American and Caribbean States
CONAGEBIO:	National Commission for Biodiversity Management of Costa Rica.
CONAP:	National Council of Protected Areas of Guatemala
CSUCA:	Consejo Universitario Centroamericano
DAAD:	German Academic Exchange Service
FAO	Food and Agriculture Organization of the United Nations
FONAFIFO:	National Fund for Forestry Financing in Costa Rica
HDI:	Human Development Index
INAB:	National Forest Institute of Guatemala
INBio:	National Biodiversity Institute in Costa Rica
KBBE:	Knowledge Based Bio Economy FP7 Program
MAG:	Ministry of Agriculture of El Salvador
MARENA:	Ministry of Environment and Natural Resources of Nicaragua
MARN:	Ministry of Environment and Natural Resources of El Salvador
MARN:	Ministry of Environment and Natural Resources of Guatemala
MBC:	Mesoamerican Biological Corridor
MBR	Maya Biosphere Reserve in Petén Guatemala
MINAE:	The Ministry of Environment and Energy of Costa Rica
PROMEBIO:	Regional Biodiversity Monitoring and Evaluation Program
OSPESCA:	Central American Organization of the Fisheries and Aquaculture Sector
SAG:	Secretary of Agriculture and Livestock of Honduras
SERNA:	Ministry of Natural Resources and Environment of Honduras
SICA:	Specific International Cooperation Activities
SINAC:	National System of Conservation Areas of Costa Rica
UNIBE:	Universidad Iberoamericana of Dominican Republic
UNIPESCA:	Special Unit for Fisheries and Aquaculture of Guatemala



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INBio (2010): Conocimiento y Conservación de la Biodiversidad en Centroamérica, Vilma Obando and Álvaro Herrera, compilers. INBio, 88 pgs.

Macaya, G. & Santos, M. (2010) El Caso de Centroamérica, in El rol de las universidades en el desarrollo científico y tecnológico. Educación Superior en Iberoamérica, Santelices, B. Editor. CINDA, Santiago de Chile, p143-1522011.

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