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*Jeffrey Orozco – Olman Segura – Birgitte Gregersen –
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Policies for Innovation and Sustainable Development in Central America

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Table of Contents

1. Policy Implications of Systems of Innovation Approaches	1
1.1 Innovation system approaches.....	1
1.2 Policy implications.....	3
Human resource development.....	4
New forms of organization	4
Building innovative network	4
Increasing role for the service sector	5
Increasing collaboration with research organizations	5
Policy coordination.....	6
1.3 Innovation systems in the countries in the South.....	7
2. The Need for Policy Learning	8
2.1 Increasing transformation pressure	8
2.2 Policy learning.....	9
2.3 Innovation policy learning.....	10
2.4 Sustainable innovation policy learning.....	12
2.5 Low trust traps for policy learning.....	13
3. Policies for Innovation in Central America.....	14
3.1 Introduction	14
3.2 Policies to develop the knowledge infrastructure	15
3.3 Policies to develop institutions, which affect interactive learning	18
3.4 Policies to create specific organizations to support innovation	20
3.5 Policies to improve the financing of innovation	22
3.6 Policies of selective direct support of science and technology.....	23
3.7 Technology procurement policy.....	23
4. Conclusions	24
4.1 Introduction	24
4.2 The knowledge infrastructure	25
4.3 Institutions.....	25
4.4 New organizations.....	26
4.5 Environmental issues	26
4.6 A double focus	27
References	28

1. Policy Implications of Systems of Innovation Approaches¹

1.1 Innovation system approaches

The basic idea behind the concept of a System of Innovation (SI) is that the innovation performance of an economy depends on both the innovation capabilities of its individual firms and organizations and on the way they interact with each other.² This idea builds on the observation that learning is (almost always) interactive.³ The individual person or firm does not learn very much in isolation but usually has to engage in different kinds of communication and interaction with other persons and firms for learning to be effective. Innovation systems thus conceptualize the idea of a system of learning and innovating actors (usually private and public firms and organizations) communicating, interacting and sometimes cooperating with each other in ways which make the performance of the system as a whole to something different from the sum of the performance of the individual actors.⁴

An innovation system approach to the study of innovation as an integrated and endogenous part of the economic process encompasses identification and analysis of all relevant factors that affect innovation processes. Clearly, both the character of the firms and organizations and the quality of their interactions matter for the innovation performance of the system. One way of organizing these factors analytically is to distinguish between organizational factors, structural factors and institutional factors.

How firms are organized and managed affect the patterns of communication within and between them and hence their competence building and capabilities for learning and innovation. The increasing amount of literature on 'learning organizations' testifies to the importance of this group of factors.

It is also well known and documented that the distribution of technological opportunities and bottlenecks differ between production sectors and change over time. This leads to technological trajectories and implies that the specialization pattern of an economy, i.e. its structure of production and trade, affects its innovation performance. Economic structural factors of this kind do not totally determine innovation activities of course, but they clearly influence them.⁵

Finally, almost all students of innovation systems underline the importance of institutional factors. This is not surprising since institutions can be thought of as the things that lead to regularities of behavior and patterns of communication and

¹ The SUDESCA project (<http://cinpe.una.ac.cr/sudesc/>) is a research cooperation project between universities and other research organisations in Central America and Denmark financed by the development aid department of the Danish Ministry of Foreign Affairs (DANIDA). It focuses on strategies for sustainable development in Central America and uses a system of innovation approach. This summarizes some of the policy conclusions from the project.

² Innovations are here understood as new creations of economic significance (Edquist, 1997). Usually they are simply thought of as new products or new processes, but we can also more encompassing include new types of organization and new institutions.

³ This is in fact an old observation, which has been elaborated by several distinguished economists. We may, for example, refer here to Kenneth Boulding's (1985) discussion of different kinds of learning and to Joseph Schumpeter's (1934) discussion of innovations as new combinations of knowledge.

⁴ The performance of a system of innovation can be thought of both in a narrow sense, for example how many product and process innovations it produces, or more broadly, for example how well it creates, and introduces new knowledge into the economy and how well it distributes and utilizes it.

⁵ Other structural factors like the ownership structure and the firm's size distribution are relevant as well.

interaction. Institutions in this sense may be formal like laws and written regulations or informal like social norms and shared routines and habits but in both cases they deeply affect how people, firms and organizations communicate and interact. As a result they also deeply affect the creation and utilization of new knowledge in the economy. The co-evolution of the economy and its institutions is a major force shaping innovation systems.

As hinted at above the ideas of interactive learning and new combinations of knowledge as sources of innovation go back a long time in economic thought. The specific concept of an innovation system, however, is of recent origin. It was introduced and developed in the end of the 1980s (Freeman, 1987, Lundvall, 1992, Nelson, 1993). Since then it has diffused fast and widely. Several international organizations (for example OECD, UNCTAD and the European Commission) and national governmental policy makers have adopted the concept for policy analysis (Lundvall et al., 2001).

Systems have borders and innovation systems may be studied either territorially, i.e. on local, regional and national basis or in a sectoral context. A focus on national systems of innovation may be controversial in a situation where so-called globalization has come into focus. However, the choice of system delineation is largely a pragmatic one depending on the specific character of the problem to be analyzed and different research groups have concentrated on different systems⁶.

In the literature on innovation systems one can identify a narrow and a broad innovation system approach. The narrow approach concentrates on the private and public research and development system and on high-tech and science-based innovations. The broad approach elaborates the observation that innovation processes have many sources and are broadly based in the economy. They often emanate from everyday economic activities like production and marketing and they often take the form of minor improvements of products and processes. Such everyday innovations may be individually insignificant but become important because of their number when they are built into the economy and repeated over and over again as a normal activity in an ongoing process. In the broad approach innovations are ubiquitous.

Furthermore, tacit knowledge like competencies and skills, which cannot be made explicit and easily communicated between individuals or transmitted through telecommunication networks but which is bound to persons or groups, plays an important role in the broad approach to innovation systems. Tacit knowledge is crucial for economic dynamics. Engineers use tacit knowledge when they solve technical problems. Managers base complex business decisions on tacit knowledge. Scientists use tacit knowledge when researching, etc. To share tacit knowledge between people, groups and organizations is costly and time consuming, but it is an integrated part of economic change and development. This makes interactive learning, and the social context in which it occurs, crucial for innovation.

The innovations system approach in its broader sense may be regarded as a result of a new understanding of economies as systems of learning, competence building and innovation, which has been developed during the last couple of decades as an alternative to the neoclassical picture of economies as systems of allocation of given

⁶ Local, regional, national and sectoral systems coexist and complement each other (Edquist, 2001 and Gregersen and Johnson, 1997)

and scarce resources. Simply formulated this understanding includes the following main results (Mytelka and Smith, 2001):

First, innovations are not like specific events that can be localized in time and space but more like cumulative processes over time.

Second, innovations are ubiquitous. They are not only located in high-tech industries but in all sectors including so-called low-tech and traditional sectors, which produce considerable numbers of new products and processes.

Third, firms use many sources of innovation like training, capital goods, consultants, customer contacts and design development besides R&D. The relative importance of the sources varies across sectors, but everywhere they interact and feed upon each other.

Fourth, firms usually innovate with the help of cooperation and collaboration with other firms, organizations, research institutes, universities, technical service institutes, etc. Innovation is interactive and learning is a social process.

Fifth, innovation is uncertain and often unpredictable. Firms frequently make mistakes and innovation may happen "by accident" rather than being planned.

Sixth, territorial and sectoral clusters and long-term relationships between firms are important for innovation capability.

Seventh, innovation is systemic and cannot be adequately understood at the level of the individual firm. It depends on interactions and feedback within the organizational and institutional set-up of the economy.

Eighth, in some sectors and for some firms there are strong links to the science system and the knowledge infrastructure and there are important interactions between science and technology.

Ninth, the possibilities for learning and innovation vary across the sectors of the economy and often follow trajectories formed by path-dependency.

Tenth, and perhaps especially important when discussing innovation systems in the South, innovation is frequently conflictive, redistributive and sometimes harmful. Innovation should not be thought of as a harmonious "everybody wins" game.

1.2 Policy implications

Gradually, some policy implications of this theoretical picture have taken form. Some of them are on a general level and rather obvious: innovation policy should not focus exclusively on science and technology or on high-tech firms. It should, more broadly, consider the needs of many sectors and different kinds of firms and include both the creation and the diffusion and utilization of knowledge. Policies catering to the needs of specific selected "winning" sectors and firms are unlikely to succeed. Instead innovation policy should concentrate on the systemic character of innovation, on framework conditions and network relations – avoiding lock-in to outmoding technologies and sectors and keeping options open. Furthermore, factors on the firm level like management, organization, training and education, and so on are important and policy relevant.

In mainstream economic theory the term 'system' seems to invoke the idea of equilibrium. The existence, uniqueness and stability of equilibrium situations attract much interest. Innovation systems, however, are systems in which equilibrium

situations are analytically dubious. Innovations are processes over time in which new knowledge is created and utilized. This is in contradiction to the notion of equilibrium, which is normally understood as a situation in which economic agents have no reason to change their decisions from last period, which were presumably made on the basis of all available relevant knowledge.

Equilibrium analysis cannot be a guideline for innovation policy. Like institutional analysis innovation system analysis and innovation policy rely heavily on comparative methods. Comparison of regions, countries and sectors in terms of how different organizations and institutions affect innovation processes, have to play an important role in innovation policy. It is important to note, however, that different organizations and institutions may lead to the same performance.

A final general observation is that a policy that works by changing and "improving" organizations, institutions and knowledge has to have a long-term historical perspective. To contribute to the learning capability of people, firms and organizations in order to improve the performance of innovation systems is a long-term project, which has to operate with quite another time perspective than, for example, macroeconomic stabilization policy.

These general implications constitute a new policy perspective and lead to a focus on long-term learning and competence building in firms and organizations and in society as a whole. This perspective is useful but not very specific and it is not obvious which types of concrete policy measures it implies most important. Following Lundvall (2001) we may give priority to policies aiming at human resource development, creating new forms of organization, building innovative networks, re-orienting innovation policy toward service sectors and integrating universities in the innovation process.

Human resource development

Human resource development is of course a crucial key to promote the capability to learn. This includes the formal training of the youth, vocational training, and lifelong learning. However, despite the broad and growing consensus, there is still a big gap Human resource development between the public and the private investments in human resource development on the one hand and the actual need for upgrading on the other.

New forms of organization

Along with implementing new information technologies new forms of organization emphasizing more interaction between departments, more intense communication inside and outside the firm, and delegation of responsibility to workers are key elements for stimulating learning and innovation.

Government and public policies can play a much more active role in this process for instance by initiating fora for exchange of organizational learning experiences, knowledge management issues, and benchmarking efforts. Programs giving especially SMEs access to services of consultancy firms and Technological Information Centers could help distribute good practices.

Building innovative network

The growing importance of networking and inter-firm co-operation is one of the most crucial aspects of a learning economy. It reflects both the speeding up of

change and the growing complexity of the innovation process. It involves both large firms and SMEs and public policy has an important role to play in stimulating the formation of innovative networks of firms and knowledge institutions.

At the regional level the formation of knowledge-intensive networks is a key to promote regional development. However, networks that are geographically closed may run into lock-in effects that can hamper rather than stimulate innovation. To prevent this public policy may also promote internationalization of firms and “outward” networking.

Qualitatively advanced public demand in the form of public procurement and regulation can play a crucial role for building and maintaining innovative networks. A recent study of Danish clusters (Ministry of Industry, 2001) showed that public procurement, regulation, and advanced public demand have been important driving forces in both the creation and the further development of several of the clusters (e.g. wind energy, wastewater treatment, cooling and heating technologies, medico technology and offshore technology) (Gregersen, 2002).

Such as positive role of public procurement is, however, not self evident or automatic. It presupposes that the government actors are both competent and unbiased in relation to the interests of specific groups. Even in the absence of outright corruption close relations between government agencies and specific power-groups may disqualify procurement policies as a vehicle for general development and turn it into just another part of the ongoing distribution struggle over income and power. In fact, due to historical experiences, this may be how most people in large parts of Latin America regard the topic.

Increasing role for the service sector

The service sector – especially business services, communication services and other knowledge intensive services – are becoming more and more important in relation to the overall industrial dynamics. One consequence of this trend is of course that industrial policy has to reorient its traditional focus on manufacturing firms to the growing service sector. One important policy task is to promote access to knowledge-intensive business services for SMEs and marginal regions. This includes, for instance, providing a well-functioning public or semi-public knowledge infrastructure with regional Technological Information Centers (TICs) and specialized approved Technological Service Institutes. Such knowledge centers can play an important role as mediators between universities and firms.

Increasing collaboration with research organizations

From several studies (e.g. Mowery and Rosenberg (1989), Rosenberg and Nelson (1994), Martin, Salter et al (1996), Pavitt (1997)) it is well documented that universities and research organizations play a multifaceted role in relation to knowledge production and diffusion in innovation systems.

In short, universities and research organizations contribute both directly and indirectly to innovation in firms. Directly, when the outcome takes the form of new instruments and techniques or when new knowledge turns out to be directly applicable in industrial products and processes. Indirectly through basic research,

production of researchers and graduates, and professional networks. How firms and industries “value” these different roles vary across industry.⁷

In a policy perspective, it is important to be aware of both the direct and the indirect contributions from the universities and research organizations. The direct contributions should not be stressed too hard since the indirect contributions from researchers and graduates may very well be the most important source of knowledge transfer from universities to firms. In fact, it may be argued that the social insertion of graduates that have studied in a research environment is the main contribution of universities to the use of knowledge in society.

The changing environments of both firms and universities and other research organizations certainly affect their collaboration. New technology, increased international competition, changed financial conditions and institutions; environmental pressure, “critical” customers, etc. influence the innovation activities of firms. Research networks, science parks, research joint ventures, and incubator arrangements are a few examples of new forms of network-based collaboration. Most European countries have set up specific programs like these to stimulate further collaboration between firms, universities and research organizations.

Policy coordination

The broad innovation system approach implies new perspectives on several policy areas as well as coordination between them. Education policy, social policy, labor market policy, science and technology policy and other policies as well all affect learning, competence building and innovation capabilities. They need to be designed and coordinated with this in mind. They need to be integrated into a common strategy for improving the performance of innovation systems. This, however, cannot be done solely by ministers of finance and central bankers, the traditional main policy coordinators, since their vision of the world are biased towards monetary aggregates and towards the short-term. There is a need for institutional innovations, for example new types of high level “councils for learning and innovation”, to cope with the needed coordination in policy learning (Lundvall, 2001)

It seems clear from this discussion of different forms of policy measures that they include things, which are not normally thought of as ‘innovation policy’. Measures for human resource development, for example, will often reside within ‘education policy’. In fact, it is characteristic for the learning and innovation capability of an economy that it is influenced by a vast range of policies aiming at other things, like education, employment, income distribution, social security and so on. Policies which primarily aim at retraining and reeducating unemployed people and at giving them economic support may actually at the same time make it easier for firms to introduce new technology and organization and, thus, indirectly, support innovation. Such “indirect innovation policy” may be more important than the often quite modest direct innovation policy most countries employ today.

⁷ A Danish survey from 1994 showed, for instance, that large research-intensive firms mainly emphasized access to specialized research, but important differences between industries exist. Firms within telecommunication and machinery especially stress access to new instruments and techniques, while, for instance, firms within chemicals and electronics find that access to specialized and applied research are the most important (The Danish Ministry of Research, 1994).

1.3 Innovation systems in the countries in the South

The innovation system approach was developed in the North and has also been concentrated on the dynamics of these countries. Now the interest for innovation systems is growing in Latin America, Asia and Africa. This may not be surprising since many of the important elements of this approach are, in fact, imported from the development literature. The focus on interactions between different sectors and economic activities was very important for Hirschman (1958). The idea of cumulative causation, especially in the form of vicious and virtuous circles, started with Veblen and was fully developed by Myrdal (1968), who also forcefully underlined the importance of institutions, and so on.

Generally, the reason for the increasing interest for the innovation system approach from the South is that it concentrates on factors and relationships, which many scholars believe to be important in development (Johnson and Segura, 2001). It is "capability based". It takes departure in learning capabilities and focuses on innovation processes and their role in development. It has a broad explanation of innovation; they are based both in research and in everyday, routine economic activities, in both high-tech and low-tech sectors and in both the formal and the informal part of the economy. Its growth factors are interacting and feeding upon each other. Institutions and production structures matters. Interaction between firms, organizations and the public sector is the essence of the concept. Furthermore, it is a flexible approach, which interchangeably, can put the emphasis on local, national or regional systems and their mutual interdependence. It contributes to an actor-centered approach to development, which takes the roles of both state and market actors into account. At the same time it goes beyond the normal dichotomy between state and market by focusing on the interactions and complementarities between them and by drawing attention to civil society and its importance in the innovation process. Finally, it is an inherently comparative approach; it does not try to define illusive states of equilibrium but compares the anatomy and changes of different innovation system.

However, when applying an innovation system approach to countries in the South it is also important to be aware of some weaknesses. Some of these have to do with the fact that so far it has been applied mainly to the North. It has been used mainly as an ex-post rather than as an ex-ante concept (Arocena and Sutz, 2002): it has been used to describe and compare relatively strong systems of innovation with well-developed institutional and infra-structural support of innovation activities. It has not, to the same extent, been applied to system building. The existing innovation systems in the South often may be described as fragmented and rather weak, the focus naturally shifts in the direction of system construction and system promotion.⁸

Even if the approach covers both territorial and sectoral systems of innovation and even if territorially defined systems in principle include local, national, regional and global systems, the focus in the research on territorial systems has so far mainly been on regional (within countries) and national systems. In a developing country context one should devote much more interest to local systems and their interaction with regional and national ones.

⁸ To some extent this has already been done. See for example a recent study of innovation systems in Brazil (Cassiolato, Lastres and Maciel, 2003).

The most important weakness of the system of innovation approach, at least when applied to developing countries, is probably that it lacks an adequate treatment of the political and power aspects of development. Introducing new technology and changing the control of knowledge is often an instrument for changing the power structure. The focus on interactive learning – a process in which agents communicate and co-operate in the creation and utilization of new economically useful knowledge – has led to an underestimation of the conflicts over income and power, which are also connected to the innovation process. Interactive learning and innovation may sound like a positive sum game, in which everybody gains. In fact, there is little learning without forgetting. Skills and competencies are destroyed and some people experience decreasing income and influence. Increasing rates of learning and innovation often lead to increasing polarization in terms of incomes and employment.

Of course, it does not have to be like that. Different policies might counteract the polarization tendency. But the tendency is inherent in the innovation process and counteracting policies are in more short supply in the South than in the North. Furthermore, a certain amount of stability in the macroeconomic and financial environment, including well behaved and not too conflict provoking fiscal and monetary policies is important for interactive learning and innovation. Again, such stability is typically lacking in developing countries. Corruption and lack of trust may also aggravate the situation. It is clear then, that the system of innovation approach has to be modified in some important respects, when applied to countries in the South.

The main thrust of the innovation system argument is rather clear, however. Policies in the South need to reinforce and improve the existing local, national and regional systems of innovation. In doing so they also need to counteract tendencies to dismantle and break-up linkages in the previously existing innovation systems, which are inherent in the present process of globalization.

2. The Need for Policy Learning

2.1 Increasing transformation pressure

As argued above, when the innovation system approach is applied to developing countries, the perspective needs to be shifted from ‘ex post’ to ‘ex ante’ (Arocena and Sutz, 2002). The interest moves towards system building and system improvement. Structural change, institutional change and policy change come into focus. The importance of innovation system promotion becomes even more obvious when we concentrate on small open economies trying to implement and encourage sustainable development, like the countries of Central America. These countries are facing the combined challenges of political, social and economic development and environmental protection in a period of increasing international competition.

Globalization is a more and more widely used term that signifies growing importance of cross-border activities connecting many different parts of the globe with each other. It includes increasing trade in goods and services, increasing foreign direct investments and above all an increasing speed of financial capital movements. It is not limited, however, to economic factors in a narrow sense but also includes broader areas like people, knowledge, institutions and culture.

An important aspect of globalization has been institutional changes related to the process of economic liberalization that has been going on for several decades now, for example dismantling of financial regulations and deregulation and privatization of public utilities. Part of this liberalization is connected to the development of information technologies but there are political forces related to changing power relations involved too.

The result of the process of globalization with its technical, economic, demographic, institutional and cultural aspects is that the typical small, relatively poor, environmentally vulnerable Central American country is put under a strong pressure for transformation. Its specialization structure, its technologies, its competencies, its institutions and policies come under pressure for change. The innovation pressure increases. Clearly, this is a pressure that is felt both by firms, financial institutions and people. Furthermore, there is a pressure for new and improved government policies – not only monetary and fiscal policies but for all kinds of policies affecting the country's ability to cope with transformation pressure, especially policies which improve the learning and innovation capabilities and the performance of the national system of innovation.

2.2 Policy learning

This implies a need for 'policy learning'. In economic textbooks economic policy is traditionally described as a branch of rational decision-making. The politicians decide which goals to pursue and the economist, given a reasonably accurate model of the economy and access to relevant and sufficient data, calculates the best use of the instruments in order to achieve the goals. This rational choice perspective has tended to exclude another important aspect of policymaking – that it is a process of learning. It may improve over time for a number of reasons. It can make a fundamental difference if the process of policy learning is handled badly or well and if it is slow or fast.

To clarify what policy learning is about one may refer to the well-known case of macroeconomic stabilization policy: it may be argued that Keynesian fiscal policy was born in Sweden in the 1930's several years before the publication of "The General Theory" in 1936⁹. It took a considerable number of years, however, before a capability of conducting a reasonable effective counter-cyclical stabilization policy was developed. First employment policies such as governmentally financed construction investments, increased public consumption and unemployment benefits leading to budget deficits were forced onto the political agenda and implemented against strong political opposition and against the advice of most economists which were arguing for balanced budgets based on what in those days seemed to be sound theoretical grounds.

Later, and over a long period of time, experiences and practices, administrative competence, statistical data not the least in the form of national accounts, policy preparing organizations in the government administration, organizations and institutions for economic counseling and advice, macroeconomic theory and visions and ideas about what was politically and economically possible and valuable co-

⁹ A similar argument may be made about the New Deal in the US starting in 1933 under President Roosevelt.

evolved supporting each other in a self-reinforcing way. Considerable development of values, institutions and organizations were required before macro-economic stabilization policy was established on the policy scene.

2.3 Innovation policy learning

Even if it seems as if policy learning in the area of macroeconomic stabilization policies has been slow lately and its result dubious, this does not mean that policy learning as such has come to an end. Rather, it has changed both character and focus as a result of the unemployment-inflation crisis of the 1970's. The desperate anti-inflation policies of the 1980's did not help much on the productivity, growth and unemployment problems of many countries. This was partly due to a lack of theoretical understanding of the situation. Macroeconomic theory did not provide adequate policy guidance and learning and innovation slowly emerged as a new center of the theoretical and political debate over growth and competitiveness. This tendency, which is strongly linked to evolutionary and institutional theory, has been unevenly distributed over the academic landscape, but a growing number of researchers are focusing on learning and innovation as a main source of economic dynamics.

Innovation policy may, thus, be regarded as a new area of policy learning. It is a subset of economic policy in the sense that efforts to support innovation processes are used as means for improving economic performance in terms of (more traditional economic policy goals like) employment, balance of payment, inflation, economic growth, etc. Furthermore, in Europe continued weak macroeconomic performance in many countries in combination with increasing doubts about the efficiency of fiscal policy and new institutional restrictions on policy options in the European Union (convergence requirements, procurement rules, the stabilization pact, etc.) have also helped innovation policies to enter the policy scene and made them more and more acceptable and relevant.

Innovation policy learning includes many aspects. In terms of theory simple linear models of innovation have been replaced first by more complex, "chain-linked" models and then by innovation system approaches. Parallel and connected to this theoretical and political development the statistical description of innovation activities and innovation performance has become better. Infrastructures like universities, libraries and databases as well as institutions like intellectual property rights, technological service systems, tax rules and government subsidy systems have also been improved. Gradually, and in interaction, the theories, practices and institutions of innovation policy have become a normal part of economic policy.

The innovation policy learning process has so far mainly taken place in a rather limited number of policy areas. Even so it is now possible to identify at least the following six innovation policy types, excluding policies that affect innovation as unintended side effects of policies with other targets:

(1) *Policies to develop and strengthen the knowledge infrastructure*, which consists of universities, schools, training systems, research labs, telecommunication networks, libraries, databases, etc. (Smith, 1997). The knowledge infrastructure depends very much on government decisions and investments. It has a major impact on innovation capabilities and has in the last decades or so become much stronger in many countries.

(2) *Policies to develop institutions affecting interactive learning.* Intellectual property rights, tax incentives, laws regulating for instance up-start and shutdown of firms, and other formal institutions, which the government affects, may have direct influence on interactive learning and innovation capabilities. However, also trust, willingness and ability to co-operate and other informal institutions affecting innovation are indirectly formed by government policies.

(3) *Policies to create specific organizations to support innovation activities.* Patent offices, standard setting agencies and technical service organizations are examples of organizations, which are set up by governments and pay important roles in innovation processes.

(4) *Policies to improve the financing of innovation.* This includes policies related to high levels of risk, large genuine uncertainty, long gestation periods, etc.

Policy types 1-4 may be termed *framework condition policies*. However, there are also targeted or selective types of policies, especially those used in instances when governments want to intervene in the support of new entrants and innovators:

(5) *Policies to selectively and directly support the development of science and technology.* Public investment in R&D is a significant component of overall R&D and knowledge creation in for example most European countries.

(6) *Technology procurement policy.* This as a 'demand side' policy and occurs when a public agency places an order for a product or system that does not yet exist in a developed form in an effort to trigger innovation.

There are many different instruments and procedures within each of the six types of innovation policies and it is also possible to identify or develop other types of innovation policy instruments. A seventh type might be policies that try to stimulate innovation by monetary carrots and sticks connected to specific activities. For example, pollution taxes may be used to support the development of 'greener' technologies. This would represent a combination of environmental policy and technology policy and require cooperation between relevant ministries.

These different kinds of innovation policies may be looked upon as areas of policy learning. None of them is yet supported by well-defined and efficient practices and routines. They all need to be sustained by new institutions and monitored and evaluated in dialogues between different actors to become more effective.

Summing up, innovation theory and policy emerged in a period of economic crisis and change. Not only was macroeconomic performance poor, but there was a widespread pessimism about the ability of the economic systems to deal adequately with the quite substantial changes in technology and demography. There was for example much talk about "institutional sclerosis" in the OECD countries. Policy learning was a response to this but, of course, it has far from solved all problems. It is not only a question of improving the competence of the economic experts that advise politicians or even of getting more mature and wise politicians. It also includes improved data, including innovation statistics, and new and improved economic theories and models. It is clear, for example, that there is still no developed theory that connects learning and innovation to growth and development and there is still a lack of good measurement tools for both the inputs and outputs of innovation. Furthermore, as has been mentioned above, the values, visions and targets of

innovation policy are still rather vague and the necessary supporting organizations and institutions still rather underdeveloped.

2.4 Sustainable innovation policy learning

Following the Brundtland Report sustainable development is:

“a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are made consistent with future as well as present needs” (WECD, 1987).

Sustainable development is not a simple state of harmony or natural resources preservation. On the contrary, it endorses a “process of change”, “exploitation of resources” and “institutional change” to fulfill human needs. In other words, sustainable development is pursuing an economic system, which will intelligently use human and natural capital for development. In addition, the need to take into account present and future generations implies that intra- as well as inter-generation equity should be accounted for¹⁰.

A key contribution of SI analysis has been to clarify the role of social capital for learning and innovation, but the present and urgent focus on sustainable development stresses the importance of clarifying the role of natural capital as well. It seems clear, therefore, that innovations may grow from learning based on the relationship between the environment and the economy (Segura and Gregersen, 2003).

According to Segura (1998), it is possible to make a more specified definition of Sustainable Systems of Innovation (SSI). A SSI may be constructed by adding explicitly the “natural elements” to the SI definition from Lundvall (1992). However, adding the word “natural” actually implies an important change in the IS definition. A Sustainable System of Innovation:

“is constituted by human, social and natural elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge” (Segura, 2000).

Without the sustainability dimension there is a risk that system of innovation approaches may encourage conventional short-term economic activity and technological change, which in many cases threaten the sustainability of ecosystems.

Several authors have been using the concept “eco-innovation” to describe innovations favoring the sustainability of environment and natural resources:

- Eco-innovations are all measures of relevant actors (firms, politicians, unions, associations, churches, private households) which:
 - *Develop new ideas, behavior, products and processes, apply or introduce them and*
 - *Which contribute to a reduction of environmental burdens or to ecologically specified sustainability targets (Rennings, K., 1998; Segura, 2000)*

¹⁰ There are several positions and explanations related to the sustainable development concept. Some researchers have classified sustainability in four levels as “very weak; weak; strong and very strong sustainable development”. For definitions of each one of these see Ollikainen, M. (1997). For separate explanations see Pearce and Turner (1990) and Turner (1992).

Building, sustaining and improving firms' and individuals' capabilities of green learning and developing and implementing eco-innovations is closely related to the institutional set-up of society and the process of changing this set-up towards a more sustainable development. The policy implications of this are straightforward in the sense that sustainable innovation policy defined as policies aiming at increasing the capacity to make eco-innovations by enhancing the learning capability imply holistic, coherent and long-term strategies.

- It requires close co-operation and dialogue between government, regulatory bodies, industry, and stakeholders and it implies co-ordination in various dimensions (Rennings et al, 2003):
 - Top-down co-ordination, for instance in the form of target setting on the government level.
 - Bottom-up co-ordination, for instance related to experiments with alternative energy systems at the local level.
 - Horizontal co-ordination, for instance related to special programs for diffusion of environmental innovations within transport, agriculture, energy, education, etc.
- It should not only focus on technological innovation but also on organizational innovation, social innovation, and institutional innovation. It should stimulate experiments with a focus on combining various types of innovation.
- It should rethink specific policies related to for instance education, labor market, social issues, energy and environment, science and technology, and industrial development and it should redistribute the cost and benefits of change.
- A public sustainable innovation policy guiding investment and innovation in the direction of cleaner technologies and eco-markets has to include tools that stimulate both the supply and the demand side. On the supply side it is necessary to strengthen the knowledge infrastructure including an appropriate division of labor between the involved actors (firms, universities, and the technological service system). On the demand side it is necessary to create a market for cleaner technologies by for instance public procurement, economic incentives (for instance green taxes), direct regulation, and financial support (Gregersen, 2002; Segura & Gregersen, 2003).

2.5 Low trust traps for policy learning

As stated above, all learning is interactive and, accordingly, policy learning requires communication, interaction and cooperation between private and government sectors. This is not an easy thing. It presupposes trust that in its own turn develops through interaction and cooperation. It is to be expected then, that policy learning is ineffective and slow in conflict riddled, low-trust societies. It takes long time to break out of such low trust traps. Trust is not scarce in traditional sense. But since it, like knowledge, tends to grow when used and erode when not used one can get trapped in a condition of low trust.

This seems to be the case in many developing countries. Here we often find very uneven distribution of income, wealth, and power. Access to information, education and training is limited for large parts of the population. Universities are relatively isolated from the business sector. There is generally little cooperation between the

government sector and private interests and the relations that do exist are often contaminated by corruption. This is not a good environment for policy learning and may be the deeper reason why so many problems in the public-private interface remain unsolved even when there is no lack of resources in a traditional sense. There is often a lack of capability for conflict management, negotiating and consensus building. Such capabilities are basic ingredients in policy learning and without new institutions to foster them policy learning will remain slow and developing countries unable to handle the requirements and challenges of the globalizing learning economy.

Certain types of "policy forgetting" (getting rid of harmful practices in the relations between private and public agents) seem to be especially important but at the same time lacking in the South, for example in relation to corruption. According to the World Bank corruption affects growth negatively. There are different kinds of costs connected to corruption. An important but neglected one is its ability to prevent open interaction and cooperation both between and within the private and public sectors. Corruption thus conceals information and hampers conflict resolution. Because of this it may also retard and block policy learning which is highly interactive and depends on trust and long-term cooperation.

The importance of trust, cooperation and uncorrupted relationships for policy learning is especially important in innovation policy. Procurement policy, for example, builds on long-term processes of intense interaction between competent government customers and private firms in which the parties learn to cooperate. It seems to have been successful in a number of cases, for example in telecommunication procurement in France, Finland and Sweden, in which a positive atmosphere of trust and cooperation for mutual interests was present. In other countries and cases it has been blocked by lack of competence, trust, and conflict resolution (Edquist et al, 2000). In Latin America it is usual to argue against it pointing at the many examples of corruption. It is both important and difficult to break out of low-trust traps and it seems necessary to embark on new roads of institution building to create communication, interaction and consensus building between firms, universities, NGOs and state agencies.

3. Policies for Innovation in Central America

3.1 Introduction

Within the SUDESCA project different researchers have studied different sectors in Central America: the forestry sector, the textile industry and selected agro-industries (coffee, cotton, palm oil, organic cashews, cheese production). There have also been studies of sustainable progress in "green" markets and other approaches to social and ecological sustainability. Some of the studies were designed as "state of the art" papers on innovation issues in the region.

These studies were focusing on specific sectors or activities and did not try to analyze the national systems of innovation as a whole in the region. Neither has there been a systematic effort to get an overview of the innovation policies of the region. However, most of the papers have made observations about innovation policy issues and sometimes policy recommendations were put forward.

The purpose of this chapter is to sum up the policy discussion in the different papers, explaining briefly the context in which policies were recommended. The summary is as far as possible organized according to groups of policies for innovation presented in section 2.3 of this document.

3.2 Policies to develop the knowledge infrastructure

Studying policies to stimulate innovation in El Salvador Cummings and Mena (2000) underlined the relevance of the knowledge infrastructure. They concluded that the forestry sector reflects a weak infrastructure. Low education levels of farmers and problems of transferring knowledge from experts to farmers are evident. Organizations related to the sector have had problems of analyzing and learning from past experiences. Therefore they continuously repeat the same kind of mistakes. Considering these and other similar problems the authors emphasized the need to strengthen the knowledge infrastructure with three general policies: investing in training programs for farmers, promoting efficient interactions among producers and users of knowledge, and building new institutions to facilitate learning processes.

A related problem is that in the cases, studied by Cummings and Mena (2000), there are hardly any examples of strong long-term relationships between actors in the knowledge infrastructure (universities, research centers, trade organizations, etc.) and the firms and organizations directly involved in the production sector with the objective of generating, diffusing or facilitating the application of innovative knowledge. One exception is the incipient relationship in the case of the Tecoluca region of students from a private university who were researching on alternative processing techniques for the pseudo-fruit of the cashew for the Organic Cashew Agro Industrial System.

Orozco (2002) also refers to the knowledge infrastructure. The study discusses feasible policies for performance improvements in the cooperative palm oil sector in Costa Rica. The author argues that policies of education and training are necessary in order to promote innovations. The objective is to improve the capacity of leaders, employees and associates in generating and adapting useful knowledge. The mechanisms are implementation of training programs with periodic evaluations. The programs should consider the knowledge necessary for improving critical aspects of performance and the most effective mechanisms for transmitting the relevant knowledge. In a previous paper Orozco (2000) also suggested the need to develop innovative mechanisms to transfer the results of technological research in universities and public agencies to the cooperatives.

Studying the forestry sector, Segura (2000) argues that “in order for the forest sector to become competitive and innovative, it must involve a development of the knowledge infrastructure, institutional and organizational learning, technological development and human resource development and the sector must be better integrated with the rest of the economy” (Segura, 2000, p.248). The author argues that the knowledge infrastructure does not correspond to the needs of the forest sector, especially in Guatemala and Nicaragua but also, to a smaller extent, in Costa Rica. One of the problems is a weak interaction between the private sector and universities and technological schools.

‘The Program for Development of Suppliers of World Quality’ and ‘The Training Program INA-Textile Sector’ in Costa Rica may also be regarded as infrastructural policies. The first one illustrates the potentials of co-operation to enhance productive

links between the free zone entrepreneurs and national companies. The second shows another type of policy in the form of training strategies facilitated by the Instituto Nacional de Aprendizaje (National Institute for Learning, INA in Spanish). INA is a public institute financed by taxes. In this case it was in charge of evaluating programs for the preparation and instruction of workers involved in the textile sector and clothing manufacturing. These examples illustrate the objective to develop national suppliers to provide services, raw materials, parts and components with international standards and characteristics, which satisfy the quality standards required by multinational firms established in the free zone regime and by other large firms participating in the project.

Many of the policy issues raised in the SUDESCA reports concern environmental problems. Vargas and Segura (2000) refer to the links between the firms and the environment. The authors describe how the project “Processes of Environmental Management in Belen” shows the importance of the enrolment of most of the social actors of a community. The large number of industries operating in the Belen county in the province of Heredia, Costa Rica, as well as their impact on the environment led to the establishment of this project in 1991, when the National University of Costa Rica (Universidad Nacional, UNA) was carrying out a project in order to rescue the watershed of the river Río Segundo and improve the management of garbage in the northern part of the province. In the last few years, through the participation of different organizations, firms and the community, this project has been consolidated and has improved the process of environmental management.

When the project “Industry: Friend of the Environment” was established in 1998, its activities included environmental teaching in elementary and high schools in co-ordination with the Ministry of Energy and Mines and the Ministry of Education. It also included training of industrial firms in issues of clean production and environmental management, the formulation of plans for reduction of contamination at its source (with goals to reduce water pollution, waste, energy and the implementation of methods for better use of financial and human resources), the implementation of environmental auditing and municipal monitoring of complaints from the residents of the community and the provision of joint solutions for the industries (Vargas and Segura, 2000). Vargas and Segura (2001) conclude that the project does have some limitations. They especially mention the scarcity of skilled human resources and the lack of legislation regarding the powers of local governments. This, again, underlines the importance of developing and strengthening the knowledge infrastructure.

Another program, “The Ecological Flag”, which the National University developed to rescue a watershed in Costa Rica is discussed by Segura and Vargas (1999). This program includes a regional and national initiative to distinguish industries, organizations and communities that are working to rescue and protect the environment. Though the program didn’t start until 1994 and without much financial support, there are now several companies and communities involved which have received a public recognition of their results strengthening the incentives for further efforts.

In the recent years, more than twenty private firms were rewarded with environmental distinctions. No public firm or community, however, has yet received it. This is shown by Segura and Vargas (1999) to be one of the main problems faced by the program. It has to do with modifications in the organization and availability of public resources, due to changes in the government. It is also related to a lack of

continuity in the environmental efforts of some firms, which have already received the “Ecological Flag”, but did not qualify to stay in the program at the end of the period.

The cases of tourism and ecotourism are analyzed by Miranda (2003). Apart from the benefits of employment offered by these activities, tourism stimulates the development of local education programs, encourages community organization and diversifies and strengthens the local economy. On the negative side there are some cultural drawbacks as weakening of traditional culture or economic changes that may make people more dependent on developed countries: “These are part of the elements to balance to assess the impact of tourism. The visibility of these elements may differ in and between areas.” (Miranda, 2003, p. 85).

Miranda (2003) concludes that since ecotourism has become a major source of income in Costa Rica policy initiatives by the state, NGOs and firms are generally well received by the public, who support advertising campaigns and take advantage of the initiatives. The author admits, however, that national initiatives are not always supported by adequate local initiatives.

In the perspective of the ‘globalizing learning economy’, Segura and Gregersen (2003) underline that “dynamic innovation policy should give priority to policies aiming at human resource development, creating new forms of organization, building innovative networks, re-orienting innovation policy towards service sectors, and integrating universities in the innovation process within a sustainable development framework.” (Segura and Gregersen, 2003, p. 21).^{11, 12}

According to the authors, setting up specific institutions and organizations related to the production, maintenance, distribution and management of “eco-knowledge” is one way to stimulate learning and eco-innovation capabilities of both individuals and firms. Another is to integrate environmental issues and “eco-knowledge” into the existing curricula and responsibility of knowledge institutions. “Although most countries try to “walk on both legs”, there is still a long way to go before environmental issues and green knowledge production and distribution gets top priority in the educational sector”. (Segura and Gregersen, 2003, p. 22).

The educational program of biodiversity recently implemented in the primary school system in Costa Rica is, however, an encouraging example breaking this general picture. Bio-alphabetization is a learning process over time, which allows individuals to value biodiversity, develop ethics concerning the living environment and assume management and conservation responsibilities towards all kinds of living

¹¹ Innovation is a driving force in the journey towards sustainability. Often the focus has been on innovation of environmental technologies like end-of-pipe technologies. However, during the past 15 years the integration of environmental concerns in the innovation of processes and products has been a major concern in the environmental policy. Within some areas like transportation it is likely that functional and system innovations are necessary in order to reduce the environmental impact of the sector.

¹² Beside industry and government, the consumers play an important role in the Integrated Product Policy, since the demand side is a necessary precondition for the diffusion of cleaner products at the market. Several cases of consumer activism like Shells’ Brent Spar oil-drilling platform, and consumer boycott of French wine because of nuclear tests in the Pacific gave an optimism towards the “political consumer”, but these expectations seem only to be fulfilled in cases with either cost savings possibilities or health benefits for the consumers.

species and ecosystems. This aims at promoting changes in the human behavior favoring harmonious relations between nature and social development. (Segura and Gregersen, 2003, p. 22). This initiative is developed through the Ministry of Education and coordinated with the National Biodiversity Institute (INBio), an NGO created in October 1989 dedicated to promote the knowledge and sustainable use of biodiversity, in collaboration with other organizations and initiatives and in close interaction with the Ministry of Environment and Energy.

Segura and Gregersen (2003) explain that this bio-alphabetization is managed through several means, one at primary schools another with the creation of “INBioparque”, a thematic park that includes recreational and educative areas with interpreted trails through groups of representative plants from different tropical ecosystems. Another instrument is the Bio-literacy Program, which INBio is coordinating with the Ministry of Education, in order to bring information, teaching, field trips and even the use of multimedia to educate children about conservation and sustainable use of biodiversity.

3.3 Policies to develop institutions, which affect interactive learning

Segura (2000) argues that national institutions such as property rights, legislation and government organizations including separate offices in charge of forest development have affected the sectoral systems of innovation in the forest sector. He argues that several actors have played an important role changing institutions to consider the forest. For example, the primary school system, NGOs and some private firms have developed institutions of denouncing misuse of the environment and the forest. This has contributed to developing a new rationale for the forest sector. The government in coordination with other actors has also promoted similar policies. Eco-labeling¹³ and forest certification are examples of new kinds of institutions developed in this policy framework.

Modernization of legislation and a decentralization of the forest administration have also contributed to promote innovations in Costa Rica, Nicaragua and Guatemala. For example, “the public sector that in the past exclusively played the role of watchman for the forest is increasingly acting as facilitator for the processes of interaction among different economic agents, especially in relation to the productive forest activities” (Segura, 2000, p. 226).

López and Amaya (2000) suggested that even if policy makers in Nicaragua have prioritized macro-economic stabilization it is possible to identify some measures to facilitate innovation. That is the case for a program to support small- and medium-sized enterprises, which is coordinated with the alliance of universities. The authors analyzed the program for development of the competitiveness of micro industries in textiles, foodstuffs and furniture in Nicaragua. This now also involves universities such as the University of Engineering (UNI), the Polytechnic University (UPOLI),

¹³ The market is a driver via eco-labeling, public procurement, green consumerism, etc., but the extent will depend on to what degree large companies are putting environmental demands on their suppliers. The different domains of the government, the market and the firms are increasingly overlapping, and an integrated product policy is an indicator that this will be the case even more in the future. Eco-innovations will be promoted combining technology push, market pull and soft regulations.

and the National Technological Institute (INATEC). The program is sponsored by the government of Canada and benefits about one thousand Nicaraguan micro-firms.

A key issue mentioned by Cummings and Mena (2000) is the need to improve the mechanisms of coordination of the different state agencies in El Salvador, with the objective to generate better conditions for innovation both in the textile and the forest sectors. Vargas (1998) also suggests promoting joint activities for design and commercialization amongst firms as a policy measure to stimulate interactive learning and innovation in the textile sector in Costa Rica.

Orozco (2002) recommends improving the knowledge base of the co-operatives by strengthening collaboration networks. Another mechanism to facilitate interactive learning is the improvement of communication with research organizations and universities. The author proposes: "It is important to improve the canals and codes of communication between the producers and the users of technology. It is suggested that the exchange of experience, opinions and practical pieces of advice among firms stimulate the technological development. Some organizational culture changes in the co-operatives may be useful. Focus should be on stimulation of more efficient communication processes and on elaboration of powerful labor teams instead of vertical structures of decision making" (Orozco, 2002, p. 180).

The study by Orozco (2002) concluded: "Feed-back mechanisms defining quality of interactions have been a clear determinant of innovation processes in the co-operative sector. Some interactions have facilitated the innovation process but poor interactions have also hindered innovations to improve the performance of several critical variables" (p. 177). "Most of the innovation barriers (including the introduction of cleaner technologies) are related to the weakness of the innovation system. The main challenge is recovering a systematic approach promoting innovations, which aim at improving the performance of critical variables. The strategy is based on improving quality of interactions. An important issue to consider is the development of mechanisms as regards knowledge generation and transmission. Three areas of action would be: resolving problems of institutions on technology transfer; improving mechanisms of communication; and improving firm capabilities of absorbing cleaner technologies" (Orozco, 2002, p. 180).

In the case of Costa Rica, the 1996 Forestry Law (No. 7575) created a totally new kind of incentive by giving forest owners the possibility to request Environmental Service Payments (ESP) for their forest. The law established four key forest commodity services: a) mitigation of greenhouse gases (fixation, reduction, sequestration and storage), b) watershed protection, c) protection and development of the biodiversity, and d) the protection of natural forest ecosystems with particularly beautiful scenery or of particular interest (Art. 3, K). The law empowers Forest Authorities to make contracts with landowners and pay them for providing the society and the world in general with these services, as long as they can present a forest management plan signed by a licensed forester (Segura and Gregersen, 2003 p. 11).

These financial instruments in forestry management can be used to share responsibilities (Miranda, 2003, p. 60). In Costa Rica, the national program of ESP regards the forest as an ecosystem with the implication that forestry affects the services it provides. The main participants in the process are the landowners, but the mechanism offers also business firms a clear opportunity to participate in forestry management and environmental improvements. Segura and Gregersen (2003 p. 11)

consider this to be an interesting but also very fragile policy tool, in the sense that it depends on both the influence of several different parties (forest owners, conservationists, etc.) and the 'will' of the financial authorities of the country.

Miranda (2003) established that "The Costa Rican case of ESP, shows that a participatory approach using financial incentives is promising. However, the success of the approach depends on a society's consensus on the value of nature, the availability of knowledge, an innovative organizational structure, on well qualified NGOs and last but not least on enough funding possibilities" (Miranda 2003, p. 60).

Segura and Gregersen (2003) argued that accompanying the emerging green techno-economic paradigm is the creation of markets for new environmental goods and services. Eco-tourism, waste turning into valuable products, EMAS certification, carbon sequestration, water resources protection, and bio-diversity protection are all examples on products and services on the emerging 'eco-market', which require different institutional adaptations and innovations in order to be efficiently provided.

In the case of the organic cashew agro industrial system in El Salvador, Cummings (2002) reports collective reflection among the involved agents - NGOs, local and national governments, cooperation agencies and local producers organizations: "Collective reflections to clearly define problems and opportunities for the initiative is necessary to effectively orient search operations for knowledge acquisition and application to innovative solutions" (Cummings, 2002, p. 19).

For Cummings (2002) innovative local development initiatives should be characterized by a dynamic and synergistic connection to key elements of the national and international innovation systems in which they are embedded. However, just as important is the integration of initiatives into local development processes and adaptation to the enabling and constraining conditions that the history of the territories provides. Key factors among these are the livelihood strategies and accumulated resource base of the families and also the integration into development plans of local government as in the case of Tecoluca in El Salvador.

When concluding on policy learning and innovation in Costa Rica, Segura and Vargas (2001) stated that it is urgent to fortify specific policies. For instance, there is a need to develop the knowledge infrastructure of the country and the government should consider the need to direct its resources and specific policies towards the enhancement of the innovative capacity. It would also be possible to develop policies favoring basic institutions that positively effect interactive learning. Property rights, fiscal incentives, laws and regulations may be examples of these kinds of institutions. New policies favoring organizations that help the promotion of selected products on both the domestic and international markets should be developed as well as organizations that finance long -term initiatives.

3.4 Policies to create specific organizations to support innovation

Some of the SUDESCA reports and articles discuss the need to create or support new organizations or organizational forms within existing organizations. In Segura (2000) for example it is recommended to strengthen sectoral organizations in order to promote a stronger leadership to coordinate the development of the forest sector.

Flores (2003) recommends the creation of sectoral organizations to promote the environmental performance of the coffee sector in El Salvador. One of the tasks of the new organization would be to promote certification and adjustment to

international labels such as ISO 14000. The author also recommends internal organizational changes in firms in order to promote the organizational culture and the development of alternative systems of training.

New organizations have been important in the development of ecotourism. Policy initiatives in Costa Rica were made with a growing support of both NGOs and other organizations. Miranda (2003) emphasizes the creation of Sistema Nacional de Áreas de Conservación (SINAC) in 1995 and the activities of the Instituto Costarricense de Turismo (ICT). "SINAC as a decentralized and participatory institutional system that put together the Ministry of Environment and Energy's responsibilities regarding protected wild-lands, wildlife and forest areas, in order to plan and execute processes aimed at achieving the sustainable management of country's natural resources. ICT is an institute to promote Costa Rican beauty for tourism activity in a very strategic way. And NGOs take an active role in protecting landscapes to promote private reserves. It is estimated that 4% of protected land is privately owned" (Miranda, 2003, p. 91).

Since ecotourism has become a major source of income for Costa Rica, policy initiatives of the state, NGOs and market parties are well received by the general public. The author admitted, though that "national level initiatives are not always supported by adequate local initiatives." (Miranda, 2003, p. 92).

Segura and Gregersen (2003) also mention the need for new organizations. For example, new formal institutions to create and regulate the market for eco-products are needed and this also implies new organizations. In Costa Rica, the joint implementation policy was established as a strategy in the framework of the "Climate Change Convention" to reduce climate change worldwide (FCCC, 1992). The first transaction for the sale of the service of carbon capture with Norway was in 1996. For Costa Rica to enter the business of the sales of carbon capture, it was necessary to create a new organization. A special national office - Costa Rican Office for Joint Implementation (Oficina Costarricense de Implementación Conjunta, OCIC) - was created. It is in charge of the international agreements and negotiations. The funds obtained from the sales are transferred to the National Forest Finance Fund (Fondo Nacional de Financiamiento Forestal, FONAFIFO), which in turn invests in the conservation and management of forests and reforestation projects. The control and monitoring of the program related projects is carried out by the National System of Conservation Areas (Sistema Nacional de Áreas de Conservación, SINAC) of the Ministry of Environment and Energy (Ministerio de Ambiente y Energía, MINAE), together with the certifiers (auditors) of the national and international private sector. (Segura and Gregersen, 2003).

Also in the case of innovation policies in Nicaragua the need for new organizations has been noted. López and Amaya (1999) suggest that according to what has been observed in each one of the firms and associations visited, it can be argued that any process with the objective to promote innovative processes to improve sustainable competitiveness must be related to the policies for training, learning and transferring knowledge, which are necessary for the absorption and successful reproduction of the experiences accumulated. "The birth of new public institutions may be seen within the dynamics of the governmental restructuring policy, or the so-called governmental modernization policy" (López and Amaya, 1999, p. 10).

3.5 Policies to improve the financing of innovation

One problem for developing better conditions for financing innovation in the forest sector is that the private actors have normally been pressuring for incentives in terms of subsidies rather than for funds or special programs for innovative behavior. Even so, it is possible to identify some policies improving the conditions for the financing of innovation. One case is the “Environmental Service Payments” (ESP) in Costa Rica (Segura, 1998).

Orozco (2002) studied the relevance of financial mechanisms for the performance of the cooperative palm oil sector. He argued that, “financial mechanisms are a critical aspect of promoting innovation and technological transfer. It is also true as regards the introduction of cleaner technologies. State agencies and firms ought to spend more money on both research and development programs and on introduction of cleaner technologies. Some kind of policy is necessary in order to stimulate the funding of these projects. It is also necessary to develop the programs by making the processes of funding more efficient” (Orozco, 2002, p. 181).

According to Cummings and Mena (2002) it is necessary to strengthen state agencies working on innovation issues. One mechanism is by special funding of innovation processes of small farmers and small and medium sized enterprises.

In the discussion of barriers for the introduction of cleaner technologies in the coffee sector in El Salvador, Flores (2003) argues that lack of funding is one of the main obstacles. He suggests creating a fund to facilitate the introduction of cleaner technologies in the sector. It is important to create alternative financial mechanisms by the direct participation of the state through a bank for development or to act as a guarantor of projects that could be financed or co-financed by international cooperation.

When discussing experiences from innovative practices in local development in the case of the organic cashew production Cummings (2002) pointed at networking as a key to get financing, techniques and knowledge. Financing was crucial for the new processing plant but also important for incremental changes of productive and managerial activities. The network relationships of NGOs with the municipality, central ministries, USAID and others actors like producer associations, “has been necessary to get key infrastructural services built” (Cummings, 2002, p18).

Segura and Gregersen (2003) argue that in the case of eco-innovation finance is essential. Compared to other investment decisions, the element of uncertainty is even more marked when it comes to investments in innovation activities. In general, the more radical the innovation activities are, the higher is the degree of uncertainty in relation to technologies and markets. That is why special financial arrangements like for instance “green funds”, special CO₂ tax or minimum electricity prices may be necessary to secure long- term investments in environmentally friendly technologies like renewable energy systems and transportation where conventional technologies and power constellations still prevail.

In the paper “Institutional innovation and policy learning in Costa Rica”, Vargas and Segura (2003) conclude that the national productive sector needs to have more active and stable sources for financing of investment.

“The stock markets and the companies stocks negotiations are still very poor at the national level, and the bank loans system for emerging initiatives and with special considerations are not flexible enough to

consider long run investments, such as the ones who consider the environment as part of the gains, with very few exceptions.” (Vargas and Segura, 2003, p15).

The forest sector faces a particular problem in this respect, because investments in forest plantation and forest management generally needs 10 to 20 years before new incomes are generated. During this period forest owners need cash flows to continue their normal activities. If this is not possible they will prefer to invest in other activities, forgetting the national and international benefits that a well-managed forest sector provides.

3.6 Policies of selective direct support of science and technology

These kinds of policies are not very strong in Central America and are not reflected very much in the SUDESCA reports. This does not mean, of course, that they are not needed. In his study of the forest sector in Central America Segura (1999) concluded that a closer and more dynamic relation between higher education and public R&D organizations and the production sector are required for creating and disseminating innovations.

Orozco (2002) argues that, “state agencies should promote agreements on research projects involving state and private research centers, universities and other stakeholders in the palm oil sector (co-operatives, suppliers, customers, and competitors). The challenge is the generation and the diffusion of knowledge and technologies. A fundamental objective is the increasing capacity of technology adaptation in order to fit the specific needs of the co-operatives. A possible mechanism is that state agencies finance research projects designed by firms or groups of firms in co-ordination with universities or other research agencies” (Orozco, 2002, p.180).

In the case of innovation in organic coffee production in El Salvador, Flores (2003) concludes that national policies of research and transference and adaptation of technologies are urgently needed. The state is a fundamental actor as a promoter of a more efficient and sustainable innovation system that may strengthen the competitive advantage in both the domestic and international markets.

3.7 Technology procurement policy

Like the policies for direct support of science and technology procurement policies are not common in Central America. Again, this does not imply that they are not important or that they could not be developed. It is also interesting to note that the government of Costa Rica has been an important actor in developing a set of long-term integrated values for sustainable development. Costa Rica joined the international environmental movement early and lots of private land was bought and converted into protected areas. This supported a demand driven development of new eco-products and services like ecotourism and carbon bonds.

The policy recommendations above have been classified according to their objectives. Other classifications may also be contemplated, for example according to policy makers (the main policy maker may be the national government, the local government, specific public agencies, private and semi-private organizations, etc.) and according to whom the recommendations are addressed. We have chosen the criterion of policy objectives because in most cases it is difficult to clearly identify a

main policy maker or a main addressee. As is underlined in chapter 4 below interactive learning and innovation capabilities have been in focus. This has implied that infrastructures, institutions and organizations, which are important for communication, interaction, cooperation, trust building, etc. have been at the center of the scene. It is true that people often assume (or hope) that “the state” will take initial and strategic initiatives, but in many cases this is not the only possibility. Usually more than one actor is involved both as policy-maker and “policy-taker”. In fact, this follows logically from focusing on policy learning rather than rational choice.

4. Conclusions

4.1 Introduction

The SUDESCA project has focused on the relations between innovation systems and sustainable development. It has been a basic idea that the concept of a system of innovation may improve our understanding of development in Central America and that it may help us to formulate and implement policy strategies for sustainable development. Innovation is regarded as a driver of sustainability. This point of departure has influenced most of the sub-projects within the SUDESCA framework. Even if the sub-projects have focused on specific sectors or specific localities the policy issues and recommendations, which they have raised, have been strongly influenced by the idea that innovation is an ubiquitous, cumulative and systemic process that feeds on different kinds of interactive learning. Learning and innovation capabilities have been a center of attention.

It is not surprising, therefore, that factors like linkages between actors, communication, interaction, coordination, cooperation, trust, and partnership figure frequently in the reports. Neither is it astonishing that the reports often return to the question of how institutions and sector characteristics affect innovation performance. The key characteristics of innovation systems have been focusing devices for the research.

In order to support interactive learning and innovation the weak or missing linkages of the relevant innovation systems have to be identified and mended and the already strong linkages have to be further improved. Such an approach leads to a focus on institutions and institution building rather than to a more traditional focus on the availability of resources for capital investment, including investment in human capital. Furthermore, the policy strategy of promoting local, sectoral and national systems of innovation has implied a tendency to formulate policy recommendations in terms of needs for focused and continued policy learning rather than identification of optimal policy decisions. Above all it seems urgent that governments and other policy actors start thinking about initiating processes of policy learning aiming at creating infrastructures, institutions and pattern of interaction, which support learning and innovation.

Examining the many reports of the SUDESCA projects leads to some broad policy conclusions: quite generally, innovation policy in Central America is often segmented and irrational. Innovations are usually perceived as isolated events and not as parts of an integrated process. It is therefore a good idea to encourage government organizations as well as universities and other research centers to use the system of innovation approach as a tool for forming policies for sustainable

development. As reported in chapter 3 above applying the innovation system perspective in the SUDESCA sub-projects has led to that at least three policy areas have been singled out as specially important – the knowledge infrastructure, institutions and organizations. The policy conclusions from these areas will be shortly discussed below. In addition to this there are some conclusions regarding environmental issues. Finally, the need for a double focus in development policy – on basic living conditions and on innovation – will be emphasized.

4.2 The knowledge infrastructure

In Central America there seems to be a general need for *a stronger knowledge infrastructure*. In the longer view the educational system is a main issue. It needs to be improved on all levels, including the university level. Vocational training is also insufficient. This is a general problem but it may be particularly serious in some sectors as for example agriculture. In a few other sectors the situation seems to be quite good, however. The infrastructural resources connected to the development of the environment as a source of income, is a well-known example.

In relation to the competition pressure stemming from internationalization and globalization the R&D systems certainly also need more resources. But the problems of the knowledge infrastructure are not only problems of resource scarcity. There is also a problem of a relative isolation from the rest of society. There is a poor coordination between different actors. A closer and more dynamic relation between higher education and public R&D organizations on one side and the production sector on the other is much needed for the creation and dissemination of knowledge throughout the society.

4.3 Institutions

There is a clear need for *“better institutions”*, especially institutions supporting learning and innovation capabilities. Again the focus should be on institutions, which improve communication, interaction and cooperation. Promotion of networking and joint activities in different sectors is mentioned in several reports. Supporting national level initiatives with local ones in for example the agro-industry is also recommended. The “quality of interactions” within as well as between firms and organizations is in focus in the reports about the palm oil sector but are probably important in other sectors too. The crucial importance of new institutions as part of the development of environmental resources in Costa Rica has been underlined and again there is no reason to believe that institutional innovation is not important for new activities more generally.

Trust and partnerships are vital elements of well performing systems of innovation and may be strengthened by livelier interaction between the different sectors and actors. But the relation between interaction and trust is not necessarily positive. Interaction may destroy as well as strengthen trust between the interacting parties. It is therefore necessary for policy makers to consider how “meeting-places” for “positive” communication and interaction can be created.

Collective reflections in order to define development problems and opportunities are vital and should be supported by new institutions. The performance of a national system of innovation depends much on trust and the degree of consensus in society. To build consensus around the goals and instruments of development including the

value and character of knowledge and of nature may be an exercise of both instrumental and substantial value. The government, research agencies, universities, NGOs and private firms, cooperation agencies and local producer organizations may all join new forums for consensus-building and cooperate to stimulate interactive learning. Clearly, in countries where there for “historical” reasons exist deep mistrust between different social strata this is a task, which has to be addressed with great care and with a long time perspective.

4.4 New organizations

In some cases it seems necessary to *create new organizations* in order to stimulate innovation. For example, to support certification and labeling for international markets new organizations are needed. High transaction costs often accompany the promotion of new products and services, not the least for developing countries with limited market experiences. New organizations may be needed to handle this problem. The INBio organization in Cost Rica is an example.

Finance is often crucially scarce in connection with innovation. In general, the more radical the innovation is the higher is the degree of uncertainty. The stock markets and the companies’ stock negotiations are still very poor in the Central American countries. Furthermore, the system for credit financing through bank loans is also weak and with very few exceptions not flexible enough to handle long-term innovative investments. This means that for example environmental innovations are often difficult to finance.

For those reasons institutional and organizational innovation is needed. It may be possible to create alternative financial mechanisms by the direct participation of the state through for example a bank of development. The state could also act as a guarantor for projects that could be financed or co-financed by international investors or through international cooperation. Special funds or special programs for innovative behavior should also be considered. For instance “green funds”, special CO₂ taxes or minimum electricity prices may be instruments for securing long term investments in environmentally friendly technologies like renewable energy systems and low energy transportation.

4.5 Environmental issues

Systems of innovation clearly affect the environment and environmental performance can be improved by innovation policies. As shown by for example Porter and van der Linde (1995), high environmental standards create new incentives for the industry and may improve its competitiveness in relation to countries with lower environmental standards. This new approach, in which the focus shifts from regulation to innovation, means that the environment is not only the responsibility of the government but also of the industry. It also implies that other stakeholders must be engaged and press the industry to take this responsibility. The systems of innovation approach can make clear the need to promote better practices in many parts of the society including both more use of the market and self-regulation by the industry as driving forces for environmental innovations.

Some interesting trends in innovation policies can be identified in the Central American countries. A clear example is the effort to improve the environmental performance by using new instruments, which are common in some European

countries. The challenge is to combine normative instruments (environmental approvals, integrated pollution prevention control, differentiated enforcement), economic instruments (financial support programs for cleaner technology, EMAS, cleaner products, green taxes on resource consumption and emissions, green public procurement), information instruments (eco-labels and other product declarations, green accounts/environmental reporting) and institutional instruments (self-regulation, ISO, 14001, LCM, eco-design, voluntary agreements, stakeholder participation). The movement towards innovation approaches instead of regulation approaches emphasizes the importance of collaboration networks and is thus in accordance with innovation systems approach to sustainable development.

4.6 A double focus

The most important conclusion, however, is that it is both possible and meaningful to apply the concept of a national innovation system to the Central America. Even if in some of the countries many people suffer from problems of poverty, insecurity and bad health, it is not irrelevant to use the innovation system approach. Innovation is not a luxury, which should wait until more basic problems are solved. It seems clear that competence building and innovation is crucial for development also in a situation where fundamental problems remain. To mobilize and improve existing technology and knowledge when building new production capacity is necessary for an open economy in a globalizing world. To innovate and constantly upgrade capabilities is necessary in order to remain competitive. This implies a need for mobilizing people in processes of education and life-long interactive learning.

What may seem like a contradiction may be eased by a double focus on basic living conditions and innovation. Fighting poverty and building institutions to create order and stable living conditions is necessary to give people the opportunity and incentive to learn new competences. But such institutions cannot be built if people are not engaged in competence building and learning. Learning and innovation is a necessary and basic process, which should interact with the fight against poverty. This is not unrealistic. Innovativeness and learning capabilities are basic conditions for daily survival in many parts of the South. The fact that many people survive and live in these environments testifies to the existence of such abilities. However, to get learning and innovation to contribute to the fight against poverty and to make this become a goal and incentive for learning and innovation is really the main problem. Policies need not only support learning and innovation but also to channel substantial parts of it towards poverty alleviation. This is certainly not easy but the system of innovation approach may help to overcome some of the problems and conflicts in this endeavor.

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SUDESCA: SUSTAINABLE DEVELOPMENT STRATEGIES FOR CENTRAL AMERICA

El proyecto SUDESCA es un proyecto común de investigación entre el Centro Internacional de Política Económica para el Desarrollo Sostenible (CINPE), de la Universidad Nacional, Costa Rica e IKE y Centro de Ambiente y Desarrollo, Universidad de Aalborg, Dinamarca. El proyecto incluye colaboración en investigación con la Escuela de Economía de la Universidad de El Salvador, Fundación Nacional para el Desarrollo (FUNDE), de El Salvador y Escuela de Economía Agrícola (ESECA) de la Universidad Autónoma de Nicaragua (UNAN).

El proyecto aspira a reforzar la capacidad de investigación en Centroamérica en las áreas de sistemas de análisis de innovación y la implantación de tecnología limpia. El proyecto incluye un programa PhD sobre la economía en cambios tecnológicos e institucionales.

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The SUDESCA project is a joint research project between Centro Internacional de Política Económica para el Desarrollo Sostenible (CINPE), Universidad Nacional, Costa Rica and IKE & Centre for Environment and Development, Aalborg University, Denmark. The project includes research collaboration with Escuela de Economía, Universidad de El Salvador, Fundación Nacional para el Desarrollo (FUNDE), El Salvador and Escuela de Economía Agrícola (ESECA), Universidad Autónoma de Nicaragua (UNAN).

The project aims at the enhancement of the Central American research capacity within the areas of systems of innovation analysis and the implementation of cleaner technology. The project includes a PhD programme on the economics of technological and institutional change.

The project is financed by the ENRECA programme (Enhancement of Research Capacity in Developing Countries) of Danida (Danish International Development Assistance), Ministry of Foreign Affairs.

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