SOCIAL CONSTRUCTION OF INNOVATIVE CAPABILITIES IN RURAL ECONOMIC INITIATIVES IN EL SALVADOR

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ABSTRACT

This article analyzes the innovative capabilities demonstrated by the actors involved in economic initiatives integrated in the *Grupo Bajo Lempa* emerging in the rural Tecoluca municipality in El Salvador. Over the span of more than fifteen years, this core network of actors involved in creating and strengthening these initiatives has been able to mobilize local and external capital and knowledge resources from diverse public and private sources in order to introduce significant technological innovations that have led to progressive improvements in the livelihood conditions for the families involved. The question is: how do innovative capabilities emerge and how are they expressed in the innovative practice of the task-networks directly involved in *Grupo Bajo Lempa's* economic initiatives, especially those related to interactive learning and synergistic networking?

Key words: innovation, innovative capabilities, local economic initiatives.

RESUMEN

Este artículo analiza las capacidades innovadoras demostradas por los actores involucrados en iniciativas económicas integradas en el consorcio del Grupo Bajo Lempa emergiendo en la municipalidad rural de Tecoluca en El Salvador. A través de más de quince años la red básica de actores involucrados en la creación y fortalecimiento de estas iniciativas ha logrado movilizar el financiamiento, conocimientos y otros recursos necesarios de diversas fuentes para realizar innovaciones tecnológicos importantes que han permitido mejoras progresivas en las condiciones de vida de las familias involucradas. La pregunta a contestar es: Cómo emergen las capacidades innovadoras y cómo son expresadas en la práctica innovadora de las redes de actores directamente involucradas en las iniciativas económicas del Grupo Bajo Lempa, especialmente las relacionadas con el aprendizaje interactivo y la interacción sinérgica en redes?

Palabras clave: innovación, capacidades innovadoras, iniciativas económicas locales.

INTRODUCTION

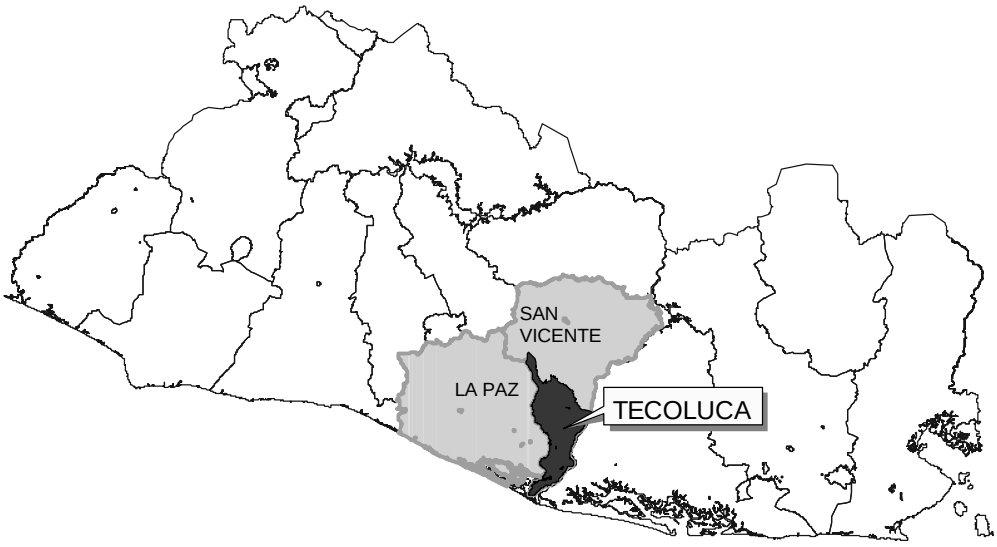
A realistic analysis of past and present «development» dynamics in El Salvador paints a generally pessimistic picture of the livelihood possibilities for the majority of its rural population and suggests the continuation of migration as a principal survival strategy. However, an overly pessimistic outlook also reflects a lack of imagination and recognition of the capabilities of actors to overcome even the greatest odds to improve their livelihoods.

The emergence of more sustainable development dynamics in rural El Salvador will require structural changes to create local contexts for providing opportunities that families will be able to take advantage of to improve their livelihoods. This will imply the recognition and strengthening of capabilities that many of these families have demonstrated by maintaining and sometimes improving their livelihoods, even when faced with seemingly insurmountable odds. Also important is the recognition and capitalization on capabilities demonstrated by other local actors, especially municipal governments, non-governmental development organizations, NGDO, and diverse territorial development programs, in providing opportunities for improvements in rural family livelihood.

The main limitation to substantial improvement of rural livelihoods in El Salvador is not a lack of understanding development problems or the absence of potentially viable proposals for solutions. The problem is one of societal will and the need to build capabilities in creating, strengthening and creatively replicating alternatives for local economic initiatives, learning from emerging experiences that have the potential to make substantial contributions.

This article analyzes the innovative capabilities demonstrated by actors involved in local economic initiatives integrated in the Grupo Bajo Lempa consortium emerging in the rural municipality of Tecoluca (see Map 1). The main actors involved in creating and strengthening these initiatives are associative organizations of small-scale producers and the regional office of the CORDES Foundation —referred to as CORDES Bajo Lempa—. Over the span of more than ten years, this core network of actors has been able to mobilize local and external capital and knowledge resources from diverse public and private sources to introduce significant technological innovations that have led to modest but progressively important improvements in the livelihood conditions for the rural families involved.

Map 1. Tecoluca and its Regional Context in El Salvador



The central question to be answered through this analysis is how innovative capabilities related to interactive learning and synergistic interaction emerge and are expressed in the practice of networks of actors directly involved in the development of innovative economic initiatives in the Grupo Bajo Lempa consortium.

GRUPO BAJO LEMPA'S INNOVATIVE ECONOMIC INITIATIVES

Grupo Bajo Lempa, GBL, is a consortium of diverse social and economic organizations that have emerged from the local development process in a group of what are now 55 communities —with an estimated 30,000 residents in 6,000 families— located in the municipalities of Tecoluca and Zacatecoluca on the western side of the Lempa River.[1] The conformation of the GBL in 2002 was the culmination of a participatory process aimed at integrating the diversity of social and economic initiatives that had emerged after the Peace Accords in 1992, with the support of the local development work of CORDES Bajo Lempa, the community base organization CRIPDES and others. The GBL represents a concerted effort to «construct improved opportunities for sustainable rural development and advocate for the structural changes necessary in coordination with other relevant actors, in order that the rural families and communities can achieve … a dignified quality of life» (Escobar and Zepeda, pp. 282-3).

The GBL's economic initiatives are designed to complement existing economic activities and build on the basic resource base of the producers involved. The most important design features that make them innovative, differentiating them from other

economic initiatives in their regional context, are based on a particular conception of economic competitiveness and social and environmental sustainability that includes:

- Adding value to local products through small to medium-scale agro-industrial processing and organized commercialization, and thus providing stable, better-paying markets for local producers and creating local employment opportunities;
- Differentiation of products and production processes through a strategic emphasis on organic and fair trade certifiable products, as well as production processes and associational forms of governance involving small-scale producers as owners.

The business initiatives being consolidated are innovative in terms of the technological systems they are managing, as compared to similar SME business initiatives in their regional context and rural El Salvador. The organizational proposal of integrating small producers and factory workers as members of the associations that own the processing and commercialization enterprises, as well as progressively improving pay for input providers and industrial working conditions, further differentiate them from most rural agribusinesses. These are novel ways of integrating income distribution and social sustainability issues into economic development activities. The effort to introduce cleaner technologies and certified organic production techniques in these initiatives and provide specialized bio-tech pesticide inputs to support some of their production processes, are also significant eco-innovations (Segura 2000).

The most important of GBL's economic initiatives discussed in this article are:

- APRAINORES: an association of small-scale organic cashew producers that own and manage an industrial processing plant, exporting cashew nuts to the organic and fair trade markets in Europe and the United States;
- BIOLAC: a cooperative association of small-scale milk producers who are the owners of a processing plant making gourmet European style chesses with European technology, for national niche markets;
- SAAO: a small-scale processing plant, using sugar cane from small-scale producers to make granulated *panela*, a type of non-industrialized, unbleached, natural sugar.
- AGROLEMPA: an association of irrigated vegetable producers organized around a legalized commercialization business that is competing for public contracts, selling to supermarkets and competing in the national wholesale market;
- BIOTEC: El Salvador's only biotech laboratory capable of producing (limited) commercial quantities of biological pesticides.

An initial clarification concerning the «successful» nature of these experiences is necessary, as GBL's economic initiatives are not success stories in the sense of being consolidated competitive businesses with steadily increasing shares in national and international markets. Most are struggling to completely cover their operational costs, while a few are minimally profitable, including the most consolidated of these business initiatives: the APRAINORES-APRAINORES organization that integrates the growing,

processing and commercialization of organic cashew nuts. In this sense, I discuss emerging innovative economic initiatives and not competitive firms as such. What I argue, however, is that the experiences accumulated by GBL's economic initiatives have important implications for local economic development practice, and especially the social construction of innovative capabilities in rural economic initiatives.

DYNAMICS OF TECHNOLOGICAL TRANSFORMATION AND THE ACTORS INVOLVED

INNOVATION IN TECHNOLOGICAL SYSTEMS

Understanding dynamics of technological innovations being implemented in the diverse GBL economic initiatives demands a broad systemic definition of technology, as Muller (1980, 2003), Bell and Albu (1999) and Hillebrand et al. (1994) argue.

For example, applying Muller's (2003) operative definition of technology, the APRAINORES initiative's technological system through which raw cashews are processed and ready to market, is constituted by: a) the knowledge that the actors apply in the production process, and that which is embodied in the machines, plant design, production and managerial routines, and organizational forms, etc., b) the techniques used and processes employed in productive operations, c) the ways in which these operations and their management are organized, and d) the final products which embody a specific history «imprinted» upon them through their production, including the identity of the producers themselves. This processing system is linked to the systems of primary production and commercialization which, as a whole, are operated with the purpose of consolidating the

associative business enterprise and providing income to improve the family livelihoods of the producers and plant workers.

As Muller (2003) argues, changes in one system component have required complementary changes in the others, within and between the linked technological systems of growing, processing and commercialization. For example, in the APRAINORES and BIOLACT initiatives, the process of assimilating new production techniques and the certification of processing operations have created qualitatively new product characteristics that have demanded marketing innovations to take advantage of them. These are accentuated by the organic and fair trade certification of APRAINORES's cashews. Likewise, innovations in the techniques used in these initiatives' processing operations have required new knowledge of the people directly involved in the production process to operate the new machines, to follow new hygienic procedures, etc., as well as for the management of new organizational forms for production. The introduction of new production techniques for new crops —irrigated vegetables, organic cashews and other fruit trees— and the cleaner production of more traditional crops like sugar cane, as well as milk products, have required new knowledge and organization for production activities of the families involved.

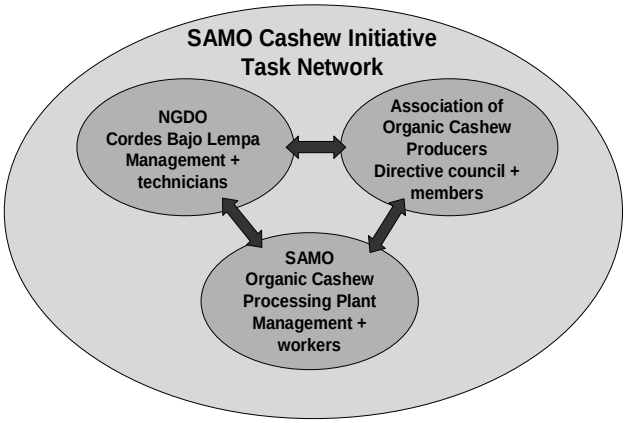
Considering the product as an integral part of the technological system facilitates understanding the flow of intermediate products through the linked systems of production, processing and commercialization. This is especially important within the context of institutional regimes for organic and fair trade certification in the APRAINORES initiative that value tangible as well as intangible product characteristics, as well as the quality

control regimes for the APRAINORES and BIOLACT processing operations. An in-depth understanding of the specific characteristics and history of the final products is also important for the design and successful functioning of commercialization operations.

INNOVATIVE ECONOMIC INITIATIVES AND TASK-NETWORKS

GBL's economic initiatives involve specific configurations of local actors engaged in coordinated efforts to create and strengthen interrelated economic activities, involving the introduction of innovations in their production and marketing practices. Figure 1 illustrates the APRAINORES initiative's task-network which is similar to that of GBL's other initiatives. The application of the task-network concept developed by Muller (2003) to the characterization of GBLS's economic initiatives highlights the fact that their innovative practice is best understood through analysis of the coordinated actions of the multiple actors involved.

Figure 1. APRAINORES-SAMO Initiative Task-Network



INNOVATIVE CAPABILITIES EXPRESSED IN TASK-NETWORK PRACTICE

INNOVATIVE CAPABILITIES: INTERACTIVE LEARNING AND SYNERGISTIC NETWORKING

The innovative capabilities of task-network actors can be defined as «the ability they possess to mobilize and creatively apply a diversity of endogenous and exogenous resources to innovative practice; i.e. the generation of different kinds of technological innovations, while embedded within a diversity of enabling and constraining contexts. Innovative capabilities are reflected in innovative practice, or put another way; innovative practice emerges from the mobilization and creative combination of complementary resources by capable actors. Transformative practice can emerge from within the technological system through the endogenous generation of novelty or through the creative integration of exogenous elements, or most often, a skillful combination of both types of processes» (Cummings 2007: 65)[2].

Effectively engaging in innovative practice requires a context-specific synergistic combination of networking and learning capabilities that enable the creation and implementation of innovative technological alternatives, designed to solve specific business performance problems. The initial processes of technological innovation in GBL's economic initiatives have required the combination of the different task-networks' capabilities for:

- Establishing and upgrading innovation-relevant networking connections, enrolling relevant actors within the task-network and relating to exogenous actors in the process of mobilizing additional complementary financial and knowledge resources for innovative practice; and
- Reflective interactive learning to innovate, by making synergistic connections between different areas of endogenously generated and endogenously developed knowledge bases.

The accumulation of these capabilities in the different task-network actors and the realization of potential synergies between them, explains to a large degree the effectiveness with which GBL's task-networks have been able to innovate, or not. They are expressed in the different functional aspects of the innovation processes being implemented in the initiatives analyzed in the following sections.

NETWORKING CAPABILITIES AND THE COORDINATION OF INNOVATIVE PRACTICE

Using Saviotti's approach (1997), this analysis of networking capabilities of the task-networks involved in GBL's economic initiatives, focuses on the development of synergy or self-catalization dynamics in their internal and external networking relationships, as well as the stability of these networks and their effectiveness in achieving their collective goals. Their external networking capabilities have been crucial for obtaining specialized knowledge as well as financial resources necessary to enable their innovative practice in the APRAINORES and other GBL initiatives, as suggested by Carlsson and Jaccobsson (1997) and Van Geenhuizen and Nijkamp (1999). However, it must be emphasized that the dynamic assimilation of exogenous knowledge and technological alternatives depends on the synergistic relationships forged endogenously and the complementary capabilities of the task-networks.

In terms of external networking capabilities, CORDES Bajo Lempa has demonstrated significant capabilities for establishing synergistic long-term networking relationships through which they have been able to mobilize interest and convince a diversity of international and now increasingly national agencies to fund their development project proposals. This has been a key factor enabling the initial emergence and consolidation of GBL's economic initiatives. Especially important has been the development of long-term relationships with an important group of international NGDO from Europe and North America that have worked as partners in mobilizing resources to invest in GBL's initiatives, reflecting an important degree of mutual commitment to the

GBL process and mutual benefit from their partnership —self-catalization—. CORDES has also demonstrated an important capability for leveraging resources from internationally funded territorial development programs and government agencies, to strengthen GBL's economic initiatives without sacrificing their principles (interview with Espin 2004).

In the APRAINORES initiative, the development of external networking capabilities has been a causal mechanism accounting for innovative practice. CORDES and the APRAINORES management have been working to leverage funds from state agencies and locally installed internationally financed development programs for complementary infrastructure, technical assistance and market studies, necessary to consolidate the technological transformations being implemented in this initiative. Increasingly, the APRAINORES management has assumed responsibility for securing the resources necessary for continued innovative performance, indicating increasing autonomous capabilities in this area.

The transfer of property rights for the APRAINORES processing plant —land, building, machines, etc.— from CORDES to the legalized APRAINORES producer association marked a fundamental turning point in the evolution of this initiative's financial status. However, APRAINORES's capabilities associated with resource mobilization and management have been insufficient, as compared to the needs for increasing the productivity of their processing operations and increasing the local production of organic cashews, in order to maximize the installed production capacity of the plant. APRAINORES does not have the capability to finance their own technical

assistance needs, and CORDES' ability to mobilize enough external financing to maintain the quality of their technical assistance to the producers is diminishing.

In terms of marketing relations, APRAINORES's experience with its international buyers has been positive, as they have been responsible with the scheduling of payments for purchases made. Their key buyer, GEPA from Germany, pre-pays up to 40% of the scheduled shipment upon signing the contract for the sale. APRAINORES has had to learn to respect delivery dates, as these clients demand a level of responsibility similar to what they offer. APRAINORES management stressed the importance of developing a solid relationship with GEPA, as a loyal as well as demanding buyer that provides stability for the enterprise. All of APPRAINORES's most important buyers have visited the plant in El Salvador indicating their interest in learning about local production conditions and building stronger relationships with the people involved.

Several of GBL's other initiatives have also demonstrated significant networking capabilities in relation to their innovative practice. BIOTEC, for example, has from its inception established important relations with scientists in Cuba and El Salvador as a complement to their professional knowledge base, for the development of their products. They are also building increased networking capabilities in relation to the marketing of their products, creating relationships with potential clients, such as producer associations and the business service providers supporting them, as well as potential distributors on a national and regional basis. In the case of the SAAO initiative, CORDES has demonstrated significant capabilities to search for and acquire relevant knowledge inputs for initiating

and consolidating the process of technological innovation implied in making the production of granulated *panela* a viable business venture.

The development of GBL's economic initiatives and especially their entrance into exclusive national and export markets has and will continue to require flexible management of dynamic external networking connections. However, just as important for GBL's innovative practice, have been the strengths and weakness of endogenous networking mechanisms for the internalization and diffusion of exogenous technological elements and the coordination of efforts to apply them to innovative practice. This argument will be further developed in relation to the dynamic assimilation of exogenous knowledge in the next section.

In conclusion, it could be argued that networking capabilities, expressed both through the dynamic inter-connections between GBL's initiative task-network members and through their interaction with external actors, are the most important resources, and that network construction is the most important process for strengthening this type of innovative economic initiatives. These capabilities are fundamental for the acquisition of financing, specialized knowledge, specific machines and other technique components of the technological systems.

INTERACTIVE LEARNING WITHIN AND BETWEEN GBL'S INITIATIVES

The development of the endogenous knowledge base necessary to dynamically assimilate knowledge leveraged from exogenous sources depends fundamentally on the internal dynamics of reflection on practice and diffusion through interactive learning mechanisms established within the task-networks. Learning from interactive reflection on problematic aspects of the innovative process and business performance, is the principal feedback mechanism stimulating the transformation of business strategies and the generation of specifications for new searches for innovative alternatives to solve problems and take advantage of development opportunities.

HUMAN CAPITAL BASE FOR INNOVATIVE PRACTICE

The importance of adequate formal and informal mechanisms of human capital formation for innovative performance, as stressed by Dalum et al. (1995), Edquist (2004) and Bell and Albu (1999), is revealed in several ways in the experience of APRAINORES and GBL's other economic initiatives. The historical exclusion from the formal educational system of a large number of adult men and women producers and workers related to these initiatives is a limiting factor in relation to their capability to absorb new innovation-relevant knowledge. Knowledge assimilation depends in part on how it is presented, and this is a weakness in the university-level training received by many of the technical personnel working with NGO like CORDES. Low producer educational levels are also a

crucial factor weakening the associative business management and oversight capabilities of the producers involved as the new owners of several of GBL's business initiatives.

There are few professionally trained local people capable of taking on the overall management responsibilities for these complex business initiatives or occupying key professional positions within CORDES Bajo Lempa. The resulting dependence on external professionals has proven to be an endemic weakness for business management and support services. On the one hand, the process of their enrollment takes time, and as Espin puts it, not all «vibrate» in the same way —i.e. share the same perspectives and development goals— with respect to GBL's local development process, or demonstrate the same amount of dedication to their tasks (Espin 2003, 2004)[3].

An important advance in this area has been the systematic formation of a reduced group of producers, trained to serve as «popular technicians» linked to the different production «lines» being promoted. In the case of organic agriculture, a young local man has received specialized training and now carries a significant part of the work load for technical assistance. He has learned about organic production, visiting experiences in Central America and Cuba, and also through trainings in El Salvador by experts that have put special emphasis on practical application. There is a similar case of a local man trained in the area of milk cattle production who is now part of CORDES technical staff and the BIOLACT cooperative's directive council.

INTERACTIVE LEARNING DYNAMICS AND INNOVATION

Dynamic assimilation of exogenous technological elements and the generation of performance improvements in production, processing and marketing systems have required synergy between the knowledge using, acquiring and creating capabilities, as defined by Bell and Albu (1999); also, between the dynamics of learning by producing, searching and exploring (Johnson 1992), and learning from various kinds of internal technological activities and exogenous sources (Bell and Albu 1999).

The strengths and weaknesses of the APRAINORES task-network's capabilities can be seen in relation to their efforts to improve the productivity of cashew growing, as well as the diversification of cashew cropping systems in order to improve profitability for producer families. The search for alternatives to the problems caused by limited initial income generation from land under cashew production began, as Loasby (2002) suggests, with a limited existing base and thus significant uncertainty,[4] and proceeded through trial and error making connections between knowledge generated by producers involved in the initial experiments and CORDES' technical staff's growing knowledge of alternatives.

Over time, the technological knowledge necessary for improving cashew plantation management, including the introduction of organic agro-forestry systems, has been built up incrementally through the application of knowledge derived from a combination of internal generation and external capture. Exogenous knowledge inputs have been acquired through visits by Brazilian cashew growing experts, as well as several international experts who have stayed to work with CORDES' agricultural program for more extended periods. Input

from these sources has been complemented by that generated through an active endogenous process of trial and error concerning the combination of cashews with other crops, beekeeping, small animal and cattle production, etc. Producer training has also been an important service provided by CORDES directly or indirectly by enrolling other specialized institutions. The evolving diversity of productive systems represents the interactive process of developing alternatives that fit with their overall economic livelihood strategies.

However, there is still a persistent lack of systematic interactive learning mechanisms among the producers integrated in APRAINORES, and this limits their capability to take advantage of the diversity of the accumulated knowledge they possess. One effort to stimulate greater interactive learning was the promotion of on-farm participatory experimentation with producers, concerning diverse techniques for vegetative grafting to renew unproductive trees, and for selecting the genetic material to be used in renovating or replanting the cashew plantations, as well as for biological pest control and the production of organic fertilizer (interview with Tasso Hettershmidt 2004). This process was promoted by an agricultural technician from a Dutch NGDO with a long-term commitment to provide technical support to CORDES' agricultural program. In addition, CORDES' agricultural program has also been experimenting with artisanal irrigation technologies, some of which are now in use in the cashew agro-forestry production systems. There have also been knowledge exchanges with producers from other regions where CORDES works, and these have assisted local producers in learning about the

design and management of more developed agro-forestry systems. These efforts are, however, limited in scale and are always dependent on external project funding.

These examples reflect a more general trend within CORDES's agricultural program to progressively increase their capabilities in endogenously generating innovation-relevant knowledge. As Bell and Albu (1999) state, their capabilities to learn from supporting productive practice are being extended to more systematic efforts to incorporate reflexive learning mechanisms, as well as practical experimentation into their work with producers.

Loasby's (2001, 2002) emphasis on the interaction between actors with diverse knowledge bases, reflected in divergent conceptions of problems and solutions for innovative practice, further highlights the importance of constructing synergistic learning connections between local producers and NGDO technical staff, as well as industrial workers, plant management and business support personnel.

As Cooke (1999) argues, explicit efforts to search for new knowledge have enabled the task-network to evaluate and progressively improve their exploitation of innovative alternatives. In relation to APRAINORES's processing operations, interaction with exogenous knowledge sources has been especially important for innovative practice. The designing of APRAINORES's processing plant exemplifies the task-network's knowledge search and interactive learning capabilities. The different innovations implemented in the processing system also demonstrate the task-network's capability to acquire knowledge from external sources in areas that have been identified as critical. For example, when APRAINORES bought the frying machines and ovens —originally designed for

bakeries— for the new plant, they worked with their Salvadoran supplier to incorporate mechanisms for improving safety and enabling more precise monitoring of the temperature and time necessary for their operations. This demonstrates APRAINORES's emerging endogenous capability to adapt exogenous technology to the requirements of their technological system.

The innovative application of contributions from different exogenous actors has been dependent upon the APRAINORES management's capability to mobilize them and to translate their knowledge into changes in the plant's design and technological system. Innovations in the cashew processing technology have required detailed knowledge of international market requirements for organic and fair trade certified cashews. The implementation of these innovations also demonstrates an integral understanding of the technological system, beyond that necessary to utilize the productive techniques involved. Tacit knowledge accumulation through practice in APRAINORES's processing operations has been the principal mechanism for the consolidation of team skills and organizational routines related to the innovation process, as the basis for increasing operational efficiency, along with more conscious trial and error experimentation.

In regards to commercialization, the APRAINORES task-network has used the experience of selling their nuts in national and especially international markets as a basis for incremental improvements in their marketing practice. Through interaction with their international buyers as well as a diversity of similar producer and new potential buyers from the *Bio-fache* and other similar trade fairs, the key actors have assimilated the need to continuously improve their product quality. They are currently (2008) in the process of

applying a certification regime for better manufacturing practices in response to market demands.[5]

This practice reflects the importance of the social and spatial dimensions of tacit knowledge accumulation and application for innovative practice, as argued by Morgan (2004) and Spender (1996). The contextual contingency of interactive learning related to innovative practice, as argued by Fleck (1997), is reflected in the particular way in which diverse types of knowledge —from local producers, plant workers and management, consultants from organic and fair trade certification agencies, diverse national and international cashew growing and marketing experts, etc.— have been creatively combined and applied to innovative practice in the evolving *milieux* of these initiatives.

In contrast to APRAINORES, the SAAO initiative task-network was initially unable to dynamically assimilate the imported and adapted production techniques, and to consolidate the knowledge and organizational capabilities necessary to manage the production and commercialization of granulated *panela*. They were initially unable to achieve the expected results in terms of product quality, quantity and marketing that were used as the basis for project planning and analysis of business feasibility. This initial failure reveals the significant risks involved in this type of innovative process, due to uncertain knowledge of production techniques and market acceptance. One key element that contributed to the failure in the initial efforts to assimilate this exogenous technology, was insufficient attention paid to tacit knowledge accumulation for the adequate functioning of production operations. SAAO was not able to initially overcome the lack of local workers with the necessary knowledge to successfully produce granulated *panela*.[6]

As Fleck (1997) suggests, the implementation of this technological alternative was constrained by a host of locationally-specific knowledge contingencies. These were related to finding sugar cane varieties adequate for *panela* production and adapted to the hot coastal conditions, managing the specificities of the newly constructed *trapiche,* the historical lack of *panela* production knowledge among the local people involved, the difficulties of involving other national expert producers in their productive effort, the way in which exogenous knowledge acquisition was managed, etc. This localized technological system demanded certain types of contingent knowledge that the task-network involved was not able to adequately mobilize and apply, at least initially (Spender 1996, Fleck 1997).

However, the subsequent systematic approach to learning through a combination of methods and from a diversity of sources in order to develop new technological specifications and enable the SAAO task-network to resolve the indeed complex technological problems of producing granulated *panela* in this area, is indicative of CORDES Bajo Lempa's increasing capability to combine endogenous research and development with exogenously acquired knowledge.

The BIOTEC initiative demonstrates an emerging task-network capability to understand the potential importance of knowledge developed by Cuban and Salvadoran scientists through exploratory knowledge generating processes, and to apply this knowledge to the development of their innovative products. Their capability to elaborate product specifications for their biological pesticides, taking into account the priorities of producers as potential users, as well as their accumulated knowledge base and exogenous knowledge

resources, also reflects an increasing capability to conduct endogenous research and development.

CRITICAL REFLECTION ON INNOVATIVE PRACTICE

Critical reflection on the different phases of their innovative practice in order to learn from advances and difficulties is necessary in order to consolidate current innovative endeavors and further develop their innovative practice. Within the initiative task-networks, and especially CORDES Bajo Lempa, there is an increasing capability to engage in what Sunbo (2003) denominates strategic reflexive practice, involving an explicit effort to learn from experiences in implementing technological innovations that have led to strategic changes in their continuing practice.

Following Sunbo's (2003) arguments, the evolving local economic development strategy being promoted by CORDES through GBL's initiatives, reflects an integral analysis of market restrictions and potentials for local agricultural products and the internal resources and capabilities of local families of producers.[7] The initial market analysis suggested severe restrictions for the commercialization of basic grains and primary agricultural and dairy products. There was thus a definite need to add value to local production and create differentiated products that could compete in higher priced national and international market niches.

Reflexive learning in relation to organization for primary production has led to a progressive move to promote smaller, more family-based, primary production units, instead of larger associational producer organizations that proved difficult to govern and

unresponsive in term of credit payment. The production systems being promoted in relation to the APRAINORES, BIOLACT and AGROLEMPA initiatives, are more integrated and diversified, and there has been a related shift to less capital-intensive production technology, most notably in the types of irrigation technology being promoted, breaking down the investments required into more risk-able, viable steps.

In the APRAINORES initiative, additional critical reflections on market position and internal business dynamics motivated the feasibility studies and the development of concrete proposals for investments to expand and diversify their processing operations. Also, reflexive learning on the development of this initiative has informed key aspects of project designs for successive initiatives such as SAAO and BIOLACT, in terms of their focus on organic or cleaner production techniques, adding value and creating differentiated products and associational governance mechanisms.

INTERMEDIATION OF EXTERNAL KNOWLEDGE FLOW

The generation of new knowledge can only be transformed into innovative options if the new knowledge can be connected to an existing knowledge base in a synergistic way (Loasby 2000, 2002). This is especially true in relation to the dynamic assimilation of exogenous knowledge and other elements into localized technological systems, and this leads us to the mechanisms explaining GBL's «cluster absorptive capacity» (Guiliani and Bell 2004). Here the concept of knowledge/technology gatekeepers (Ibíd.) can be applied to analyze the role played by CORDES in mediating the flow of externally acquired

knowledge and other resources into the task-network context and supporting their application in innovative practice.

CORDES is directly mediating flows of exogenous knowledge to be applied in renewed efforts to produce organic *panela* in the SAAO initiative, and the infusion and diffusion of knowledge concerning the production and use of biological pesticides through the BIOTEC initiative. However, what CORDES mediates is frequently not the actual capture and internalization of knowledge, but rather the enrollment of knowledgeable actors who play this role and «transfer» their knowledge through different interactive situations to the producers, business managers, workers, etc. Examples include the enrollment of the international marketing expert —linked to CORDES' central office—, who played a key role in expanding APRAINORES's connections to the international market and to international financing under favorable conditions, as well as the expert from an international NGO financing the APRAINORES plant to strengthen APRAINORES's initial management capabilities. This is also the case with the succession of two Dutch experts who supported CORDES Bajo Lempa's agricultural program, as it adopted a progressively more agro-ecological focus and developed its participatory working methodologies, as well as the Basque business consultant working to strengthen the BIOLACT initiative.

CORDES' capabilities to play this role are directly related to the accumulation of specialized knowledge bases by key people who are directly responsible for this organizational function. The proximity of these people's knowledge bases to those of the

exogenous actors with whom they are interacting enables the learning process, and explains their knowledge absorptive capability (Giuliani and Bell 2004).

SYNERGISTIC CONNECTIONS BETWEEN EXOGENOUS AND ENDOGENOUS KNOWLEDGE BASES

In conclusion, as Loasby (2002) argues, new knowledge relevant for innovation in GBL's economic initiatives has been created by making connections with exogenous knowledge bases through «appropriate receptors», and endogenously through connections between existing knowledge bases, for example, the knowledge bases of producers, plant workers, management and supporting consultants in the APRAINORES initiative.

The implementation of innovative technological alternatives in GBL's economic initiatives has depended on understanding why, how and from whom to mobilize a diversity of endogenous and exogenous resources. Building endogenous research and development capabilities is becoming increasingly important in order for GBL's task-networks to complement and facilitate the dynamic assimilation of increasingly more complex exogenous knowledge. Equally important is the involvement of people with sufficient practical knowledge in order to understand and enable the transfer of technological components from exogenous systems, when their functioning implies a great deal of tacit knowledge, such as granulated *panela* production in visits to Colombia. These two situations are frequently present in the same innovative process, adding complexity in terms of requirements for people who are able to translate, and make the necessary connections between these related, but dissimilarly constituted knowledge bases.

Innovations that imply more substantial, radical changes in technological systems require learning processes that are different from those necessary for the incremental innovations required to consolidate the more radical innovations. Incremental innovations are more based on tacit knowledge accumulation and internal processes of reflection, while more substantial changes require learning by searching for new knowledge, techniques, and organizational examples from external sources. In both cases, however, the key has been synergistically linking these distinct types of learning processes, making innovative connections between the knowledge bases of the different actors involved: i) those responsible for the conceptualization and design of the more radical changes and those involved in the incremental process of transforming the technological system to accommodate and consolidate these changes; ii) the exogenous knowledge sources enrolled in support of the initiatives and those people involved in endogenous research and development efforts; and iii) the scientific and engineering knowledge of NGDO technicians and the more tacit, experience-based knowledge of producers and plant workers.

Finally, it is necessary to note that critical reflection on business practice in order to clearly define problems and opportunities for innovation has been a necessary input for effective exogenous knowledge search operations and endogenous R&D processes for generating innovative alternatives in GBL's initiatives. This has allowed moving beyond learning by doing to improve practice, to a more conscious understanding of how and especially why the technological systems function the way they do and of their inter-relationships.

EXPLAINING THE EMERGENCE OF INNOVATIVE CAPABILITIES

The emergence of the deeper innovative capabilities of interactive learning and networking in GBL's economic initiatives, has depended on the realization of synergies between the potentially complementary actions of a triangle of key actors: the leading NGDO CORDES, the progressively autonomous management of the different initiatives, and the producers and workers who are the cooperative owners of the enterprises and their elected leadership.

The emergence of the innovation capabilities of the GBL's task-networks has depended on the development of learning mechanisms to accumulate different types of knowledge from experience and reflection on productive and commercial practice, as well as searching for exogenous knowledge from sources including actors involved in scientific exploration. Especially important has been the ability to recognize and make connections between the different knowledge bases being accumulated through these mechanisms, thus generating new options and developing them in innovative practice.

In essence, the task-networks' innovative capabilities are emerging through an incremental process of learning through participating in and reflecting on innovative practice in the context of the different economic initiatives. Innovative capabilities can thus be considered as emergent properties of social interaction in the concrete processes by which discrete technological systems are transformed, as well as interaction between initiatives in the context of GBL and with exogenous actors.

Networking capabilities are learned or acquired through repeated practice. Diverse types of networking relationships are key to obtaining different types of external knowledge and other resource inputs, each demanding somewhat different networking capabilities for establishing and maintaining. Networking practice thus implies the development of specialized, mainly context specific, tacit knowledge concerning how and why to engage in diverse types of longer term and more complex network relationships or more contingent and temporal linkages.

Innovative capabilities frequently have important collective aspects. Interaction between the actors involved is a necessary characteristic of innovative practice, which in turn is embedded in specific organizational structures or network contexts. The individual capabilities of task-network actors can be seen as opportunities that may or may not be taken advantage of in innovative processes. The overall innovative performance of these initiatives depends on the quality of interaction between the knowledgeable actors involved, and the particular nature of the interconnections between them, within and across organizational boundaries in each task-network and with key exogenous actors. Thus, innovative practice depends on their collective vision of the outcome and the coordination of their individual capabilities to achieve the expected results. In this case, the construction of a shared vision and coordinated action has required proactive facilitation.

The dynamic assimilation of exogenous technological alternatives has required skillful coordination of capabilities at the nexus between the external inflows of diverse kinds of knowledge, frequently embodied in cooperating actors, and the internal learning dynamics of the people involved in implementing the proposed innovative alternatives.

Different actors have become enrolled in different ways within GBL's economic initiatives. The evolving web of internal and exogenous, inter-personal and inter-organizational network connections provides the organizational conduits through which the diverse resources for implementing technological innovations in GBL's economic initiatives flow, and are thus key aspects of the task-networks' collective innovative capabilities.

The emergence of the capabilities involved in dynamically integrating the diverse endogenous and exogenous resources necessary for innovative practice cannot be understood adequately *only* as an interactive learning process. The emergence of these complementary capabilities in practice also requires the creation of specialized organizational and institutional configurations. The importance of establishing external networking connections, generating motivation and the enrollment of key actors, the articulation of expectations and the coordination of complementary actor capabilities, the construction of internal organizational configurations, etc., reveal the complexity of the actions involved in dynamic assimilation of exogenous technological alternatives.

The deeper innovative capabilities of GBL's task-networks have emerged from and are expressed through this interactive social practice, and thus, depend on the specific nature of the organic linkages and the more intangible qualities of the relationships between the actors engaged in these social interface situations.

The most important intangible, cognitive aspects of the key relationships between actors within GBL's economic initiatives, and between them and exogenous actors identified through this case study analysis, are: i) mutual understanding and shared

language codes necessary for effective communication; ii) complementary motivations to engage in joint practice over time; iii) conventions of social inclusion and reciprocity, building from non-exploitation to synergy; iv) reliability concerning the fulfillment of agreements and trust in the expected application of capabilities to resolve problems in agreed-upon ways, and v) agreed-upon co-responsibility in terms of assuming the risks involved in innovative activities (see Cooke 2002).

These aspects can be understood as the specific *institutional basis for the relationships* from which deeper innovation capabilities emerge. The institutional basis for these relationships is socially constructed over time and is reflected in tacit understandings of what constitutes appropriate behavior as well as more explicit formalized agreements that orient interaction. The *organizational basis for the relationships* from which the innovative capabilities of GBL's actors have emerged, is reflected in the particular configuration of linkages between the actors involved, and the way these are structured in relation to networking and learning. In the case of individuals, their engagement in collaborative innovative practice is mediated by the organizational configurations in which they are embedded and the relationships established between their respective organizations —if their relationship crosses organizational boundaries.

The energy required for this complex process has been provided by catalytic agents enrolling and facilitating the coordinated expression of the complementary capabilities of diverse endogenous and exogenous actors, however, its sustainability depends on the strengthening of the connections and synergies emerging between them in the development of GBL's innovative economic initiatives.

FINAL REFLECTIONS AND REASONS FOR CAUTIOUS OPTIMISM

The achievements of task-network partners, and especially their potential, suggest a positive end to the story of GBL's innovative economic initiatives, offering room for cautious optimism as to the possibilities of finding innovative solutions to the most pressing socio-economic problems facing rural families in El Salvador. At the same time, GBL's current problems, and the rather unique combination of capable actors involved in these initiatives, in contrast to others in the regional and national contexts, as well as the structural instability of rural El Salvador's fragile insertion in the globalizing world economy, caution us against succumbing to overdue optimism.

The construction of territorial contexts that stimulate and support the emergence and strengthening of innovative capabilities in local economic initiatives will be essential to facing this challenging situation. In countries like El Salvador in the South this requires a concerted effort to strengthen regional systems of public and private actors supporting technological and business innovation and their synergistic linkages with actors in national and international innovation systems. The construction of regional systems of innovation should be central to more integral efforts to promote local and regional development. This demands increasing linkages and strategic cooperation between localized networks of economic initiatives, public and private actors providing technical, financial and other direct support to these initiatives, as well as local governments, national state agencies and others responsible for key public services —infrastructure, education, communications,

etc.— and promoting public-private cooperation for sustainable territorial development strategies.

INTERVIEW

Tasso Hettershmidt, volunteer researcher with Cordes and Vicente Carranza, interview realized in 2004.

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Notes

[1] For further information see Grupo Bajo Lempa:

http://gbajoelmpa.esmartdesign.com/Ingles/gbl_quienes_somos.htm

[2] This initial conceptualization is similar to and can be seen as building on the conceptualization of firm-level innovative capacities proposed by Yoguel and Boscherini (2000: 8-9).

[3] With time this situation may change as young people from this region make it through university or post-secondary technical training programs, and then make the decision to return to this area to work. However, the regional university center and technical training alternatives are weak, especially in the area of business management and agro-industrial innovation, and there is a definite need to strengthen the practical training programs provided by CORDES and others to strengthen the capabilities of the different people involved in innovative practice in GBL's economic initiatives.

[4] An initial knowledge base for cashew production in the APRAINORES initiative was provided by many of the Montecristo Island cashew producers, who had accumulated relevant knowledge living near and working on the privately-owned cashew plantation located there before the war. This knowledge acquired as plantation workers was not, however, the same as that required for their management of this same plantation as owners, and cashew production was a novel activity for most of the producers involved in this initiative.

[5] For example, their principal German buyer, GEPA, specifically asked that they separate the whole nuts that have been too scratched during «skinning» from those that are more intact. These will now be sold at a price between the white halves and wholes. This suggests the need for reducing scratching during this operation, but also improving the quality of primary production to deliver nuts with fewer blemishes that must be scratched off.

[6] This is in contrast to similar initiatives involving the upgrading of traditional *panela* production systems, where the largely tacit «traditional» knowledge base of the producers involved, built up through extended practical experience, has been the key to making the transition to the granulated product, especially the know-how necessary to identify the *punto de panela* at which the evaporating sugar cane syrup crystallizes

for granulation. For further information on the *panela* production process and the benefits of improved production technologies, like those implemented by the SAAO initiative, see the following article —in spanish—: «Mejoramiento Tecnológico de la Producción de Panela en Pequeños Trapiches del Departamento de Huehuetenango» by Almengor et al.: http://www.condesan.org/e-foros/agroindustria_rural/air2david.htm.

[7] This characterization is based on various interviews with Espin and Erazo —head of the Agricultural program—, but also inferred from observed practice.

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