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## **Institutional and technological Innovations in NTFP-Cluster Promotion. The Case of the Bamboo (*Guadua angustifolia*) Sector in Colombia**

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### **Abstract**

In the Colombia *Eje cafetero* (coffee belt) located between 800 and 1.800 masl in the inner valleys of the Colombian Andes, the native bamboo species *Guadua angustifolia* is the dominant vegetation form. For local users it is the most common source of wood for day to day uses. The existing 30.000 ha of *Guadua* (representing about 60% of Colombia's total bamboo resources) are mainly distributed in small stands of a few ha on private property. Currently, the vast majority of the bamboo harvested in the region (an average of around 30.000 m<sup>3</sup> per year) is used in temporary, auxiliary purposes in the construction sector with no significant value added. The world-wide coffee crisis of the 1990ies and an earthquake in 1999 have led to a new appreciation towards the bamboo resources involving a large number of actors in the region.

This study analyses and evaluates the behaviour and strategies of the wide arena of actors involved in the development of the bamboo sector, such as public and private sector actors and micro-level producers and processors. The research clearly reveals that the behaviour of actors can be adequately explained with the principles of transaction cost analysis and bounded rationality affecting their participation in the process. Furthermore, the capacity and willingness to co-operate is crucial to the whole process, but is not found amongst many of the affected actors in the sector. Therefore, the rules of interaction and co-operation between actors were especially focused in this study.

The results of this study might serve as a reminder to all those planning development processes and trying to induce innovation processes in the non-timber forest products sector, where usually a much larger number of actors is involved than in other productive sectors. Furthermore, it may help to understand how the upgrading process from mere survival clusters to industrial clusters can be initiated and guided.

Keywords:

Non-timber-forest-products (bamboo); clusters, innovation processes, actors; institutions

## **1. Background and aim of the study**

This paper presents outputs of the research in the field of socio-economy within the framework of the EU funded INCO/DEV project "Guadua-Bamboo. Research for sustainable management and marketing of bamboo in Costa Rica and Colombia". The investigations focus on the analysis of the production-to-consumption systems (PCS) for bamboo in these countries as well as on potential markets for bamboo products in Europe. During the work on the PCS in Colombia it has become obvious, that, although public and private interest in the promotion of the bamboo resources is high, and activities of a vast number of actors have been intensified over the last years, the bamboo sector still is underdeveloped.

The potentials of bamboo products seem to be apparent in extraordinary success stories, such as the Chinese bamboo (Belcher, 1995; Ruiz Pérez, 2001) or the Indonesian rattan production - with some restrictions – (Liese, 2001). The successful participation of these two non-timber-forest-products (NTFPs) in international markets seems to affirm this assumption. In the context of regional rural development, approaches, which support the producers and extractors of NTFPs are common, assuming, that increasing economic valuation of the resource will contribute 1) to the protection of the resource itself and 2) to economical and social welfare of the producers and extractors (Becker, 1993). In the NTFP processing and manufacturing sectors promotion activities mainly focus on small and medium sized enterprises. Instruments usually comprise easy access credit facilities, technical extension services, support of cooperatives and the establishment of model projects and enterprises. The assumptions underlying these activities are, that the limiting factors to improve processing and value-adding are access to capital and knowledge, and furthermore, institutional and organizational barriers and obstacles for micro level actors. In the Colombian case the meso-level actors follow this scheme of development approach.

The ongoing research is trying to analyze and evaluate the activities of these actors and the response and behavior of the micro-level producers and processors. The underlying assumption is, that the current approach does not succeed, because it does not consider the bounded rationality of the individuals and, furthermore, it does not consider the endogenous potentials of those individuals amongst the micro-level actors, who have been the driving forces behind product and process improvement in the bamboo sector so far.

## **2. Theoretical Background**

The theoretical background underlying this study is based on regional cluster development research (Altenburg and Meyer-Stamer 1999; Meyer-Stamer, 2001). Clusters, are complex networks of actors and institutions, which usually comprise more than one value chain or production to consumption system. According to Altenburg and Meyer-Stamer (1999) there does not exist a clear definition of a cluster, however, there is a classification, which is commonly shared by scientists in this field of research: 1) large scale transnational clusters, 2) national/regional industrial clusters, and 3) regional/local survival clusters. The latter can be generally characterized through lacking coherence and organization. They are formed by micro-, small- and medium enterprises without competitive business and production structures. Activities in this type of clusters are usually undertaken temporarily and number of entries and exits is high. Most sectors based on the utilization and processing of natural resources in developing countries belong to this group. So does the Colombian bamboo sector, but also many other NTFP-sectors all over the world. Common objective of development programs and projects is the "upgrading" of these usually isolated NTFP clusters, trying to transform them into industrial clusters. Basic

concept of the cluster approach is the upgrading of the competitiveness of the sectors through a) technological upgrading, b) increasing social capital endowments, and c) adjusting the institutional arrangements (GTZ, 2001).

The basic approach of this study draws from two important sources of theory: 1) the neo-classic and new growth theories and 2) from innovation and evolutionary economics. While the first provides the background on growth related factor conditions, the second creates the framework for knowledge management and collective learning processes, with both combined resulting in a better understanding of innovation and diffusion processes in the cluster approach.

Although, the cluster approach is a systemic one, and upgrading of the competitiveness is seen as a systemic task (see Eßer et al, 2000), the analysis and evaluation of the cluster is based on actor-centered methods, thereby recent approaches from Scharpf (2000) and Manske (2000) are the most interesting ones to be scientifically probed in this context.

### **3. Methods**

#### **3.1 Micro-level Analysis**

For research at the micro-level the production-to-consumption-system analysis (PCS) approach, developed by Brian Belcher for the International Network for Bamboo and Rattan (INBAR) in 1994, was adopted. It is meant to serve as a framework for socio-economic case studies in the bamboo and rattan sectors of the world and lays out a process, which involves:

- Definition of the production-to-consumption system;
- Mapping of the various links in the system;
- Definition and assessment of the policy and institutional environments, that guide and constrain the system;
- Assessment of knowledge, resources, and incentive constraints;
- Definition of the specific changes that need to be instituted;
- Definition of the policy and institutional interventions needed to achieve the changes.

(Belcher, 1998)

The data was gathered conducting face-to-face questionnaire interviews developed for each actor group, namely small scale producers, commercial producers, intermediaries/retailers, construction, handicraft and furniture (Table 1). The questionnaires covered microeconomic and institutional aspects and were realised in the enterprises themselves. The questions were structured in the case of microeconomic basis data, semi-structured in the case of situational descriptions of markets and products and open in the case of perceptions and opinions on institutions and business options. Data collection was conducted in summer 2002 in the Colombian coffee growing region.

Due to the lack of reliable figures on the total number of bamboo-related micro-level actors in the study region, the sample size was defined as follows:

In the case of the coffee growers a fixed number of interviewees was determined in advance according to a socio-economic pre-stratification approach. The aim was to assess detailed information on small-holders possessing coffee producing farms of different sizes. Interviews were conducted with 60 farm owners/managers of 30 farms smaller than 20 has, 20 farms between 21 and 50 has, and 10 farms larger than 50 has. (CIPAV, 2002)

Bamboo marketing and processing data collection had as starting point a directory of the chamber of commerce of the city of Pereira. The listed actors were approached and interviewed. The interviewees were asked to indicate other entrepreneurs dealing or processing bamboo. Based on this snow-ball technique, about 90% of the bamboo furniture producers, 50% of the bamboo handicraft producers and probably 30% of the bamboo retailers in the study region could be identified and interviewed.

**Table 1: Number of interviewed micro-level actors during PCS 2002**

<b>Micro-level actor group</b>	<b>Number of interviewed actors</b>
Coffee farmers (small-holder bamboo producers)	59
Commercial bamboo producers	5
Intermediaries/Distributors	30
Constructors	18
Furniture producers	12
Handicraft producers	48
Total	172

### 3.2 Meso-level Analysis

In order to analyze and evaluate the efforts and activities of the various actors in the bamboo sector, a definition of the relevant actors has to be given. Therefore, a definition by Meyer-Stamer (2001) was adopted, which refers to this type of actors as those, who seek to influence a specific sector's policy and development through their activities. They differ from typical macro-level actors and policies, which usually create a framework, that shall cover all economic subjects of a nation equally. These actors constitute the meso-level in the development and promotion process of economic clusters. The basic evaluation of the actors considered Scharpf's actor-centered institutionalism (2000), which focuses on actors' interactions and strategies under certain constellations of a resource endowment regime, which includes monetary, personal and institutional resources of the actors.

Data on the meso-level were collected through guideline interviews in combination with structured interview questions. Guideline questions referred to four major thematic fields of research, namely "Regional Development", "Actors' Aims and Strategies", "Actors' Resources and Organisation", and "Guadua Sector Promotion". The structured part comprised an actor self-evaluation of activities and a graded ranking table. Further, two structured questions referring to the actors' interactions and co-operations with other actors were assessed.

The guideline-interview questions were expected to contribute to clarify the overall hypothesis: "Competitive industrialised utilisation of local natural resources contributes to economic and social regional development".

The data gathered through these guideline interviews with the actors were analysed according to the standards of qualitative contents analysis (Mayring, 2000). Categories were defined during the transcription process. These categories were revised and redefined a second time, when the data were codified and entered in SPSS 10.0 software, and then for a third time when the analysis process was executed.

**Table 2: Interviewed meso-level actors during field campaign in 2002**

<b>Meso-level actor group</b>	<b>Number of interviewed actors</b>
Governmental Actors	13
NGOs	4
Construction sector representatives	5

Agricultural producer associations	3
Research entities	7
Independent experts	6
Multi-actor associations	5
Total	43

## 2. Description of the research area

The study focuses on the departments of Caldas (Capital Manizales), Risaralda (Capital Pereira) and the Quindio (Capital Armenia), which together form the central coffee growing region in Colombia (12.700 km<sup>2</sup>). The region is predominantly located in the inner valleys of the Andes between 800 and 1.800 masl. About 70 % of the population of 2.360.000 live in the urban centres areas while only 30% of them live in rural areas (CINEP/COLCIENCIAS, 1998).

30% of the region's surface area is covered with coffee plants. The natural vegetation has been removed except for some small areas in the high altitudes of the Andean mountains. The landscape is characterized by agriculture and pasture.

Major agricultural product and also major export commodity of the region is coffee, which accounts for 0,5% of the national PIB (1999, Ministerio de Agricultura de Colombia) . However, the worldwide coffee crisis has led to a dramatic drop in the producer prices for coffee, which are still below the prices paid at the end of the 1980s. Temporarily, the prices even drop below the production costs. Thus, the 40.000 coffee growers (mainly small-holders with less than 5 ha under coffee production) in the region have to look for alternative income sources, which they have partly found in banana and flower production, but also in alternative organic coffee production systems.

Due to the elaborated coffee production system and commodity chain, the region's infrastructure is highly developed compared to most other Colombian regions. The road system in the region is well maintained and new highway connections between the regional urban centers and the Cities of Bogota, Medellin and Cali have been completed.

The coffee growing region still is one of the most secure areas in Colombia. However, activities of armed conflict parties have increased, especially in the outer skirts of the region, with heavy impact on the transport situation. Illicit drug production has also been observed, although extend of this activity can not be compared with other Colombian regions. Generally, the state is in control of the area and, with limitations, economic and social life can take place.

The bamboo species *Guadua angustifolia* covers about 30.000 ha in the region, mainly along streams and on hills (Herrera and Ospina, 1998). About 30.000m<sup>3</sup> are harvested per year. 1/3 of it is used for domestic purposes while the remaining 20.000 m<sup>3</sup> are commercially traded. The average bamboo stand size in the region is 1,4 ha or 8,4% of the total farm area. Only 30% of the stand owners use this resource commercially. Those who do so realize between 2% and 10% of the annual farm income from this activity. The farmers usually do not participate in the market themselves, rather they sell out standing bamboo to intermediaries (Guadueros), which pay blanket-prices, organise and realise harvesting and transport, and distribute the material to retailers or final consumers. According to the current prices for coffee and bamboo, the income from a high productive natural bamboo stand is equivalent to the income of 0,25-0,5 ha of an average coffee cultivation.

An estimate of 93% of the harvested bamboo is used in auxiliary, temporary applications in the construction sector. Of the final price, the producers of the raw material receive about 25%. The larger share of the final price (US\$ 1/bamboo cane) is realized by two to three intermediaries. Other applications of the raw material are found in the handicraft and furniture sector, with significant value added. However, the quantities consumed in these branches are marginal.

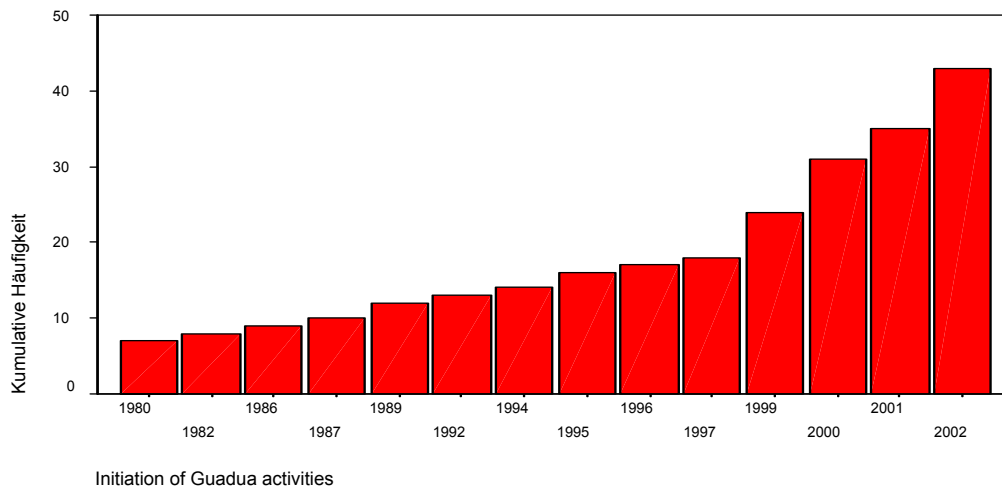
#### 4. Results

The results presented in this paper focus on the capacity and capability of the actors in the bamboo sector to interact and co-operate. This is based on the basic assumption in cluster promotion research, that through interaction the diffusion of knowledge and new technologies and products is facilitated. This chapter is structured into two major sections: 1) intra- and inter-level interactions and co-operations in the meso-level, and 2) the intra- and inter-level interactions and co-operations in the micro-level.

##### The Meso-level

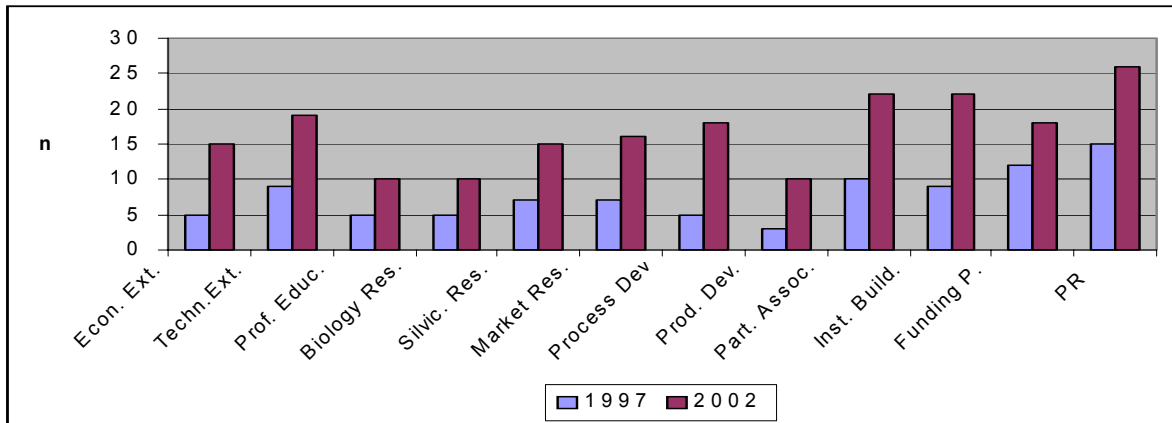
The number of meso-level actors engaging in the bamboo sector has more than doubled during the last five years (Graph 1). The activities are dominated by government actors, usually the regional environmental authorities (CARs, Corporaciones Autonomas Regionales), and few dissemination and extension services. The actors' strategies can be classified into two major strategic lines: 1) industrialization of the bamboo sector, and 2) integration of bamboo into ecologically sound agricultural production systems. Considering the basic assumption of cluster promotion research that, to the sector's development process, the coordinated activities of the meso-level actors are of crucial importance, the following results will focus on aspects of interaction, co-operation and coordination between the involved actors.

**Graph 1: Number of meso-level actors engaging in the promotion of the bamboo sector**



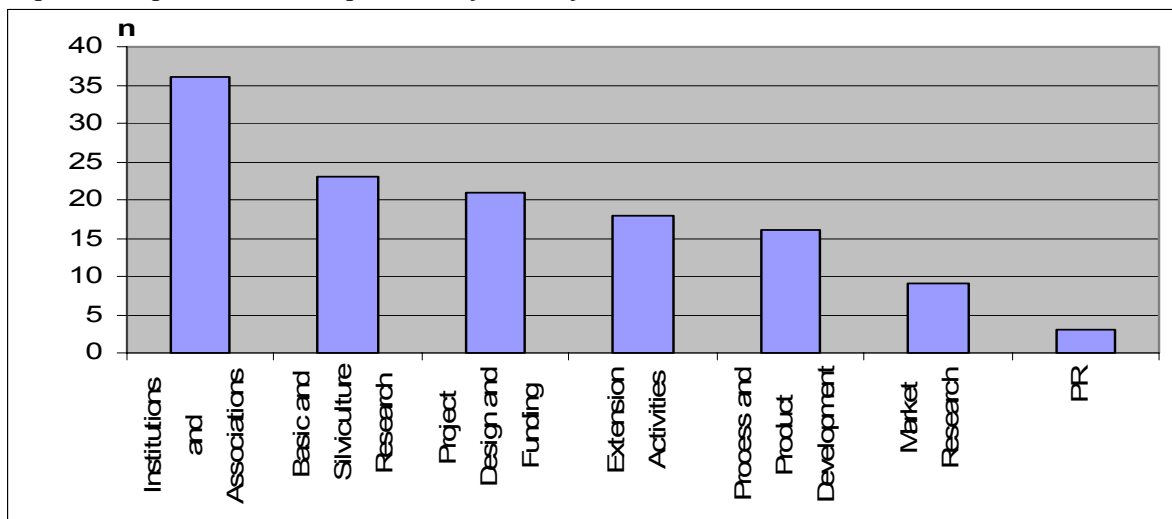
The actors conduct activities in various fields of research, project design, extension activities and institutions building. As shown in graph 2, most of the interviewed actors engage in extension activities, institutions building and association work. Public relations (PR) activities are carried out by most of the actors, but for the purpose of the following analysis this aspect will not be considered.

**Graph 2: Activities carried out by meso-level actors in the years 1997 and 2002**



The interviewed actors are involved in a number of co-operative activities, such as the development of programs and bamboo related projects and the creation of institutions (Graph 3). In Market research activities and product and process development, the actors do not interact that intensively. But, the actors engage parallel in similar activities and double studies and research of others. In combination with the insufficient dissemination of research results and difficult structures to access studies and research from other actors (as mentioned as an important problem of the bamboo sector by 54% during the interviews), this situation obstacles an efficient continuation of knowledge paths and knowledge distribution within the Colombian bamboo society. Further, the bamboo topic in the organizations and association is generally bound to a limited number of persons. Basically there is only one person knowledgeable and willing to manage bamboo related issues. Therefore, communication and co-operation between actors strongly depend on single persons with a knowledge monopoly on bamboo topics in their respective organizations.

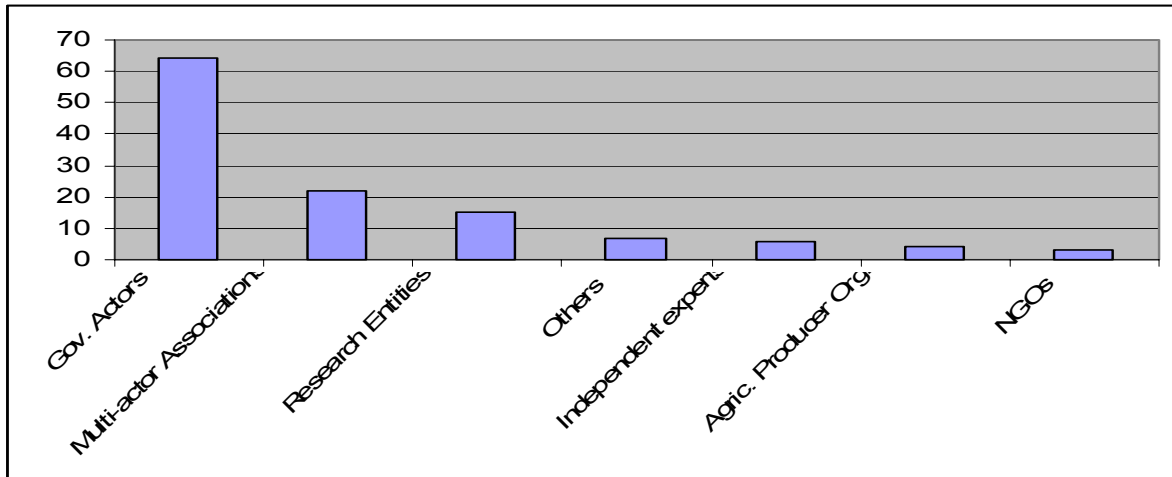
**Graph 3: Co-operation and co-operation objectives of the meso-level actors**



In contrast to the low intensity of co-operation in market, product and process research, the degree of activities related to institutions and associations building is high and the interaction structures are complex. This becomes apparent contemplating the institutional backgrounds of the actors, who co-operate with each other (Graph 4). It seems, that the most active participants in the sector are the governmental actors. However, in the bamboo sector every program, project or even only a plan to start one, has to include these governmental actors, since they are the source of resources and provide the facilitating institutional framework for the participants. Further,

since bamboo is a state controlled natural resource, involvement of the environmental authorities is obligatory. Unlike agro-industrial products and their producing and processing sectors, which are usually endowed with an own organization, extension services and commercial marketing units, the bamboo sector is subject to various stakeholding parties in the region: The government environmental authorities, the coffee growers association, the construction sector, various NGOs and research entities.

**Graph 4: Institutional background of co-operation partners as named by the 43 interviewed actors**



Graph 4 gives evidence of the co-operative interactions the interviewed actors maintain with each other. The total number of co-operations seem to be high, but only the column “Others” present co-operations with partners outside the circle of interviewed actors. The actors of the construction sector, as largest consumers of the bamboo resources, do not entertain bamboo related co-operative activities. The outside links of the bamboo-actors (“Others”) consist of funding from third parties, such as bilateral development co-operations and the Inter-American Development Bank. No co-operations at all are entertained with other industrial branches of the country, such as the wood-processing industry, the chemical industry or production sectors of capital goods, such as machinery and technology.

### The Micro-level

The micro-level actors were investigated regarding their capability and capacity to adopt successful new products and technologies as dependent variables from meso-level’s provision of framework conditions. The following results present an outline of the analysis of the handicraft sub-sector. Based on the assumption, that this capacity and capability results from three major factors, namely institutional framework, acquirement of knowledge and marketing strategies, the producers of innovative products were analyzed in depth.

Analysing the micro-level actors’ response to meso-level activities and offers, there could not be encountered a significant change in products and process improvements. Rather, the number of actors in the sector has increased and with it the fluctuation in terms of entries and exits (of the 48 actors interviewed, more than 50% started their business during the last three years). To analyze the impact of the meso-level activities on product and process development, innovative products, which are already established in the market had to be identified. The results presented in this paper refer to entrepreneurs manufacturing electric lamps from bamboo. As criteria for the selection of these actors, the contribution of the sale of such lamps to the overall output of the enterprise was chosen. Thus, 18 out of the 48 interviewed handicraft producers were classified into the group of “innovative” producers.



Comparing the two groups of “innovative” producers and “non-innovative” producers the following tables highlight some selected results of the ongoing research.

Table 3 reveals, that innovative producers are more likely to employ personal. Only 1/3 of them are pure self employers in contrast to 2/3 of the non-innovative handicraft producers. Further, the innovative producers employ an average of three employees (not considering one large scale employer of 17 employees), while the non-innovative producers employ only an average of two employees per enterprise (not considering one enterprise employing 20 persons). Therefore, the potential source of spill-overs through former employees of innovative producers starting own businesses is higher than this potential is within the group of non-innovators.

**Table 3: Employees of innovative and non-innovative handicraft producers**

		Número Empleados								Gesamt
		0	1	2	3	5	6	17	20	
innovative	yes	6	3	3	1	3	1		1	18
products	no	19	4	5		1		1		30
Gesamt		25	7	8	1	4	1	1	1	48

The ratio of interaction between the producers of handicraft with other actors of the micro-level in the bamboo sector was analyzed in table 4. Co-operation in general is not of high importance to the actors, and innovative producers even co-operate less than non-innovative ones.

**Table 4: Co-operations of innovative and non-innovative producers in the micro-level**

		type of cooperation					Gesamt
		lending materials	lending services	all of the above	client cooperation	none	
innovative	yes		14		1	3	18
products	no	1	20	2	1	4	30
Gesamt		1	34	2	2	7	48

The following table (5) shows the interviewed actors’ participation in organizations of any kind. None of the actors is inscribed in the regional commercial chambers’ registers, since this inscription implies the inscription in the national tax register. Thus, these actors can not draw from governmentally provided supporting measures, such as export promotion or special credit schemes for small and medium scaled enterprises. The organizations, the handicraft producers participate in, are usually regional associations of handicraft producers with weak organizational and a low level of formal institutional structures. Comparing innovative and non-innovative producers we see, that ¼ of the innovative and 1/3 of the non-innovative producers participate in such types of organizations.

**Table 5: Participation of innovative and non-innovative producers in organizations**

Anzahl		participation in orgs.		Gesamt
		yes	no	
innovative	yes	4	14	18
products	no	9	20	29
Gesamt		13	34	47

Contemplating the possibility of the innovative handicraft producers to access loans, the table 6 shows, that basically none of them access third party monetary sources. However, few non-innovative producers do so more or less regularly.

**Table 6: Access to credits/loans by innovative and non-innovative handicraft producers**

		access to credits/loans			Gesamt
		yes	no	sometimes	
innovative products	yes		18		18
	no	2	26	1	29
Gesamt		2	44	1	47

In terms of marketing strategies no major differences between innovative and non-innovative producers of handicrafts could be identified.

## 5. Discussion

The presented results reveal complicated interaction structures in the meso-level and extensive patterns of interaction in the micro-level and between the micro- and meso-level. The assumption, that the provision of a supportive framework of extension services promotes the innovative behaviour of the micro-level could not be proved. Basically, these offers are accepted and drawn on by a number of micro-level actors. However, the ones, who have adopted and successfully introduced a new product, were not involved stronger in meso-micro level interaction than the rest of the actors. Further, the access to capital offered from other than private sources was not a limiting factor to these actors. The lamp producers draw from private sources of capital as well as from their own sources of knowledge. Due to the low degree of inter- and intra-level interactions, the dissemination and diffusion of new knowledge is hindered. Furthermore, the extension activities of the meso-level rather promote short-term participants in the sector, than long-term contributors to the sector's development. The basic aim of cluster promotion to enlarge the micro-level's bounded rationality and tacit knowledge can not be adequately handled with the instruments currently in place. One major reason for this are the high institutional barriers to participation, which incur costs of transaction, high costs to access information and direct costs for the micro-level actors. At the meso-level the actors are facing similar obstacles. Further, through their closed patterns of interaction, they isolate the bamboo sector from other industrial sectors in the country. The weak links towards outside sector boundaries, which are crucial for development processes, are not yet established. Basically, enhanced public-private co-operation is missing especially in product and process development and research. At the current state of development the Colombian bamboo sector's major challenge is to overcome these obstacles in interaction and co-operation to get ahead.

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