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**Networks of Companies as Strategy of Technology Transfer in the Brazilian
Agribusiness - The Embrapa Case**

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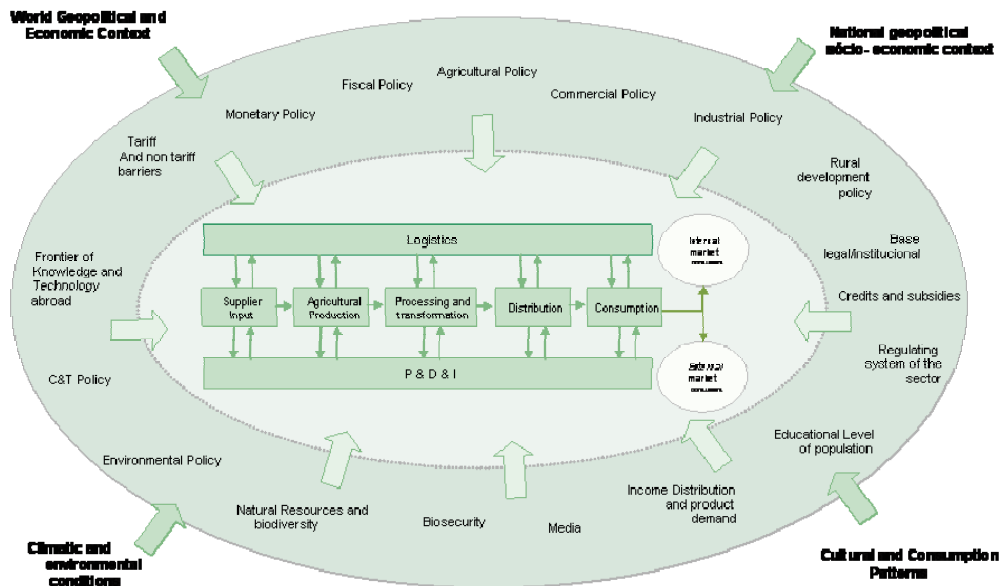
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Introduction

The agribusiness should be understood as a network that involves various processes since the input from the manufacturing of goods, passing through the production at the farm and processing, until its consumption. This network, as seen on Figure 1, incorporates all of the support services: research and technical assistance, processing, transportation, commercialization, credit, exporting, port services, distributors, commodities market and the final customer. The aggregate value on the agribusiness complex passes, necessarily, through five markets: the supply, the production itself, processing, distribution and the final customer.

Figure 1 – Elements of the Agribusiness Context

Elements of the Agribusiness Concept



Source: CONTINI ET AL, 2005

The numbers of the Brazilian Agribusiness show its importance. They represent one third of the GDP of Brazil, 40% of the exporting values and active jobs for more than half of the economically active population. According to Bolson (2005) the most important are not the actual figures, but the huge potential for growth that exists in the sector. The area cultivated with grain can be tripled. There are lands available, technology, tropical sun and lots of water.

The production of food, fiber and biofuels are going through a rapid and revolutionary technological development. The biotechnology evolution, according to Marburg (2005) is the latest manifestation of the constant effort of humanity to control the various processes of nature and thus contribute to the advancement of the human condition, trying to settle the dichotomy that exists between producing healthy foods and preserving the environment. This progress will require radical changes in the traditional way to produce, process and store food.

Even more the agribusiness will demand new technologies that are generated by the Research and Development Institutions seeking to improve performance in the production chain, and with that the governance of the agribusiness network will be the big difference so that companies that operate in this segment can survive.

This article aims to address issues related with the process of using network of seed producers that adopted the technologies generated by Embrapa (Brazilian Company specialized in Agribusiness Research), their critical success factors, and also offers a discussion on entrepreneurship in these companies.

Embrapa

The mission of Embrapa is to make viable research solutions, development and innovation for the sustainability of the agriculture to the benefit of the Brazilian society (Embrapa, 2008). The viability of these solutions is achieved through the coordination and implementation of projects in R & D, adaptation and transfer of technology and knowledge.

According to Oliveira (2002) innovation, which is considered by the company as a technology transfer and adopted in the form of products and services that promote the economic and social development, is a major challenge for institutions of R & D, such as Embrapa.

As a result, the lapse of time between the creation and adoption of the technological innovations by the segments involved is considerably long. Embrapa, as a generator of technology for agribusiness, has sought solutions to this problem and has been working diligently to expedite the process of adoption of new technologies and technological services.

Dissemination and Transfer of Technology at Embrapa

The vision, objectives and strategies of technology transfer are going through changes since the creation of Embrapa in 1974, and can be characterized in three very different moments.

The first moment, between 1974 and 1988, Embrapa established itself as an institution initially focused on applied research. Their philosophy of action was that the search begun and ended with the farmers, through the identification of their problems.

This vision was a part of Embrapa's culture and their mission focused on the development of agriculture, where the main beneficiaries were the rural producers. In

this initial period, given the stage of development of Brazilian agriculture, almost everything that was available from research, brought gains and had a big impact on producers.

To achieve its objectives, Embrapa developed actions in conjunction with the systematic and dynamic systems of federal and state research, technical assistance and rural extension, public and private, exempting the increasing attention to the modern media, through television, technical-scientific communication and social communication.

This period was characterized by intense action of technology dissemination, especially in the 70s, through the formulation of so-called "technological packages", drawn up together by researchers, farmers and producers.

The diffusion of technology was defined as a broad process of actions that presupposed the interaction among researchers, farmers, producers and agriculture political agencies, to achieve more flexibility in the generation, dissemination and adoption of agricultural technology, with interdisciplinary purpose. Despite of the propitious time for the Company's interaction with its partners and with the producers, the diffusion activity did not have the connotation of "business" in the Company, even in the cases that involved product sales and services. It was not very common to talk about "technology transfer" at that time, since that concept was used to characterize the ownership of a technology from one country by another.

In the second moment, between 1989 and 1998, Embrapa had adapt to the changes in the political and agribusiness sectors, which resulted in a political-institutional framework much more complex in the country. The opening of trade barriers, formation of economic blocs, reduction policies from the state, deregulation, environmental

awareness, and the consolidation of consumer rights were crucial milestones for new work formats in the organizations.

The reduction of state intervention in the rural sector - with implications for the allocation of public resources devoted to agricultural modernization, rural credit, agricultural research, technical assistance and rural extension - the tendency of technology privatization by multinational companies, especially in the field advanced biotechnology, and the organization of production chains in networks, created a new spectrum of opportunities and challenges for government and private entities. It was during this period that occurred the destruction of the Brazilian System of Technical Assistance and Rural Extension (SIBRATER), leading even to the extinction of their core organization, the Brazilian Enterprise for Technical Assistance and Rural Extension (EMBRATER). At that time, there were increasing difficulties imposed to the states, regarding not only rural extension, but also the condition of the research companies, that were closed, merged or transformed (research and extension). All of these transformations produced drastic changes in the Brazilian agribusiness. Producers that always worked with a determined culture began to face a new reality in which change had become a constant factor. It was not about gaining technological solutions to achieve incremental gains in productivity anymore, they had to master new knowledge about activities / products, sometimes unknown, to advance in managerial terms and try new ways to organize themselves. All of this movement demanded the implementation of compensatory public policies to facilitate the productive conversion. With this scenario, Embrapa has become increasingly demanded, especially to represent the state organizations for research, technical assistance and rural extension, having the necessity to change the way the Company operated. It was necessary to do more than just draw a new pattern of technological solutions. It was crucial to understand the new

context, consider the alternatives through actions of prospecting technology, articulate new partnerships, strengthen the promotion of consistent technology transfer activities (validated), and act by subsidizing the development and implementation of public policies. However, the visions of these two moments were not very effective in ensuring a fair distribution of benefits generated, and maintaining public investments in R&D and in technology transfer. These facts occurred because the most organized and capitalized segments of society were more agile, taking ownership of these public goods and using them to their advantage. On the other hand, they achieved the goal of consolidating the technology as one of the main factors of production and agricultural development, and helped to create new networks of business, particularly in the area of seeds, inputs, equipment and communication services.

Transitioning of Technology Transfer

In the third moment, starting 1999, the vision of the business as a mean to facilitate the technology transfer process of Embrapa started to emphasize a broader concept, enhancing complementary roles between researchers, producers, extensions, government agencies, associations and agricultural industries. Embrapa tried to expedite the technology transfer processes with the business vision, slowly, by forming new partnerships and strengthening those already existents in the Brazilian agribusiness. The transference actions, however, were seen as an inherent part of the P & D process, being one of its steps. During this period, Embrapa adopted a posture based on the context of the major economic and social transformations that affected Brazil and the world. Accordingly, Embrapa created a new company arrangement with the objective of improving the efficiency and effectiveness of this process and increase volume of

financial resources to strengthen the research and provide access to innovations through various kinds of partnerships.

The structure of relationships networks, as described by Lazzarini (2008), was accelerated by the existing relationships in some segments of activity, thus the company that operated on the centrality of the network, as the intermediate of the relationships among the agribusiness agents, was organized with other institutions to act in a dense network, which according to FUSCO (2005) aimed to facilitate the flow of information and resources, through trust and sharing activities.

The greater advances occurred with the negotiation of the results of the genetic plant improvement through partnerships of public and private sector. However, the transference of technologies, processes, other products, knowledge and services, speed, and effectiveness suffered a few changes within the company due to its complexity, little experience and lack of instruments and procedures.

Critical Success Factors in Technology Transference

In markets for products with high technological content, companies such as Embrapa need permanent mechanisms of interaction with their customers and their sources of information to streamline and optimize the process of innovation and distribution of knowledge and technology, with the goal of effective adopting. Often times certain critical factors, become real barriers in the process of technology transfer, making the knowledge and technology generated not effectively used by the company. Likewise, Ligocki et al (1998) showed that in order to ensure the success of the knowledge and technology transfer, as strategies to be prioritized, the following aspects should be considered:

- The human element, as a holder or receiver of knowledge or technology to be available or adopted, has a key role in the process;
- The differences of priority and perception between the supplier and the recipient of the technology in relation to the availability of resources, time and confidentiality of knowledge and technology among others, which are essential to the process;
- Absence of a systematic that provides professionalism and commitment to the process of knowledge and technology transference with the results and impacts expected;
- The inadequacy of the form or stage of development of knowledge and technology to continue the process; and
- Problems resulting from the maintenance and / or the continuity of the process of technology transfer in terms of changes in research direction in institutions that generates knowledge and technologies.

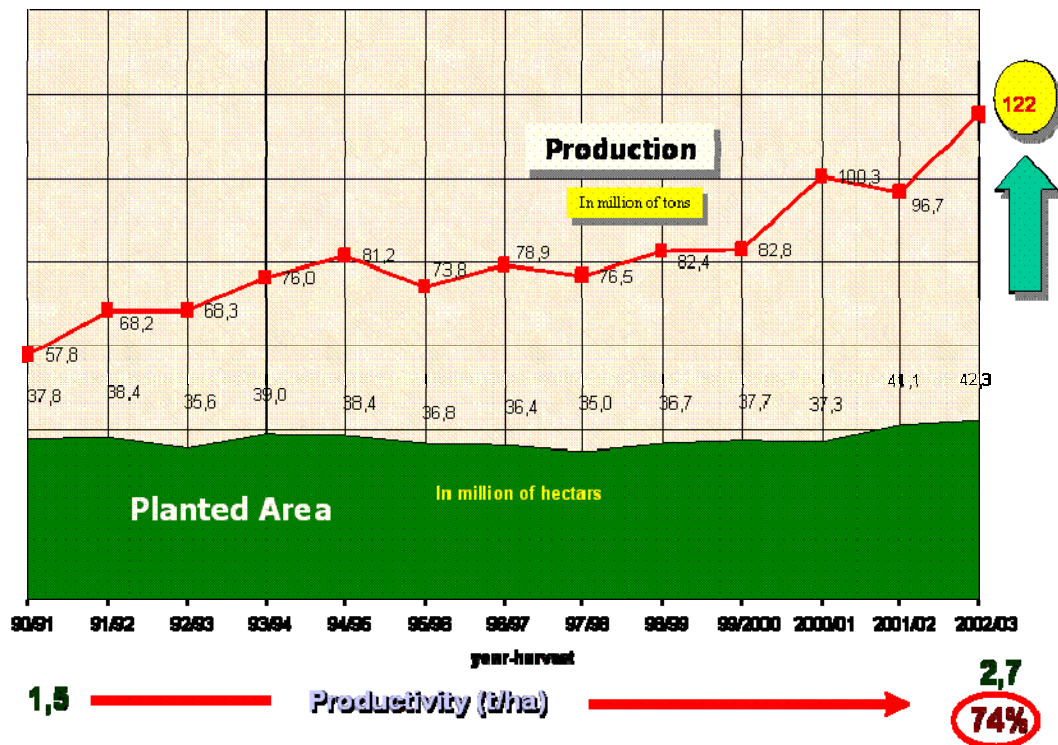
Technology transfer to the seed sector

The genetic improvement of plants was, and still is, one of the pillars that support the expansion of Brazilian agriculture, both in planted area and in the productivity and quality of production, as seen in Figure 2. The genetic research combines and selects plants during five or ten years to generate a few grams or a few kilos of seeds called "genetics." These seeds of new cultivars have to reach the farmers, keeping unchanged the above traits acquired in the improvement process. The basic class seeds are

generated from the planting of the seed gene, and are used by companies to produce commercial seed.

Figure 2 – Evolution of seed harvest 1999-2003

Evolution of Seed Harvest



Source: Ministry of Agriculture and Supply - MAPA

In the 1970s, the EMBRAPA created the Office of Production of Basic Seed - SPSB with various units of production and commercialization spread throughout Brazil. This service was implemented with the goal of centralizing the network between the results of the genetic improvement of EMBRAPA and the private seed sector, consisting of

over 500 companies. In this original format, the technology transfer was achieved through the sale and supply of basic seed from EMBRAPA to the private sector. The profits made with the commercialization of basic seed were drawn back to the maintenance of service activities. The contributions of this service to the network of agribusiness seed, according to ATRASAS et al (2006), can be summarized as follows:

- a) Source of continued innovation for businesses through launching of new and different formats of cultivars;
- b) Guarantee of maintenance, on the commercial seeds and the superior genetic characteristics obtained by breeders;
- c) Use of multiplication seed fields for basic validation, development and dissemination of new releases from companies and farmers;
- d) Reduction of the time required for a new cultivar to be adopted by farmers and reach large planted areas;
- e) Use of basic seed production to generate or improve technologies in the production area, processing, analysis and storage of seed of new cultivars;
- f) Maintenance of basic seed stocks that allows the control of supply and permits the private sector a better planning of their production targets;
- g) Use of new cultivars with the technical support and genetic reputation of the brand BRS (exclusive of EMBRAPA);

During the 1980s, the transfer of genetic technology of new EMBRAPA hybrids of corn to the national private sector assumed a new format. EMBRAPA used a system of franchises that included the supply of inputs, which through contracts, secured the selected companies providing basic minimum quotas of seed strains to form hybrids of corn. The launch of the hybrid BR-201 was essential for the survival and growth of the

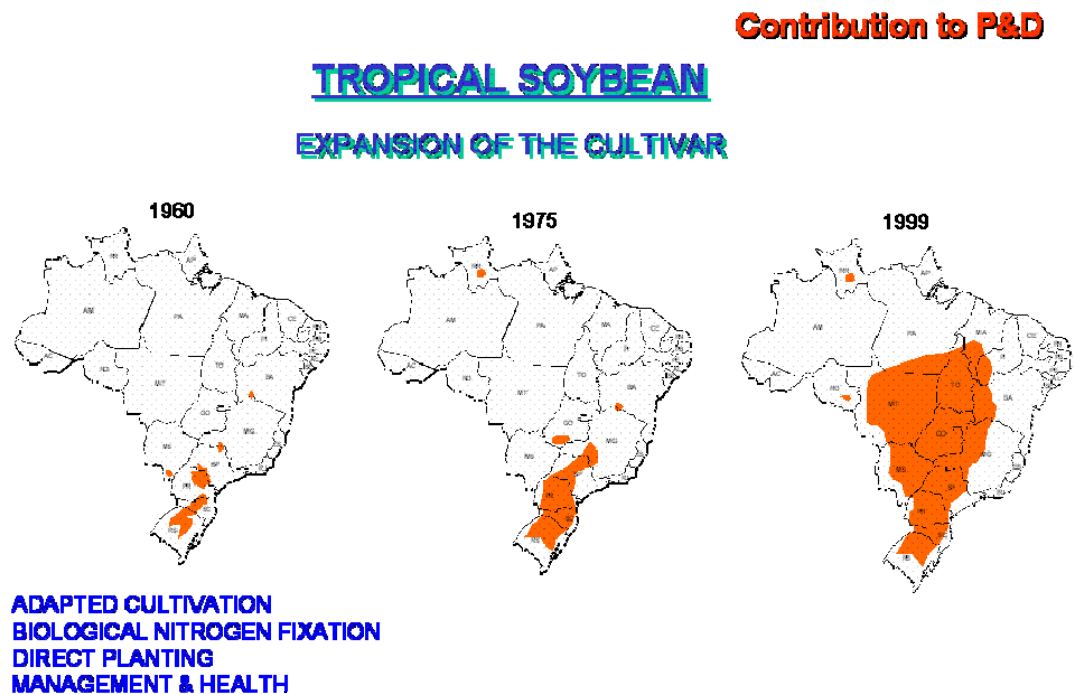
market of more than twenty national small business from the sector. In these franchising contracts, EMBRAPA provided for the companies information and technical assistance at all stages of production of hybrid seeds. The system provides to EMBRAPA revenues from the sale of basic seed, and a percentage on sales made by commercial seed companies. National companies of corn seed united in the UNIMILHO association came to dominate about 20% of the Brazilian market of corn seed. In the 1990s, demand growth from private companies for basic seed of new soybean cultivars reached levels that demanded financial, human and logistic resources that were unsustainable to the budget and the structure of EMBRAPA.

The company then opted by the establishment of networks inter organizationals, as quoted by Piore and Sabel (1984) and Powell (1990) in order to preserve their expertise and at the same time, reduce contractual risks that occur in market transactions, visioning the development of new soybean cultivars with state research companies, universities and research foundations established by seed producers and farmers.

Also, they signed several licensing contracts where delegated the production and commercialization of basic seed of cultivars developed in conjunction with the research foundation. The management agility, technical assistance and capillarity provided by the foundations and the private seed sector led the EMBRAPA cultivars to take more than 75% of the area planted with soybean in Brazil in the late 1990's, as can be seen in Figure 3. In 1997, the promulgation of the Law of Protection of cultivars completely changed the seeding scenario with respect to intellectual property and control over the genetic materials developed by the research. Some contracts that allowed the co-ownership for some soybean cultivars had to be revised, giving to EMBRAPA the exclusive condition of holder for the new cultivars to be generated by joint researches. In this new scenario and development stage of the seed business in Brazil, EMBRAPA

tends to reduce its participation in the production of basic seed. The company tends to concentrate its action on technology transfer, through contracts, partnerships with businesses and private organizations.

Figure 3 – Expansion of Soybean Culture in Brazil 1960 - 1999



Source: Embrapa

The Office of Production of Basic Seed (SPSB) has reached a structure of 14 units, offering around 140 varieties of thirty different species that includes, in addition to basic seed, seedling plants for vegetative propagation. The SPSB was later integrated with the Services for Business Technology Transfer - SNT, a new sector created to operate more widely in the transfer of technology. The SNT was created to "formulate,

propose, coordinate and implement policies, strategies, and managerial actions related to technology transfer (products and services) that can be enabled by EMBRAPA and destined for the sustainable development of the Brazilian agribusiness, in benefit of the society.”

The entrepreneurial vision of seed companies

In the current agribusiness competitive scenario, companies that stand out more are the ones with "entrepreneurial vision". In this case, according to Schumpeter, quoted by Nooteboom (1999), an entrepreneur builds a business on top of an innovation that consists of modern combinations, causing creative destruction and existing practices, emerging a power away from the balanced market. And complementing with the analysis of Bolson (2006), consists on cultivation of the spirit of opportunities observation, a fertile imagination, creativity, innovative spirit, the habit of planning and taking risks.

To have entrepreneurial vision means breaking paradigms, doing it differently, seeking competitive advantages and planning. The opportunities to engage generally arise through technological innovations and the careful observation of changes in consumption habits of potential customers. Technological innovations offer many opportunities for small companies with entrepreneurial vision. These innovations enable, for instance, turning quickly, via exclusive intellectual property, small business, seeds and seedlings into powerful companies. In the rising agribusiness in Brazil there are many opportunities to engage in the sector of seeds and seedlings. For example, there are new varieties of plants with indisputable competitive advantages. New and

revolutionary methods of seed treatment may be essential to start or expand a business in the seed sector. There is a lack of business men with entrepreneur's vision and with the management tools necessary to start or expand businesses in seeds. The following are some examples of opportunities available to seed companies endowed with entrepreneurial vision:

- a) Input of new species in cultivation in certain regions;
- b) Expansion and diversification of formation pastures;
- c) Improvement of technological level of the farmers;
- d) Reduction of the workforce in the field;
- e) Installation of agro industries in certain regions;
- f) Increasing value of biofuels;
- g) Environmental awareness;
- h) Possibility of sales combined with technical assistance;
- i) Increased production of organic food;
- j) New legal facilities, logistical and communications for exporting.

Another important characteristic of seed companies with entrepreneurial vision is long term strategy. Companies that plan, prospect the future and anticipate trends. They can predict the most likely future with several possible alternatives. They clearly define goals, actions, targets, resources and methods for monitoring and managing action plans. When you plan right, different scenarios are simulated and future decisions are discussed with calmness and rationality. The planning is not something sophisticated,

just for large and medium enterprises. It is an intelligent tool cost compatible with the size of any business.

Conclusion

According to Hamilton et al. (2005) in the next 50 years the world will have to produce more food, feed and fiber than they did in the whole history of humanity. The technological revolution produced by the genome offers a unique opportunity to achieve this goal. Genetic modified crops resistant to herbicides and insects produce benefits offering more food, feed and fiber to the market that require fewer pesticides; they maintain the soil and contribute to a more sustainable environment. And, on the contrary to what the critics say, biotech crops have proved to be as safe as, or even safer than those produced by conventional methods. In the future, advances in agricultural biotechnology will result in crops that will increase the tolerance to drought, heat and cold; will require fewer applications of fertilizers and pesticides; will produce vaccines to prevent major diseases, and will have other desirable characteristics.

In this scenario Bolson (2005) shows that a powerful path of changes is close to the seed production chain and will destroy the old way of conducting business. It is crucial that the seed business owners are up to date about technological innovations and changes in customers' behavior, which means that it is necessary to tune the seed business with the demands and future needs.

Success in this scenario, will come with the consolidation of inter organizational networks, mainly formed by public-private partnerships, requiring, in addition to

offering good products and services, the cooperation with the sectors in order to implement a fair and equitable system of distribution and promotion of their results.

Overcoming this challenge requires greater integration with the people involved in this network and the market; it also demands complementary skills, which are often found outside the company. The recognition of the intra and inter articulation, and the ability to link projects together with the institutions representing various segments of the Brazilian agribusiness should be prioritized. This integration will be done with the purpose of organizing and integrating the R&D actions and communication toward technology transfer to society.

The authors conclude that the model used by Embrapa for technology transfer, through the support on the creation and governance of networks of agribusiness companies can and should be replicated to other countries. This success model should seize the expansion of Embrapa to countries such as South Africa, Venezuela and others still on negotiations, for strengthening the local networks and thereby collaborate with the growth of the economy.

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