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Controversies about the Process of Technology Transfer from Public Research Institutions in Brazil: The Case of the Brazilian Agricultural Research Corporation - Embrapa.

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Abstract

This article investigates the process of technology transfer in the Embrapa - Brazilian Agricultural Research Corporation, one of the most important center for tropical agricultural technology in the world. Our research is survey-based, and a questionnaire was applied to the employees working at strategic and operational level of a research unit of Embrapa.

The results demonstrate that the technology transfer from Embrapa needs instruments, standards and standardized strategies. The lack of standardization of the can lead to disjointed actions among professionals and researchers, and may to make the Embrapa is seen in a fragmented form. Is important to explore new alternatives to treat simultaneously the issues of planning, research and development, transfer and communication in order to reset the current model, such as the use of Dual - use of technology transfer, characterized by a strong interaction between the chain production and potential users of the technology.

Keywords: technology transfer, public research institutions in brazil, embrapa.

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Introduction

Public institutions working in the area of S&T are social sectors held by a society that believes, somehow, gets or will get return on public funds invested. These institutions have a social responsibility to be accountable for the use of resources and contribute to the evolution of society, through the actions of its members who may, in addition to divulge the knowledge produced, be active in incorporating science in daily life. In the opinion of Geller (2010), one must consider that scientific advances alone will not solve the problems of humanity, but can help improve certain political, social and economic conditions. Therefore, it is essential that the priority scientific issues to society are widely disseminated, so that citizens have elements to provide feedback and to influence rationally in situations that affect their lives. However, in the case of public research institutions is not enough to communicate scientific results. It is necessary to find an efficient way to transfer them to users.

The concern with the technology transfer (TT) has been the subject of research since the 1970s. Araújo (1979) states that a major barrier in the Technology Transfer process is the inability to communicate effectively with potential users of the generated technologies. For Wildner et al. (1993), inadequate transfer may be the result of poor communication between the institution and the users. The authors also observed that inappropriate technology is more common than inadequate transfer as a cause of their low user adoption. This inadequacy is the result of a reductionist method used by traditional research, which causes a lack of integration between research and user. This is supported by Fujisaka (1994) that identifies some reasons why users do not adopt technologies, namely: the technology results from a research ill-defined problem, that is, users do not face the problem that the researchers assumed; producers practice is equal to or better than that suggested by the researchers; widespread technology does not adapt to the conditions of the producers, for which it was developed; created other problems or worked against existing solutions and better outcomes; the transfer was not effective; it was directed to the wrong audience; the cost of technology is very high. In this sense, Schlottfeldt (1991) states that although there have been some advances in the field of TT, it has not yet started a model that considers more demand and less supply market and technological packages. The author believes that despite the effort spent by TT professionals and researchers and recognition of the need to maintain a two-way communication with the various public channels, remains the reductionist view of TT as a mere dissemination of research results.

Embrapa - Brazilian Agricultural Research Corporation is the largest and main Brazilian research institution. Considering its performance in different areas and their responsibility to seek solutions to the Brazilian agriculture, it is vitally important that it counts on efficient processes to communicate and transfer the results obtained. Thus, the aim of this paper is to describe and analyze the processes of scientific communication and TT used by Embrapa. The article is structured in five parts: the first is the introduction of work, then the methodology. The third part provides a contextualization of technology transfer institutions in S&T. The fourth part focuses on the process of technology transfer and the fifth part brings characterization of Embrapa Swine and Poultry, its process of communication and technology transfer, ending with the conclusions in the sixth part.

Methodology

To analyze the process of technology transfer at Embrapa and its research unit called Embrapa Swine and Poultry, we used the methodology of deductive research with technical descriptive and qualitative analysis, using content analysis. Documents available in print and electronic manner, and internal documents of Embrapa were analyzed. At Embrapa headquarters, the process of technology transfer is conducted mostly by the Department of Technology Transfer (DTT).

Thus, for information about the strategies used, two managers of this department were interviewed. Data were collected through semi-structured interviews, in which questions were about: How the TT strategies are plotted at Embrapa, which instruments are used, the form of participation of the decentralized units, the use of instruments to measure the efficiency of processes, perception of the process efficiency, and suggestions for improvements. In addition, direct observations, documentary and files analyzes were made.

To understand how this process develops along the research units, a unit was selected, called Embrapa Swine and Poultry, located in Concórdia-SC. In the Unit, we interviewed employees allocated along the Prospecting and Technology Assessment Sectors (SPAT) and the Coordination and Implementation of Technology Sector (SPIT), responsible for technology transfer activities. A total of nine employees assigned to these sectors were interviewed. Data were collected through semi-structured interviews in which questions were about: the target audience of the institution, the form of interaction with this audience, strategies and communication tools and TT used, the efficiency of these instruments, the availability of bank data with the results of the research, planning dissemination of project results and suggestions for improvements in processes. The interviews were conducted between January and April 2013.

Technology transfer in S&T institutions

In the conception of Bozeman (2000), the study of technology transfer, the neophyte and the veteran researcher are easily distinguished. The neophyte is the one who is not confused. Anyone who studies technology transfer includes how complicated this issue can be. First, "technology" is not so easy. Second, describe the process of technology transfer is practically impossible, because there are many concurrent processes. Third, measure the impacts of technology transfer challenges the analysts and evaluators, forcing them deep research because the impacts are usually numerous and are often difficult to separate from other parts of organizational life. Thus, in many cases, determine the direction of transfer technology and its effectiveness is a very difficult question (Bonzeman, 2000).

However, Choi (2009) states that define the term technology is critical as it helps identify phenomena related to technology transfer. This term has been studied since the 1960s by researchers who seek to understand the real meaning of technology, using different underlying philosophies (Devore, 1987; Frey, 1987, Galbraith, 1967; Skolimowski, 1966).

The definitions or meanings of the term technology proposed by these authors were unique, according to the context of each one of them, philosophy, economics, or other areas. To Choi (2009) this fact shows that is not easy to define the technology, because it is a specific case of value. However, the concept of technology must be designed in order to understand what is being transferred in a process of technology transfer. Two approaches were used to understand the technology: one is to define the technology in a way that captures its essence from the science of technology, and the other is to provide characteristics to technology. Scholars like Skolimowski (1966), Galbraith (1967) and DeVore (1987) can be considered as representing the old approach.

Skolimowski (1966) defined technology as a form of human knowledge and a process of creating new realities. He argued that science is concerned with what it is, but the technology is concerned with what is to come.

Galbraith (1967) defined technology as the systematic application of scientific or other organized knowledge to practical tasks. This definition emphasizes the systematic and practical aspects of technology.

DeVore (1987) argued that technology should create the human ability to "do", and should be used to create new and useful products, systems, machines and/or devices. To DeVore (1987) the technology is not dependent or subservient to science, as commonly known and perceived. Technology is one of the new sciences and the big problem is that the term science is commonly used. The common results or traits of the new science (technology) are predictability, replication, reliability, optimization and efficiency of operations of the system based on theoretical models. It also emphasizes the relationship between technology and social purpose, stating that technology has always been conditioned by values, attitudes and economic factors, so its goal is the pursuit of knowledge for specific social purposes (GOBBLE, 1987).

Frey (1987) was also one of the scholars of technology which realizes it as an object, a process, or knowledge that is created by human intention. In most cases, the technology tends to be the integration of all three components: object, process and knowledge. Therefore, a technology provider must try to transfer the integration of all the components that make up the technology, and not just one component.

According to the American researcher Barry Bozeman (2000), there are many controversies regarding the definition of technology and not one of the major works on transfer technology utilizes any of these settings. Works on transference usually focus on technology as an entity, not a specific study or applied science.

Most authors have a common vision of technology as a "tool". Sahal (1981) it is one of the few theorists who wrote about alternative concepts of technology and on the confusion resulting from poorly specified concepts. He refers to technology as "settings", "observing that the transfer object," technology "," must have a determinable set of processes and products.

To Bozeman (2000) focus on the simple product is not sufficient for the study of technology transfer, since it is not only the product that is transferred, but also the knowledge of its use and application. In the opinion of this author, this approach solves a major problem analysis: the difference between technology and knowledge transfer. According to Sahal (1981) the concept of the two are inseparable - when a technological product is transferred or distributed, the knowledge that its composition is based is too diffuse. Without the knowledge base, technology cannot be put to use. Thus, the knowledge base is inherent, not alternative (Sahal, 1981).

The transfer of technology, according to Johnson, Gatz and Hicks (1997) it is not a new field of study. The term "technology transfer" was coined in the United States in 1940 and examples of technology transfer can be traced to the advent of the technology itself. Formal studies of technology transfer began with research and dissemination of technology held by European social scientists and rapidly gained acceptance in various disciplines as an important area of research (Rogers, 1995).

Technology transfer has been the subject of studies by various researchers as Eveland (1986) who defined it as: "the movement of communication technology through a channel, an individual or an organization to another" (Eveland, 1986). Blakeney (1989) on the other hand, describes as "the process by which a technology is commercially widespread" (Blakeney 1989, p. 136).

Johnson, Gatz, and Hicks (1997) tried to interpret the transfer of technology through a holistic approach that included both the movement of technology from the point of origin to the place of use as issues relating to final acceptance and use of technology of the end user. They argued that recognizing the end user's needs and context where technology is used is essential to the success of technology transfer.

More recently, new concepts of technology transfer were created, as from researchers Rogers, Takegami and Yin (2001) who describe it as a special kind of communication process, while for Barreto (1994), technology transfer implies a process of knowledge production and transfer of technological information, but is likely to generate new knowledge in a particular context, and is therefore a need for people who send and people who receive the information, regardless of transmission mechanisms.

Based on the literature, it is clear that technology transfer has different processes and perception. As clarified by Johnson, Gatz and Hicks (1997) universities, companies, public research institutions, and developing countries have different roles and interests in technology transfer. For example, universities, as a technology provider aims at the transfer technology as a means to serve the community by sharing knowledge. On the other hand, for companies, this process is seen as a way to gain competitive advantage through the performance enhancements and profiteering (Johnson, Gatz, and Hicks (1997).

Technology transfer begins with the development of a new technology or modification of an existing technology. This process occurs when there is a perception that there are users who want or need a product or process technology. Thus, the process of technology transfer necessarily involves communication, both by the transferor. In this sense, Johnson, Gatz and Hicks (1997) emphasize that communication is a key element in the transfer process. If a new product is released, but the public is not aware of it, technology will never reach its intended market. Therefore, the transfer requires human intervention in order for a technology to be adopted. Rogers, Takegami and Yin (2001) describe the main communication channels used in the technology transfer process:

- Spin-off: it is a new company established with the aim of exploring new products or technology or innovation-based services. This company was born from ideas or processes spawned in an existing organization, whether a business, a health public or private research or a university that welcomes and supports the new initiative.

- Licensing: it is granting of permissions or rights to manufacture, use and/or sell a specific product, project or process, or to perform certain other actions, by a company or person who has the right to give such permission. Usually a licensing fee is charged to acquire a technology license. Royalty licensing can earn a handsome income for a research university or a R&D public laboratory.

- Publishing: are also considered as a means of technology transfer. Articles published in academic journals are the most used means of technology transfer. Unfortunately many articles are written primarily for fellow scientists, and not to potential users of a technology. Thus, scholarly articles are not an effective means of technology transfer, although it is the activity of technology transfer most cited by research centers and universities

- Meetings: involve person-to-person interaction through which technical information is exchanged.

- R&D Cooperation Agreement: The intention is to transfer Technologies of R&D federal institutions to private companies, collaborating institutions. These legal agreements involve sharing of researchers, equipment, intellectual property rights. By not sharing a common organizational culture, there is some degree of difficulty in this type of transfer (ROGERS ET AL., 1999).

Instruments, tools, resources and methods of transfer should be used to obtain results that lead to empowerment for incorporation of new technology to the processes of wealth generation. According to Dereti (2009) it is necessary to differentiate the actions and communication techniques of the transfer process, from the transfer itself. The transfer cannot take place without communication actions, however, communication actions and dissemination do not characterize the transfer of technology. In this sense, Rogers and Shoemaker (1974) explain that the difference between communication and transfer is that the former includes all types of messages while the second refers only to new ideas. Unlike communication, when the receiver receives routine messages, transferring the conduct of this is different because it involves a degree of risk: accept or reject the innovation (Rogers and Shoemaker, 1974, p 12.).

According to the National Technology Transfer Center - NTTC (1999) there are three main types of technology transfer:

- Spin-off Technology – In this case, the technology is developed by a federal organization and transferred to the private sector, to other federal agencies or local governments.

- Spin-on Technology - Refers to commercially viable technologies developed by private organizations, but with potential application in public organizations.

- Dual-Use Technology – It is co-development of technology by a public and private organization, with costs divided and both are benefited by the new technology.

Technology transfer can also occur on a contractual basis. The most common types of contracts, according to the National Institute of Industrial Property – INPI (2013) are:

- License to exploit the patent and industrial design: authorizes the exploitation by others under patent regularly filed or granted in the country and industrial design application, identifying industrial property right.

- License to use the Brand: authorizes the effective use by third parties of the brand duly filed or registered in the country.

- Providing Technology: provides the conditions for the acquisition of knowledge and techniques not supported by rights, including knowledge and techniques not supported by industrial property deposited or granted in Brazil (know-how).

- Services for Technical Assistance and Research: stipulate the conditions for obtaining techniques, methods of planning and programming, research, studies and projects for implementation or specialized services.

- Deductible: involves services, technology transfer and transmission patterns, and use of trademark or patent.

As stated earlier, the process of technology transfer is complex and success is not achieved by the simple movement of technology to a new environment, it requires the development of a process and infrastructure technology that helps to break down existing barriers. In some cases, according to Johnson, Gatz and Hicks (1997), technology is needed so that the end user will help break the barriers of technology, in others, the technologies need to be "pushed" through the maze of barriers to the end user. The degree of user's desire towards technology will determine whether the technological potential or social constraints will prevail, and the speed with which innovation will go from the original source to the end user (Johnson, Hicks and Gatz, 1997).

In this context, Johnson, Gatz and Hicks (1997) point out that technology is not autonomous, but encompasses political, economic, social and cultural values that can serve as barriers to its diffusion. The main barriers to technology transfer process mentioned by these authors are:

- Social barriers. It is important to recognize that the transfer occurs within a social system that defines the limits within which the technology will be transferred and disseminated. Most transfers receives some kind of judgment of society. An individual will not recommend a technology he considers bad or has substantial benefits. Likewise, news of a new technology will not be published in a journal, if its benefit was not substantiated.

- Political barriers: It read as an example, the case of India, where the situation of almost shortages led the government to change the research agenda that aimed to increase the production of cash crops for export, bypassing the need for the creation of partnerships between institutions of public and private research. This change "pushed" technology, overcoming the political barriers and creating a supportive infrastructure for its transfer.

• Personal Barriers: Rogers (1995) states that the transfer depends on the characteristics of the end user. He said that a very small percentage of the population-innovators, constantly seek innovations. This group is followed by a larger group called early adopters who are generally eager to test new technologies. This is a key group to be identified by agents working in technology transfer because they can have a strong impact on their peers. Most users (and almost half of the population) expects feedback from this group and then adopt the technology.

• Cultural barriers. Cultural barriers also play a key role in technology transfer. Thus, one must consider the characteristics of the workforce and the user resources available, the region or the host country. With automation systems, provided the technology tend to believe the computer will make processes more efficient. The philosophy of automation does not consider the knowledge and skills of workers, leading them to resent technology. In an attempt to facilitate the transfer process and technology, Bozeman (2009) established some criteria that he called "criteria of effectiveness for technology transfer" (Table 1).

Bozeman (2009), based on the conceptual view of technology transfer, says the ease with which technology is transferred depends on several factors. The power or suitability of an innovation seems to have a significant impact on their ability to overcome barriers to transfer. The need perceived by the user, which can help the technology to overcome the existing barriers, the time of transfer and the characteristics of the agent directly influence the process.

Transfer of technology in public agricultural research

Agricultural activities over time were developed, mostly by public institutions and universities, since many large agricultural and technologies of the knowledge created had little market value. Physical products were not being produced and technologies were considered "public goods" that anyone could use (Pineiro, 2007). However, since the late 1970s, this scenario has changed. The technologies have turned into physical products, such as agricultural machinery or pesticides. The exponential growth in industries led to a rapid expansion of private companies that create, manufacture and sell technology. Private companies have also seen opportunities to profit research using improved seed and creating new hybrids of crops (Rubensteinand and Heisey, 2005; Pineiro, 2007).

The changes in relation to intellectual property innovations in basic and applied agricultural research complicate the mission of public research institutions, forcing the public sector to also change, keeping, however a key role in agricultural research, especially in the management and

Criteria of effectiveness	Key Question	Basic theory	Advantages and disadvantages
Out-the-door	Which technology to transfer?	Theoric or classic	Advantage: Do not blame the transfer agent on factors that may be beyond control. Disadvantage: It encourages cynicism and focus on activity rather than results.
Market impact	The transferred technology had an impact on sales and profitability of the company?	Microeconomics of companies	Advantage: Focuses on a key feature of technology transfer. Disadvantage: Ignores important public and non-profit sector; transfer; must accommodate problems of market failure.
Economic development	The technology or recipient agent benefited politically from participation in the technology transfer?	Theory of political exchange, bureaucratic political models	Advantage: Realistic. Disadvantage: Does not answer the systematic review
Opportunity cost	What was the impact of technology transfer in alternative uses of resources?	Political economy, cost-benefit analyzis, public choice.	Advantage: It takes into account the loss of opportunities, especially alternatives to the use of technical and scientific resources. Disadvantage: Difficult to measure, implies dealing with the counterfactual.
Scientific and technical human capital	Activity of transfer technology has led to an increase in the ability to run and use research?	Social capital theory (sociology, political science), human capital theory (economics)	Advantage: Treats technical activity and technology transfer as a high investment. Disadvantage: Not easy to equate inputs and outputs.

Table 1 - Criteria of effectiveness for technology transfer. Source: Bozeman, 2009.

transfer of new knowledge, supporting research to fill any remaining gaps (Pineiro, 2007). Despite the increase in investment from multinational companies, private research have a limited range as, for example, research in biotechnology, where more than 70 percent of the area planted with transgenic occurs only in four cultures - soy, corn, canola and cotton (Pineiro, 2007).

In the opinion of Pineiro (2007), due to this narrow focus, the private sector usually announces its advances to developing countries that practice commercial agriculture in temperate climates and are relatively large markets. Small farmers in developing countries still depend heavily on the public sector for technology transfer, especially of cultivars that are not of interest of private companies.

The domestic research institutions are slowly trying to adapt to these new circumstances, redefining their positions and priorities as the National Institute of Agricultural Technology of Argentina and the Brazilian Agricultural Research Corporation, in Brazil, are focusing on cultures and relevant ecological conditions for small farms. They also develop research techniques that complement the development of the private sector, for example, developing production systems and conservation methods that make use of new technology products (such as agrochemicals, farm machinery and crop improvement) more efficient (Pineiro; 2007, Rubensteinand and Heisey, 2005). For these authors, private companies can develop research in this area, but the public sector remains the main source of new technologies with these characteristics.

Atkinson et al., (2003) points out that the changes in the laws and regulations in relation to innovation has encouraged the public sector to patent their innovations and license them to the private sector. As a result, the formal mechanisms of transfer public research results to the private sector have accelerated, and there has been a sharp increase in the number of public sector patents and licensing technologies to the private sector (Atkinson et al., 2003).

Agricultural technologies, according to Atkinson et al., (2003) represent a special challenge for programs of technology transfer from public institutions that must balance the goals of technology commercialization with the objectives of humanitarian or applications for special crops. As a result, some institutions have used licensing practices to promote the market, preserving the rights of philanthropic or working to keep certain technologies in the public domain. However, these practices are not universally applied between institutions, causing "many significant discoveries and technologies developed with public funding are no longer accessible as public goods" (Atkinson et al., 2003 p.3). To Rubensteinand and Heisey (2005), the transfer of agricultural technology of the public research system to the private system, is a way to do more with less, in theory. Technology transfer from the public sector has several goals: to bring the benefits of research and development (R&D) public to potential users; find ways for public institutions to fulfill their mission in a time of scarce resources, influencing the direction of technology development and increase funds of research through licensing revenues.

The instruments used to achieve these goals may include direct communication between scientists and users of technology, publications, networking among scientists, using mechanisms of intellectual property such as patents and licensing companies or cooperative research (Rubensteinand and Heisey, 2005).

According to Atkinson et al., (2003), when the intellectual property rights for materials and agricultural technology jointly belong to the public and private sector, this fragmentation results in situations that hinder the commercialization of technologies developed in partnership. Marketing problems associated with public acceptance and regulatory approval, conditional or limited access to a wide range of patented technologies have been identified as significant for the partnership in the development and transfer of agricultural technology barriers (Atkinson et al., 2003).

Pineiro (2007) states that the new scientific and economic context demands a new and more complex model for the transfer of agricultural technology. The model proposed by Pineiro (2007) has four main components: knowledge management, gap filling research, promotion and regulation of the private sector, and environmental impact analysis (Figure 1).

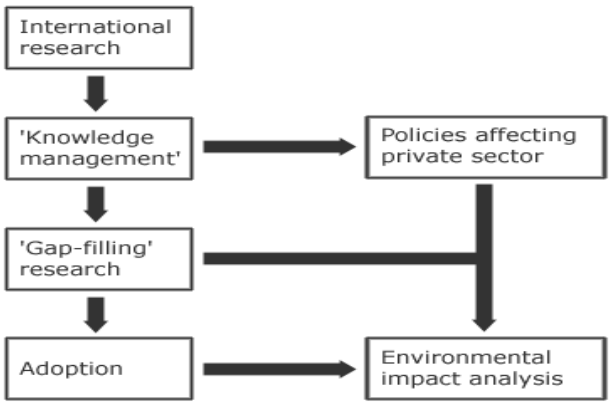

Figure 1 - Multidimensional model of agricultural technology transfer to the public sector. Source: Pineiro, 2007

• Knowledge management: The public sector continues to be largely responsible for knowledge management. It helps promote successful agriculture in poor ecological condition and solve technological problems of small size, in which the private sector has no interest.

• Gap filling research: The national public research institutions also have a great responsibility to search in areas ignored by the private sector. This "gap filling research" is particularly relevant for technologies that are not embodied in physical products. The public research for agriculture in developing countries represents about a quarter of global spending on agricultural research (Pineiro, 2007), but needs to be managed effectively to produce high quality research to complement technologies available internationally and help developing countries to acquire and use them.

• Promote and regulate the private sector: The public sector should both promote private investment as regular private companies. The law of intellectual property rights adequately allows private companies to protect the profits of their research, attracting investors and promoting research. Tax and credit laws may provide indirect economic incentives for investment and the creation of structures to transform new technologies into products can stimulate interactions between private and public companies, encouraging technology transfer.

• Analysis of environmental impact: Policymakers should consider the environmental consequences of agricultural research. New technologies often use natural resources intensively, potentially harming the environment. This is especially true if the new technology is imported and used without being tested on local conditions. Policies can develop regulatory measures, such as mandatory environmental impact assessments, minimizing potential environmental damage and protecting consumers.

Pineiro (2007) states that if the public sector acts on these four themes, it will support the relevant transfer of agricultural technology. For this author, public institutions need to join forces with the private sector to fund sources of funds and trained personnel, since the agricultural innovation always occurs collaboratively between public institutions, the scientific community and the researchers themselves. Considering the growing importance of the private sector in the innovation process, the challenge of the public sector is to work with these new players (Pineiro, 2007).

In the opinion of Schaun (1981), technology transfer is the consecration for all the energy used in the generation of knowledge and to the safety of research validity via technology adoption, hence why it is believed that among the factors, limiting the adoption of technologies generated, is how to transfer the same. The understanding of this problem lies unquestionably with the need to execute a communication strategy for technology transfer with predominantly new forms of relationships between the various sectors of these processes. Technology transfer does not only mean the transfer of knowledge, but also the application of this knowledge.

Another aspect that should be considered is the possibility of technology generated to not be in line with the reality of the social system to be modified, due mainly to the lack of integration between research-user (Wildner et al., 1993). In this sense, Fujisaka (1994) lists a number of reasons why the technologies generated are not adopted and including, the technology results from a poorly formulated problem from the research, i.e., users do not face the problem that researchers assumed. This observation leads to the need of establishing a process of a "two-way" communication, i.e., the integration between the various sectors involved in the process of technological innovation, aiming to facilitate the adjustment of technology to the conditions prevailing in the production unit (Tagliari, 1984).

The technological development must be viewed in whole, observing the conditions of adaptability, access and interest of the target audience, in order to enable the identification of new demands that may facilitate the process of decision making, by part of the research, in relation to the generation/adaptation of new technologies (Rosa Neto, 2006). In this sense, Dereti (2009) believes that the inclusion of plans of action of TT, from the design of projects in R&D technology can increase the effectiveness of the transfer, provided that there is participation of potential users and identification of opportunities for TT of the developed ones. To Dereti (2009) the articulation of different research lines in TT programs enables the generation of synergistic results and the enhancement of the impact of the developed technologies. As the articulation of research institutions with government or private organizations, forming networks of TT to reach potential beneficiaries of developed technologies, has multiplier effect (Dereti, 2000).

Araújo (1979), examining the main channels of communication to transfer clarifies that books, catalogs, data sheets, technical fairs, conferences, training courses are responsible for the awakening of attention to technological advances, but do not lead to effective technology transfer once the necessary conditions for selection and assimilation of technology from these primary sources, capabilities are extremely rare. This is supported by Dereti (2009), who believes it is necessary to differentiate the actions and techniques and communication tools that are part of the technology transfer, the transfer process itself. The transfer can not take place without communication actions to achieve

their goals, but communication actions do not characterize the transfer of technology. According to Heberle and Sapper (2006) most of the proposals on transfer is linked to the dissemination of science and technology (S & T), composing institutional efforts, usually linked to development strategies. In the opinion of Schaun (1981), technology transfer is the consecration of all the energy used for the generation of knowledge and safety of the validity of the research via technology adoption, hence why it is believed that among the factors limiting the adoption of technologies generated, is how to transfer the same. The understanding of this problem lies unquestionably with the need to execute a communication strategy for technology transfer with predominantly new forms of relationships between the various actors of these processes. Technology transfer does not only mean the transfer of knowledge, but also the application of this knowledge. The knowledge generated in ICTs is a rich source of information and training for the development of new technologies and therefore have an effective process of technology transfer is to an alternative and complementary way to achieve a higher technological level of Brazilian companies (Garnica and Torkomian, 2009).

Embrapa: characteristics and scope of activity

The Brazilian Agricultural Research Corporation - Embrapa was created on April 26, 1973, with the basic functions of implementation research, development and innovation, and their transfer to the production environment. It is a state-run company under private law, tied to the Ministry of Agriculture and Supply, thus becoming the largest and leading Brazilian agricultural research institution, standing out internationally, as the main center for tropical agricultural technology in the world. It operates through 15 Administrative Units and 47 Research or Service Units, called Decentralized Units (DUs), present in almost all Brazilian states, the most diverse biomes. It also operates in North America, Europe, Asia, Africa and Latin America, through virtual laboratories and projects.

It also coordinates the National Agricultural Research System (NARS), consisting of federal public and state institutions, universities, private companies and foundations that, in a cooperative manner, perform researches in different geographical areas and fields of scientific knowledge. Its staff consists of 9,783 employees (in 2012). Of this total, 2,389 are researchers. Of these, 18% hold Master's degree, 74% hold Ph.D.'s and 7% hold postdoctoral, and most of them are allocated on the Decentralized Units of the Company. The company's budget in 2012 was R$ 2.3 billion.

The process of technology transfer at Embrapa

Technology Transfer at Embrapa aims to provide knowledge and technologies generated by research to different segments of society through articulation and integration between research units, the central units and the different external partners involved in the processes of both national and international technology transfer. The Department of Technology Transfer (DTT) was created to systematize the TT's priority strategies along with the Units, however, it still could not effectively achieve this goal due to the fact that other central service units, such as Business Secretariat (SNE - Department of Business Affairs), Embrapa Products and Markets (SPM), and Embrapa Information Technology (SCT), coordinate part of the TT sub processes. That is, the transfer actions are not centralized in a single department, as it happens with the Department of Communication, which sometimes can hinder the process of TT, since it does not involve all the necessary sectors.

The TT strategies at the institution are developed in a decentralized manner, directly by the Research Units, since Embrapa does not have a policy of TT to guide this process. Thus, the Research Units develop their own TT strategies, according to what they believe to be the most appropriate. This fact has its advantages, considering that the unit has a much broader knowledge of their target audience and hence more efficient channels to communicate with them.

The main instruments used for the TT are the courses for extension or multiplier, Field Days, lectures, Demonstration Units, Observation Units, Technology Showcases, Events (seminars, workshops, conferences, etc.), business plans, technical publications (brochures, manuals, etc.), technical circular or statement, Field Day on TV, Prosa Rural, mini libraries, etc. It is clear, in this case, that the instruments used by Embrapa in the communication process are the same used in the technology transfer process. To Araújo (1979), these instruments are more efficient in the communication process because they raise the citizen's interest for the technological advances, but do not lead to an effective transfer and technology.

So far, there has been no extensive research with the various audience of the institution to measure the efficiency of the instruments and strategies used in the TT process, except for some more specific tools such as Prosa Rural and Field Day on TV. But the DTT is promoting some specific studies on some productive chains, which are still being executed.

The TT process was not considered effective by the people surveyed because, in their perception, of the way the process is done (decentralized) and for not having a guiding policy or standardized rules. According to them, some units

have technical and strategy competence to accomplish this process efficiently, while this fact does not happen in other units. As stated earlier, the research units are those which know more about their target audience for always being in contact with them. But the lack of standardization of actions can lead to disjointed ones between TT professionals from units and headquarters, affecting the exchange of information and experiences, and may cause Embrapa to be seen in a segmented way by society, as has occurred with the communication process prior to implementation of its policy. Regarding the improvements suggested by the people surveyed, were cited the following:

- Elaboration of a TT guiding policy;
- Definition of an internal governance to the process;
- Redefining professional profiles (along the institution and teams training);
- Mobilization of financial and material resources to improve the process of the units;
- Optimization of integration between R&D and TT;
- Strengthening state-owned and private TT agencies in all states;
- Greater integration of Embrapa on TT networks;
- Identification of the network demands by TT technologies and actions;
- Qualification and organization of knowledge and technologies by demands;
- Identifying best practices and TT strategies;
- Assessment of the impacts of technologies, strategies, R&D programming and technology evolution in regions and territories.

It is noted, on the suggestions for improvements submitted, that the TT process is still incipient in Embrapa Headquarters, with no standard instruments and strategies to guide this process. This fact confirms the perception of Heberle and Sapper (2007) that at Embrapa, it is not clear that the relationship that involves the stages of generation and transfer of technology. This lack of clarity, along with the lack of sectors in Brazil's rural area, can become a vulnerable spot for the institution.

Under this assumption, it is of paramount importance for Embrapa to rely on an effective process of technology transfer in order to reduce the time between production of knowledge and technology and its availability to users. This fact is reinforced by authors such as Garnica and Torkomian (2009) and Schaun (1981) who stress the need for ICTs to count on an effective process of technology transfer, to reach a higher technological level of Brazilian companies. It is also suggests the establishment of a guide for this process, so there is a standardization of tools and strategies used, always with the participation of the units, once they have a better understanding of the target audience of their researches.

Embrapa Swine and Poultry

Embrapa Swine and Poultry is a research unit of Embrapa and its mission is "To facilitate research, development and innovation solutions for sustainability of the swine and poultry industry for the benefit of the Brazilian society" (Embrapa Swine and Poultry, 2011). Established in June 13, 1975, as National Swine Research Center, and in 1978 it also received the task to research birds, changing its name to the National Research Center for Swine and Poultry, now called Embrapa Swine and Poultry, located in Concórdia/SC. It has a staff of 211 employees, with 51 analysts, 110 assistants and 50 researchers - which 86% hold Ph.D. and 14% hold masters degree.

The process of technology transfer at Embrapa Swine and Poultry

Just as the process of communication, the technology transfer permeates many areas of the Unity, mainly on the sectors of Prospecting and Technology Assessment (SPAT) and Coordination and Implementation of Technology (SPIT). By the nature of the activities of these sectors, they rely on the effective participation of the employees in other sectors besides the researchers themselves, always depending on the type of event and purpose of the transfer. However, for a better understanding of this process, we interviewed only those employees who work directly in these two sectors. In this case, of 10 employees, nine (90%) participated in the survey. The questions were about the target audience of the research unit, strategies and communication tools for technology transfer and possibilities for improvements in these processes.

The perception of who is the target audience of the unit is different from the communication team. The Brazilian swine and poultry production was cited as the main focus of the research unit for eight of the nine respondents. Some however, have a more segmented view of this target. Besides these chains, also were mentioned state-owned research institutions and market economy companies (two people interviewed), large agribusinesses (two people interviewed) international institutions (two respondents) and students and technicians from public and private institutions (one respondent) were cited. One of the interviewees mentioned that the target audience should be "the farmer with strategic aspects of large arrangements set out in governmental level." Despite the poultry and swine chains being considered the target audience of the unit, there is no agreement as to which segment of these chains is considered a priority for the institution.

On ways to interact with these audiences, the responses were quite diverse. Two people interviewed cited events, SAC, R&D projects, courses, and consultancy. Another person believes that occurs when the client (in this case the agribusiness) cannot solve a problem and looks for the institution to "work for him", with no reciprocity in these cases. For another interviewee, the interaction is made in direct contact with company directors, with secretaries of governmental organizations, with ministers, with market agents. It was also cited that it occurs only after the demand from stakeholders (one person interviewed), or still, in all possible ways, through demands or availability of research results to those target audiences. One of the people interviewed believes that there is little interaction with the audience, except those more technological with access to digital media. In this case, those who interact are qualified professionals who seek technologies at Embrapa, if it has, or any other local access.

In this case, it is noticed that, unlike the communication team, for professionals in the technology transfer the interaction occurs not only by the availability of information, but also by a direct contact with the audience, leading to an integration with it. However, the vision of how this occurs is quite diverse.

Regarding the strategy and instruments of scientific communication, the publications Embrapa type, internal and external events, courses, books, handouts, models, videos, banners, field days, demonstration units were cited by six people interviewed, one of whom stressed the difficulty in finding information on the website, as has occurred with some employees of the communication area. One person interviewed mentioned the participation in fairs, emphasizing that it is an ineffective strategy. Two people interviewed stated that there is no implemented strategy, and one of them mentioned that the NCO defines the calendar to participate in events with researchers and search with them technologies that may be released, while another pointed out that many results end up in unread papers. Regarding this, we can notice that although the majority of interviewees mentioned events and publications as the main instruments for scientific communication, three (33%) of them believe that these tools are ineffective and two (22%) say there is no strategies for disseminating the results of research unit.

As for the development of TT strategies, there also are different perceptions on the part of team members. Two of the people interviewed state that it depends on the outcome of the research (technologies, information, new knowledge) and on the target audience. Another person believes that it depends on government interests and access to the target audience. For two other ones, strategies are outlined on the research project itself and executed by the respective areas, while another one states that these claims are drawn only at the end of the project, when the result is already available. It was also stated that it occurs at meetings between the communication team and researchers, and after, with the TT team (one person interviewed). Two of the interviewees did not know what to answer. It is noticed that the strategies of TT are not clearly defined and when drawn, are very precise, targeting specific projects and discussed without the participation of transfer professionals.

Regarding the use of instruments to determine the efficiency of TT, seven of the interviewees stated that there is not this kind of research, while one believes is done by Embrapa Headquarters, and another person claims that studies have been conducted, but the results are not duly considered by the company's management.

When asked if the strategies, communication channels, and TT used reached their goals, two interviewees stated that it reaches the goal of communicating S&T, but not to transfer it. Three others claim that it reaches only in part, requiring greater effectiveness in the process, being more active. For two of the people interviewed, there are no strategies for producers, who do not have access to electronic media, and they do not have the habit of reading technical information. Only one respondent believes that the strategies achieved their goals. Given the responses, it can be stated that the strategies from the point of view of TT professionals should be revised in order to reach the goals that they propose.

As for the availability of a database with the results of the researches, everyone interviewed mentioned publications available on the institution's website, stating however that these are difficult to be found and accessed by users. This fact was also noted by media professionals, indicating that, indeed, there is need to review and improve how to provide this information.

Regarding the definition of the target audience of the research and the form to make the results available, three people interviewed said that the target audience is defined at the time of the project's preparation, but the communication strategies and TT are made in a fairly simplistic way, by the researcher himself, while one believes that both the audience and TT strategies are covered in the research project. It was also stated by one respondent that there is a method for that, but it is not being required and little used. For another one, there is no definition of the target audience, except when the research meets the demand of agribusiness, which is responsible for communicating those interests. Two other people consider that the research projects of the unit has no TT strategies, one of which believes that the researcher elaborates projects based on their experience or specific demands and thus, communication strategies and TT are

defined only after the project is finished. The responses show that, for the interviewees, the target audience is determined by the type of research that is conducted, which is consistent with the nature of the activities of the Institution. Various process improvements were suggested by them, as described on the Table 2.

Suggestions made by the TT team were more focused on developing research that generates practical results for chains where the unit's inserted. Moreover, it is noticed that the TT teams do not participate on the creation of transfer strategies of the research projects, which can make this process become less efficient, since the researcher often has no knowledge which is needed to develop more efficient strategies of technology transfer.

This fact is reinforced in the literature by authors such as Wildner et al, (1993), Fujisaka (1994), Tagliari (1984) and Rosa Neto (2006), who point out that one of the TT process problems is that the generated technology results from a problem poorly formulated from the research, that is, the users do not face the problem that the researchers had suspected. The authors also reiterate the need for greater integration between researcher-user so there is a "two-way" process of communication to enable the identification of new demands to assist in the decision-making process, from the research, in relation to generating/adapting new technologies.

Conclusions

The process of technology transfer, on a strategic level, it is quite incipient, there is no standard strategies and instruments, as there is no coordinating body, which may ultimately make this process less effective. At Embrapa Swine and Poultry, we also notice that there is no standardized process for the TT, which is defined mostly by the researcher responsible for the project. It is therefore suggested that there is a contribution from members of the TT teams in defining strategies and tools to be used to transfer the technology generated, since it is understood that this participation could contribute decisively to the correct definition of strategies and instruments for technology transfer.

Based on the improvement made, it is also suggested that a mechanism be established to identify the main demands of technologies chains of poultry and swine, to develop appropriate solutions to meet these demands, since the existence of a demand for the corresponding service or technology is needed for the transfer condition, and it is through the knowledge of the demand that it becomes possible to identify the needs, guiding the work of research and development.

Suggested Improvement	Quantity of respondents suggested
Developing researches for troubleshooting chains	2
Developing technologies with practical application	2
Involve the TT and Communication teams on the creation of projects	3
Develop instruments to measure the efficiency of the TT instruments used	1
Using print (direct mail) for various audiences	1
Develop a TT plan in partnership with external agents	1
Develop actions of technological prospection to guide research projects	1

Table 2 - improvements suggested by the interviewees to the process of TT of Embrapa Swine and Poultry.. Source: Data Survey (2013)

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