

Analysis of seed systems in Latin American countries

Análisis de los sistemas de semillas en países de América Latina

Wendy Catalina Arenas Calle^{1*}, Carlos Iván Cardozo Conde¹ and Margarita Baena²

¹Universidad Nacional de Colombia - Palmira. Faculty of Agricultural Sciences, Palmira, Colombia ²Bioversity International. Cali, Colombia. *Corresponding author: catalinaarenascal@gmail.com

Rec.: 16.06.2014 Acep.:18.09.2014

Abstract

Latin America is a diverse region that exhibits a high environmental, cultural and social wealth, likewise, this region presents a variety of ways according to their agricultural production conditions, cultures, practices and cultural, economic and political factors; this wide variety of factors influence the levels of agricultural productivity and hence competitiveness capacity of the region. The seed sector is different in each country and includes features, activities, dynamics and norms according to their local contexts, even within the same country coexist differences among seed crops sectors and/or regions. Considering that each system has its own characteristics, actors and interactions, it is necessary to propose studies to address knowledge through which the state of development of the sector in each country is determined. In this study a literature review and search for available data on seed systems in Brazil, Guatemala, Peru and Colombia was done to present factors and conditions on the state and development of the seed system in each of these countries. Overall, Brazil system shows an evolved system according to the Douglas (1982) classification criteria system. Colombia and Peru, have more developed systems for some crops than others, the most developed systems correspond to crops with higher economic interest while other crops rely on informal systems such as self-sufficiency. In Guatemala, the supply of seeds is largely dependent on the farmers' own production and public organizations through programs aimed at supporting small farmers.

Key words: Seeds, formal seed system, informal seed system.

Resumen

América Latina es una región que posee una gran riqueza ambiental, cultural y social, con sistemas variables de agricultura según sus condiciones de producción, cultivos, y factores culturales, económicos y políticos. Esta amplia diversidad de factores influye en los niveles de productividad agrícola y en la capacidad competitividad de la región. El sector de semillas es diferente en cada país y posee características, dinámicas y normas propias según sus contextos locales, incluso, dentro de un país coexisten diferencias entre los sectores semilleros entre cultivos y/o regiones. Considerando que cada sistema tiene sus propias características, actores e interacciones, se hace necesario proponer estudios para abordar su conocimiento a través de los cuales se determine el estado de desarrollo del sector en cada país. En este estudio se realiza una revisión bibliográfica y búsqueda de datos disponibles referentes a los sistemas de semillas de Brasil, Guatemala, Perú y Colombia con el fin de presentar el estado y desarrollo del sistema en cada uno de ellos. En general, el sistema en Brasil muestra un sistema evolucionado según los criterios de clasificación de Douglas (1982). Colombia y Perú presentan sistemas desarrollados para algunos cultivos, especialmente los de tipos comercial de mayor interés. En Guatemala el abastecimiento de semillas depende principalmente de la producción propia de agricultores y/u organizaciones públicas mediante programas dirigidos al apoyo de pequeños agricultores.

Palabras claves: Semillas, sistema formal de semillas, sistema informal de semillas.

Introduction

Through the development of agriculture, farmers have domesticated and breed plants in order to produce their own seeds, albeit with the increased demand for agricultural products it has been necessary to produce larger quantities of these with the favorable characteristics for farmers' needs (Domínguez *et al.*, 2001).

In the current agriculture exist the production system at large scale in extensive areas of technified crops and high productivity indexes and, the traditional system in farms characterized by small productive units with high crop diversity. In the large scale system, the crop productivity is associated with the use of high genetic and physiological quality seeds that guarantee high yields (Peske *et al.*, 2010). In the traditional system the small farmers keep crops of local and/or commercial varieties and the producer generally stores seeds from the harvest or he gets them from the local, familiar communities or from small distributors (Hermann *et al.*, 2009).

The above mentioned systems have particular requirements, however they demand quality seeds that guarantee a high productivity. The formal sector of seed production is composed mainly by business focused on high economic importance and targeting medium and large producers, and are controlled by strict regulations on production, quality and marketing which increase the production, research and development costs (Hermann *et al.*, 2009; Neate and Guei, 2011).

Crop breeding and the need of new production systems for high quality seeds was the base to start the Platform for Capacity Building in Seed Systems, in which partners as the International Center for Tropical Agriculture (CIAT), Bioversity International and the Universidad Nacional de Colombia participate, among other entities.

This research comes as an initiative from this Platform due to the need to understand how the seed systems are composed since they are the providers for large scale production and also for the traditional cropping systems. In this sense, the proposed objective is to contribute with information for the general knowledge of the seed systems in the region from the analysis of the programs of Brazil, Guatemala, Peru and Colombia, documenting factors that determine their development level and identifying the strengths of each one of them.

Materials and methods

The methodology involved gathering information on seed systems from four countries in Latin America (Brazil, Guatemala, Peru and Colombia). These countries were selected optionally during the work design for their contrasting characteristics. For the election of the qualification criteria was counted with the assistance of international experts in seed production. In addition, there was a previous survey on the general state of seed production systems by means of a survey of 40 representatives from nine Latin American countries participating in the workshop and consultation: Strengthening Seed Systems in Latin America, held in Santa Cruz, Bolivia, on 27 and 28 August, 2012.

The survey was focused on three publics with different objectives: (1) decision makers with emphasis on seed policies, (2) companies and producer associations with emphasis on seed production and marketing and, (3) farmers with emphasis on productivity and use of seeds. The search for information was made taking into account various sources and resources. Primary information was obtained by consulting articles, reports and publications and selected according to their validity and date of publication, giving priority to the most recent information in order to identify failures of information on seed systems in Latin America and aspects that require further attention. The qualitative information collected was sorted and categorized according to the verifiable link between information provided and bibliographical sources; when this information was relevant it was ordered and analyzed using descriptive statistics according to the frequency of categories of information. In order to establish and present levels of development the classification described by Douglas (1982) and the factors highlighted and associated with key elements for the successful development of seed systems exposed by Neate and Guei (2011) were used. To get information, validation and information of additional return he had the collaboration of the participants at the XXIII Pan American Seed Congress, held in Santa Cruz de la Sierra, Bolivia, in August, 2012 and in the workshop Organizational, Technological and Biological Principles in Modern Management of High Quality Seeds, held in Colombia in October, 2013.

Results and discussion

The seed industry in Latin America is characterized by a strong expansion in recent decades thanks to the development of biotechnology associated to plant breeding and the globalization of seed trade, in this framework in several countries multinationals and small and medium seed companies were established; in parallel, investment in research and development have been major factors to strengthen these companies in recent years. On the other hand, the new marketing targets for high quality and well adapted seeds promote the development of private companies that produce and/or research on this supply. The regional governments have worked to implement and adopt international standards for production, quality, marketing and protection of plant varieties; as is the case for the regulations established by the International Union for the Protection of New Varieties of Plants (UPOV), the creation of the Organization for Economic Co-operation and Development (OCDE), the International Seed Testing Association (ISTA) and the international conventions and treaties of the Food and Agriculture Organization (FAO), (SAA 2009; Bruins 2010; OCDE, 2012).

Despite these efforts, studies and reports show that between 70% and 90% of crops in developing countries are planted with local varieties and seeds of self-sufficiency or acquired from informal systems (Hermann et al, 2009; Neate and Guei, 2011). These results show the need for farmers to get seeds from a wide range of locally adapted crops to respond to their environmental, economic and cultural needs; also they reflect the problems of access and distribution of improved and high quality for small farmers, who do not have sufficient resources to purchase them, limiting their productive activities (Neate and Guei, 2011) seeds.

Developmental context per country

Brazil. With a surface of 851.000.000 ha, in 2009 had a cultivated area of 264.500.000 ha. In 2011 its population was 196.66 million of inhabitants, from which only the 13.09% was found in rural areas. For 2013 the active population of Brazil was 101.99 million with a population of 20.46 million dedicated to agriculture according to FAOSTAT (2013). In the last years, the agriculture in the country have grown and expanded with a larger participation in the economy. In 2013 agriculture contributed with US\$234.6 billion to the PIB corresponding to

7%, according to reports of the Brazilian Institute for Geography and Statistics (IBGE, 2014).

The steady growth of Brazilian agriculture is due to increased production and exporting of crops such as soybean, sugarcane, wheat and corn, among others; in this context, technological advancement and improved seeds have played a key role in increasing productivity and agricultural development. The regulatory framework for seed production in this country is constantly evolving including production, marketing and use of these, in accordance with international standards as UPOV 78, WTO and ITP-GRFA, which provide a regulatory framework for access to plant genetic resources and recognition and support for small farmers.

In Brazil, a dynamic seed industry is evident with the participation of the private and state sectors in research and development through the Brazilian Agricultural Research Corporation (EMBRAPA). The high rate of use of certified seeds in its main crops are shown in Table 1. According to Peske (2012a; 2012b) the success of seed production in Brazil is due to the use of appropriate technologies, investment in trained staff and access to improved seeds, all enhanced by the diversity of climates and an enabling legal framework for the marketing, export and the creation of seed companies.

Guatemala. With an extension of 10.889.000 ha, from which 4.395.000 ha comprise agricultural areas. In 2012 the population increased to 15.138.000 inhabitants, from which the 50% lived in the country side and was dedicated to agriculture that corresponds to the 13.1% of PBI giving US\$29,063 million (MAG, 2013). According to FAO, indigenous and rural communities in Guatemala are the main representatives of small family farms of infra-subsistence, subsistence or small productions for marketing. Agriculture is a core activity because it represents the main source of employment in the country; however, it is estimated that 89.8% of the production units are small subsistence farms or family farms of less than 7 ha, intended mostly for subsistence production. These small units comprise only the 16.2% of the country arable land, whereas the 65.4% is occupied by large productive areas over 45 ha, which represent 2.23% of the existing units (USAC, 2013).

The demand for seeds in Guatemala focuses on local varieties due to agricultural and traditional characteristics of the country, although it has improved varieties released by the Institute

Table 1. Seed production of the main crops in Brazil. Campaign 2011/2012. Modified from Peske (2012b). * Crops with high seed rate use.

Crop	Seed production		Sowing area		Seed demand		Use rate
	(Tons)		(Hectare)		(Tons)		(%)
	2009 - 2010	2010 - 2011	2010 - 2011	2011 - 2012	Potencial	Efective	2011- 12
Soybean	1.560.649	1.592.058	23.551.088	25.018.000	1.501.080	1.005.723	67
Wheat	292.009	283.078	2.034.049	2.166.000	303.24	215.3	71*
Corn	206.664	281.746	11.137.501	15.451.000	309.02	281.208	91*
Lowland rice	93.811	114.92	1.341.500	1.320.000	118.8	62.964	53
Bean	28.285	41.237	2.207.272	3.670.000	220.2	39.636	18
Upland rice	31.185	36.941	871.3	750	60	30	50
Barley	18.272	25.976	86.8	88.4	10.608	8.486	80*
Cotton	14.104	21.132	1.355.200	1.391.000	20.886	11.487	55
Sorghum	6.299	7.247	702.1	856	8.56	7.104	83*
Rye	57	384	850	2.3	207	104	50
Total	2.251.335	2.404.719	43.287.660	50.712.700	2.552.601	1.662.012	

of Agricultural Science and Technology (ICTA) and seed companies, which mostly correspond to multinationals. The limited production makes it necessary to import maize and bean seeds; it is estimated that by 2007 government programs accounted for 4% improvement in domestic demand in the case of maize. In the period 2004-2010 it is estimated that about 773,000 quintals of maize, beans, sorghum and rice intended to subsidize vulnerable sectors were imported (IICA, 2010).

In the country there are initiatives to promote seed production by farmers and better management practices and seed selection. These programs are community service such as participatory breeding, germplasm banks and seed production cooperatives, including: Meso-american Participatory Program Improvement (PM-FP), the Seed Development Project led by FAO and the Network Agricultural Innovation Project (Red SICTA), among others. Despite the success of these programs, farmers prefer to concentrate on grain production and rates of use of certified seeds remain low.

Peru. It has an extension of 128.215.000 ha distributed in the Andes, the coast and Amazon. The arable land is estimated in 4.2 millions of ha that correspond to only 4% of the total area of the country (FAOSTAT, 2013). The contribution of agriculture to the PIB was 8% in 2011, and 25% of the active population of the country is dedicated to agricultural activities, according to data of the Ministry of Agriculture of Peru (2013).

In Peru two contrasting realities are evident. On

one side, small-scale agriculture in the Andean region located in vulnerable and fragile lands with variable rainy seasons and crops that are affected by pests, drought and frost. More than 85% of the farms in this region are less than 10 ha where subsistence crops are established. Moreover, in the coastal region of the country tech intensive exploitation of economically important crops is generally presented, especially in favorable areas with permanent water availability (Lapeña, 2012). The rate of use of certified seed in the country are low (Table 2). Approximately 90% of the seeds come from informal systems which are held by small farmers in family farming systems that protects genetic diversity of germplasm in the country.

Table 2. Use rate of certified seed in Peru. Campaigns 2008 - 2011 modified from Lapeña, 2012.

Crop	2008 - 2009	2009 - 2010	2010 - 2011	Average
Cotton	19,17%	37,63%	27,94%	32,70%
Rice	26,52%	35,08%	36,70%	24,41%
Hard yellow corn	8,76%	10,48%	7,13%	9,65%
Starchy corn		0,25%	0,03%	0,25%
Potato	0,08%	0,17%	0,18%	0,26%
Oat - Barley - Wheat	1,58%	0,49%	0,54%	0,77%
Grain legume	0,13%	0,41%	0,25%	0,28%

Colombia. It has an approximate area of 113.891.000 ha, from which 16.2 million of ha are arable and only 4 million are used (FAO-STAT, 2013). Agriculture contributes with 5.2% to the PIB thanks to an increase of 8.8% in tran-

sient crops and 3.7% in permanent crops (DANE, 2013). Colombia experimented an agricultural expansion in the period 2010 – 11, increasing around 110.000 ha, especially in crops like sugarcane (24), rice, palm oil and soybean(23.000 ha each). It is estimated that approximately 58.9% of the crop area is occupied by crops with exportation potential (Perfetti *et al.*, 2013).

Thanks to this expansion in growing areas, the seed industry in Colombia is growing. According to representatives of the ICA (2013) 85% of the certified seed in Colombia are produced by domestic companies and only 15% of them come from other countries, even in the case of rice 100% of certified seeds are of domestic origin. (Figure 1) (Beltran, 2013 N. P.). However, there is still a heavy reliance on informal seed production systems for small farmers (Grupo Semillas, 2010). In the 2009 National Agricultural Survey stands out the participation of small farmers in crop production such as green onion, faba bean, potatoes, beans, cocoa, pea, carrot, banana, coffee, panela sugarcane and plantain, with a participation over 70% in the domestic market (AGRONET, 2013). However, small farmers have severe limitations on the access and use of quality seeds for their high costs, so often turn to other sources of seeds.

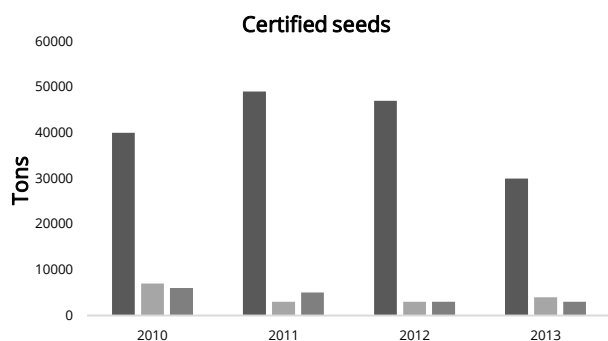


Figure 1. Production of certified seeds of rice, corn and soybean in Colombia 2010-2013. (Modified from Burbano, 2013).

Development and relevant factors of the seed producing systems

The countries included in this study reflect a wide variety of cases in which seed systems (Douglas, 1982) (Figure 2) are developed. On the first level is Guatemala with a production system of emerging category that is mainly characterized by being highly dependent on the infor-

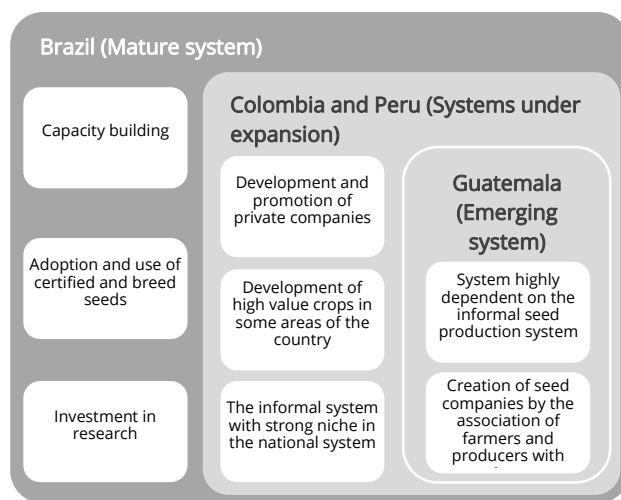


Figure 2. Developmental levels and main characteristics of the seed production systems in Brazil, Guatemala, Peru and Colombia.

mal seed production by farmers, although initiatives are observed in the creation of companies and production projects with the support of public entities.

In a second level are the seed systems of Peru and Colombia catalogued as under expansion and characterized by the promotion of seed production companies and investment in research, in this case it presents a further development of the seed sector in crops of economic value and in productive agricultural areas, while in less developed areas with a predominance of small farmers there is still a strong influence of the informal seed sector.

In Brazil, on the other hand, the system of seed production can be considered mature and characterized as predominantly commercial with a strong institutional development, high adoption and use of certified and improved seeds and high investments in research, development and training.

Each seed system presented in this study presents relevant development factors that must be taken into account for the establishment of successful seed systems. In the case of Brazil, are: (1) incentives and stable demand for quality seeds for their main crops thanks to the institutional strengthening of the sector that allows the organization and associativity of the chain; (2) investment in research, production and training in the private and public sectors with the support of EMBRAPA; (3) the establishment of monitoring and quality control units with international protocols that facilitate internal and ex-

ternal trade of seeds; and (4) an elaborate legislation on seed issues in line with international standards and agreements which meet national and international production needs.

In Peru there is a growing core in seed production, especially in crops of commercial value and, Andean crops have a potential for exploitation thanks to growing worldwide interest due to their nutritional qualities. To exploit this potential, promotion on the use of quality seeds, training farmers in production, management and marketing of seeds and encourage the formation of associations and/or companies for Andean crop seed growers must be promoted. Additionally public-private partnerships must be established to ensure the inclusion of all stakeholders, recognizing and protecting family farming that is predominant in the Andean region and providing guarantees for the development and strengthening of the chain through investment and plant breeding of commercial species. One of the strengthening opportunities for the development of competitiveness is the Partnership and joint actors in the system.

In Colombia is necessary to highlight the potential of agricultural expansion happening in the country, which must be accompanied by the strengthening of seed production systems to ensure the advancement of agriculture. In the country, the lack of resources and guarantees for small farmers limits access to improved varieties of high quality which can improve the productivity of their crops. It requires fostering favorable regulations for the seed sector as a success factor for agricultural development. One of the main challenges in establishing regulations on seed production is to consider all the elements and factors that make such a dynamic and diverse system. The legislation should establish clear and strict guidelines for the production, protection of varieties and incentives for research and development of new technologies; also involve local agro-biodiversity conservation, recognition and protection of knowledge and practices associated with peasant and indigenous communities to promote policies that encourage small-scale farming communities.

In Guatemala are highlighted the initiatives and programs to support seed production by farmers' associations. For an emergent system it is essential to promote seed production with standards and quality criteria in line with the levels of development of the sector to stimulate growth. These programs should place greater emphasis on sustainability once completed,

creating skills and abilities necessary for the maintenance and strengthening of future business and seed producer associations. The country must invest in research in new locally adapted varieties through participatory breeding strategies with the aim of increasing productivity levels in crops of economic, cultural and social importance.

In general, countries in the region should generate interest and acquire commitments from leaders to establish the necessary conditions for strengthening and growth of the seed sector in Latin America through business creation, training of qualified personnel and the strengthening research. It is a priority for seed systems in Latin America establish harmonious and collaborative relationship between the formal and informal sectors and their actors. In this sense, recognition of informal systems is a key element to strength the sector as they represent a vital element in the establishment of sustainable and competitive seed systems.

In seed production systems analyzed coexist the formal and informal sectors, depending on the crop and the country. In Colombia and Peru, farmers are turning to sectors according to their particular needs, this is mainly due to the development characteristics of the systems and to the fact that governments should establish clear measures for the proper functioning and recognition of both. In Brazil the seed production system is characterized by the partnership between private companies and between public and private, ensuring the strengthening of research, training and development of this industry. In Guatemala, the seed production systems are in a state of emerging development.

In the region there are still initiatives, promotion and support for the coordination and inclusion of all actors in the seed production chain; it is necessary that the formal and informal systems form a strategic complement in strengthening national seed systems in an efficient, diversified and competitive way. The availability of quality seeds is up to the participation of all stakeholders in the system and the strengthening of the seed sector in Latin America it depends on international integration.

Acknowledgements

To the Platform for Capacity Building in Seed Systems, led by the International Center for Tropical Agriculture CIAT and Bioversity

Internacional; to the Universidad Nacional de Colombia - Palmira and to the Research Group on Plant Genetic Resources GIRFIN; to Simone Staiger, Jacob van Etten and Marcela Beltrán.

References

- Agronet. web: <http://www.agronet.gov.co/agronetweb1/Estad%C3%ADsticas.aspx>
- Beltrán, T. 2013. Empresarios y autoridades responden a video sobre semillas. Portafolio.co Available at: <http://www.portafolio.co/negocios/empresarios-autoridades-responden-video-semillas>
- Bruins, M. 2010. El aporte del mejoramiento vegetal para la agricultura – reportagem de capa *Seed News* 14(1).
- Burbano, E. 2013. Papel de los diferentes controles en la producción de semilla de calidad: certificación, bioseguridad, derechos de obtentor. Taller Principios Organizacionales, Tecnológicos y Biológicos en el Manejo Moderno de Semillas de Alta Calidad. Centro Internacional de Agricultura Tropical, CIAT. Colombia.
- DANE (Departamento Administrativo Nacional de Estadística). DANE: https://www.dane.gov.co/files/investigaciones/boletines/pib/cp_PIB_IVtrim13.pdf
- Domínguez, C. E.; Peske, S. T.; Villela, F. A.; and Baudet, L. 2001. *Informal seed system. Causes, consequences and alternatives*. Pelotas, Brasil. Editora Universitaria. UFPel.
- Douglas, J. E. (comp.). 1982. Programas de Semillas. Guía de planeación y manejo. Centro Internacional de Agricultura Tropical CIAT. Colombia.
- FAOSTAT (FAO Statistics). FAOSTAT: <http://faostat.fao.org/site/666/default.aspx>
- Grupo Semillas. 2010. Las leyes de semillas aniquilan. La soberanía y autonomía alimentaria de los pueblos. Publicaciones web GRAIN. doi:/e/4098
- Hermann, M.; Amaya, K.; Latournerie, L.; and Castiñeiras, L. 2009. ¿Cómo conservan los agricultores sus semillas en el trópico húmedo de Cuba, México y Perú? Experiencias de un proyecto de investigación en sistemas informales de semillas de Chile, frijoles y maíz. Biodiv. Inter. Roma, Italia.
- IBGE (Instituto Brasileiro de Geografía y Estadística). IBGE: <http://www.brasil.gov.br/economia-e-emprego/2014/02/em-2013-pib-cresce-2-3-e-totaliza-r-4-84-trilhoes>.
- IICA (Instituto Interamericano de Cooperación para la Agricultura). 2010. Experiencia en la producción de semilla certificada de maíz híbrido de la Asociación de Productores Nueva Esperanza. Municipio de Ixcán, departamento de Quiché, Guatemala.
- Lapeña, I. 2012. La Nueva Legislación de Semillas y sus implicancias para la agricultura familiar en el Perú. Serie de Política y Derecho Ambiental. Sociedad Peruana de Derecho Ambiental. No. 26. Lima, Peru.
- MAG (Ministry of Agriculture and Livestock of Guatemala). MAG: <http://web.maga.gob.gt/download/El-agro-en-cifras-small.pdf>
- Neate, P. J. and Guei, R. G. 2011. Promoción del crecimiento y desarrollo de empresas de semillas de pequeños agricultores en cultivos para la seguridad alimentaria. Organización de las Naciones Unidas para la Agricultura y la Alimentación, FAO, Roma, Italia.
- OCDE (Organización para la Cooperación y el Desarrollo Económico). 2012. Sistemas de semillas de la OCDE. Síntesis de las Normas Internacionales que Regulan el Comercio de Semillas. Recuperado de <http://www.oecd.org/tad/code/semillascomercios%C3%ADntesisdelasNormasInternacionales.pdf>
- Perfetti, J. J.; Balcázar, A.; Hernández, A.; and Leibovich, J. 2013. Políticas para el Desarrollo de la Agricultura en Colombia. Fedesarrollo. Bogotá, Colombia.
- Peske, S. T. 2012a. Las semillas en el contexto de las innovaciones tecnológicas. *Seed News* 16(2).
- Peske, S. T. 2012b. Brasil y el negocio internacional de semillas – reportagem de capa. *Seed News* 16(5).
- Peske, S. T.; Barros, A. C.; and Schuch, L. O. 2010. Beneficios y obtención de semillas de alta calidad. *Seed News* 14(5).
- SAA (Seed Association of the Americas). 2009. Movimiento de Semillas en las Américas. Asociación de Semillas de las Américas. Recuperado de: <http://www.saaseed.org/site/?en&noindex&mod>
- USAC (Universidad de San Carlos de Guatemala). 2013. Caracterización de la estructura productiva y social en el agro guatemalteco. Available at: <http://www.cunoc.edu.gt/medicina/caracterizacionproductivaguatemala.pdf>.