

Strengthening local seed production systems in the Andean-Amazonian Piedmont

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Abstract

The use of quality seed in commercial crops is related to less damage from pests and diseases and increases in the productivity and profitability of the activity. Nevertheless, its availability and access are limited to a large segment of family producers. In response, the National Seed Plan project was implemented between 2020 and 2024, which was aimed at producer organizations to strengthen their local systems for obtaining quality seed that can contribute to improving agricultural productivity, diversifying sources of income, and empowering farmers in technical, associative, and commercial principles linked to seed production. The manuscript presents the experience Strengthening for the production of quality seed of the association of bean growers of Sibundoy-Asofris in technical, organizational, and commercial aspects through participatory work strategies and with a learning-by-doing approach, achieving the construction of a system of self-sufficiency, traceability, and business model for the organization.

Keywords:

beans, family farming, participatory research, rural development.



Introduction

Agricultural producers in Colombia face numerous challenges that affect the yield of production systems, such as access to markets, insufficient infrastructure, and environmental problems, which result in low yields, prices that do not cover costs, and an increase in inequalities. Among the technical/productive aspects that limit the development of family-based agriculture (peasant and that practiced by indigenous and Afro-descendant communities) is the restricted access to quality seed for small-scale agriculture (Rincón, 2018).

Seed production for food security and cash crops corresponding to the peasant, family, ethnic and community agriculture (PFECA) segment is mainly informal, being carried out at the local level and on farms under traditional and low-tech methods (Rincón *et al.*, 2024). To strengthen these relationships, it is necessary to have institutional support aimed at technifying the processes of obtaining seed to ensure its quality, consolidating organizational relations that allow the process to be sustainable, and advancing in strategies for formalizing their exchange.

In response to this need, the National Seed Plan is implemented, which aims to implement actions that allow the development, strengthening, and consolidation of seed production systems based on the rescue and conservation of native and landrace materials (Rendon-Ocampo *et al.*, 2021). For its implementation, it is supported by a multidisciplinary strategy that combines technical aspects (associated with the quality seed production process), social/organizational aspects (aimed at consolidating the cooperative dynamics of producers) and economic/commercial aspects (aimed at estimating production costs and marketing strategies), which together allow standardizing the process of obtaining seed that contributes to improving the production systems and constitutes a source of income diversification to improve the well-being of families.

Its methodology focuses on active learning, focusing on learning-by-doing and dissemination strategies from farmer to farmer that allow, on the one hand, recognizing and valuing the knowledge that producers hold as seed providers and, on the other hand, promoting the dynamics of social appropriation of knowledge through horizontal dialogue and participatory intervention strategies (Easdele *et al.*, 2017).

The project was implemented in the Sibundoy Valley region, which corresponds to an environmentally homogeneous area where agricultural activities aimed at food security and destined for regional and national markets are carried out. In particular, bean cultivation occupies a central line in the productive activity of the region, which, grown out under small peasant agriculture schemes, is one of the main activities, occupying around 879 ha, with an estimated production of 865 t (Agronet, 2022) and demanding a significant number of daily wages, making it an activity that boosts the local economy.

Despite its economic importance and relevance as a central productive activity in the area, producers lack formal seed production and supply systems that allow them to maintain the quality and productivity traits that are distinctive, and it is common to use seed from commercial crops, commonly intended for human consumption. However, according to Ávila-Marioni *et al.* (2020), the use of high-quality seed increases yields by 40.1%, showing that this practice constitutes an efficient technological innovation to maximize crop productivity. At the same time, obtaining seed represents a business alternative, which can be translated into increased yields and lower production costs, resulting in higher incomes for producers (Wagner-Medina *et al.*, 2021).

Materials and methods

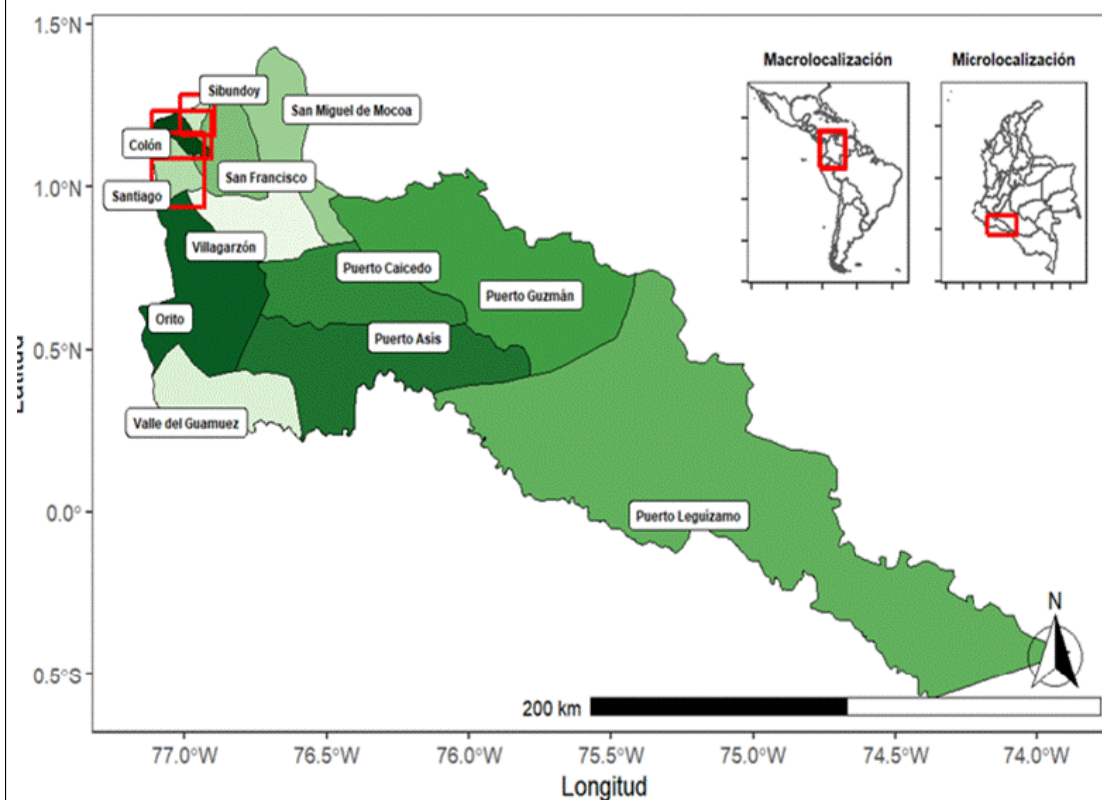
Study area

In its implementation, the NSP launched an open call to producer organizations that were interested in participating in the project aimed at strengthening their local seed production system. Following a procedure for evaluating applications that analyzed aspects such as the organization's trajectory, tradition in seed production, available infrastructure, manifest interest, among other factors, the

Association of Farmers and Growers of Beans of Sibundoy-Asofris was chosen, which brings together grain growers from the Alto Putumayo region (Colombian Amazonian Piedmont).

The Sibundoy Valley is located in southwestern Colombia in the northeast of the department of Putumayo in the Andean-Amazon subregion and is made up of the municipalities of Santiago, Colón, Sibundoy and San Francisco (Figure 1) (CorpoAmazonia, 2007).

Figure 1. Municipalities prioritized during the implementation of the NSP 2-species beans. Taken from the Administrative Department of Statistics (2022).

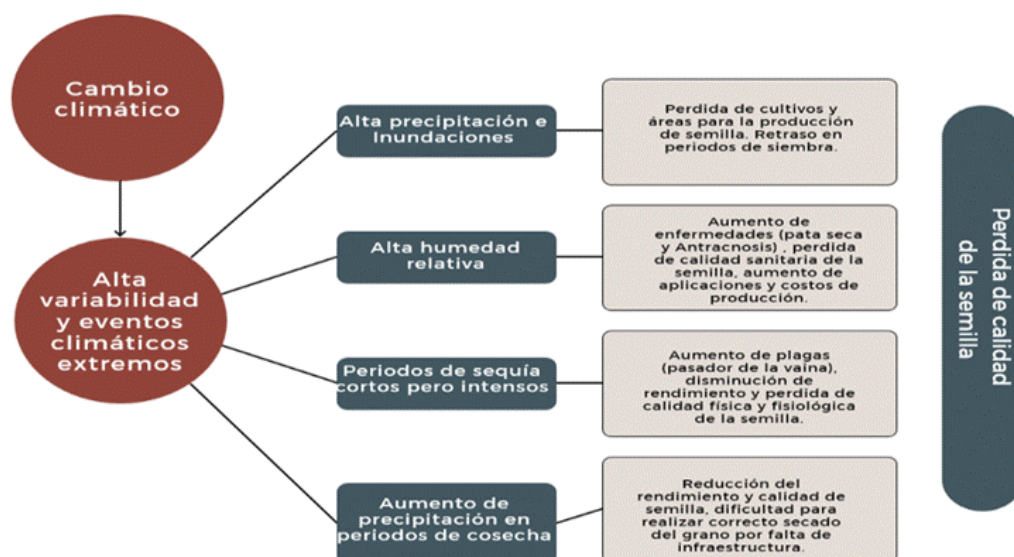


As for the conformation of the land, it is found between altitudes of 2 000 m in its flat part and at 3 500 m in the highest part. There are about 45 000 ha in the hillside area and about 9 000 ha of the territory in flat area. In the latter, agricultural practices of miscellaneous crops, monocultures, and agroecosystems are carried out to a greater extent (Gobernación del Putumayo, 2015; Alcaldía de Sibundoy, 2020).

For the region, there is an average total annual rainfall of 2 000 mm, with 50% of the rainfall concentrated from May to August, and the rest distributed in the other periods of the year (CorpoAmazonia, 2007). The average annual relative humidity in the Sibundoy Valley is approximately 79%, with an average maximum and minimum between 78 and 81%. The average annual temperature is 15.6 °C, with an average maximum of 20.6 °C and a minimum of 11 °C.

Climate change is not alien to bean producers in Sibundoy Valley, which is why below is a diagram showing the main perceptions about how the climate has behaved in recent years and what impacts has this region experienced (Figure 2).

Figure 2. Effect of climate change on seed production in the Sibundoy Valley.



Baseline development

Following the strategic route of the NSP, a series of actions were planned aimed at generating a profile of the organization that would make it possible to identify the degree of development and consolidation of the seed production processes and that would allow for the participatory construction of a work plan that would guide the intervention process. These activities were framed in the participatory action research methodology, considering the experience and knowledge of producers for social change (Zapata and Vidal, 2016; Zúniga-González *et al.*, 2016).

The meetings have the participation of producers from the Asofris organization, who would constitute the committee of seed producers, members selected by the general assembly. In this context, the methodologies used are described in Table 1.

Table 1. Methodologies developed for baseline construction with the Asofris organization, Sibundoy Valley, 2020.

Product generated	Methodology used	Exercise description
Organizational diagnosis for the production of quality bean seed.	Surveys profile of the Organization	Three surveys were carried out with single-answer, multiple-choice, and open-ended questions, distributed in three dimensions: organizational, economic-market, and productive-technical
Organization's trajectory	Timeline	Seed producers are asked to mention the iconic moments of the organization (foundation, execution of projects, conjunctures, etc.) in order to make visible achievements, strategies for overcoming difficulties, and project actions
Actors identified in the region	Network of actors	A list is made of the productive, institutional, commercial, and cooperation actors that

Product generated	Methodology used	Exercise description
Roles and functions in the committee of seed producers	Sociogram	can be linked as allies, beneficiaries, or partners for seed production An assignment of roles and responsibilities for seed production is established according to the capacities of each of the participants.
Work plan	Surveys profile of the Organization	With the inputs obtained in the survey, the critical points at the technical, organizational, and commercial levels to be included in the work plan were identified

The production of quality seed is an activity that requires a special commitment on the part of farmers to carry out the technical management of the crop following the established criteria, to make a continuous record with a view to establishing a traceability system, and to develop actions aimed at guaranteeing the commercialization of the product. To this end, it is suggested that, within each organization or group of producers, an invitation be made to its members to form a committee of seed producers who will carry out the productive and management activities necessary to become suppliers (Table 2).

Table 2. Steps to constitute a committee of seed producers per producer organization.

Who are the members of the committee of seed producers?	Partners who are interested in becoming quality seed producers
What is the function of the committee of seed producers?	Group producers and coordinate actions aimed at obtaining quality seed to improve the sustainability of production systems, reduce costs, and increase the profits of producer families
What responsibilities does the committee of seed producers have?	Know and incorporate the technical principles for the production of quality seeds Ensure quality and traceability processes in seed production Guarantee the participation of producers aimed at strengthening the local seed production system.
How can the committee of seed producers be structured?	It is made up of producers who have a tradition in seed production or who want to undertake the activity The assignment of technical/productive, organizational, and economic/commercial liaisons that can accompany and monitor the seed production process is proposed

Establishment of the learning unit

To facilitate the appropriation of knowledge, a learning plot managed by all the seed producers was initially established. This phase included activities designed to address the technical gaps identified in the baseline. Subsequently, learning units were implemented on the producers' farms, which were based on the learning obtained together with specific recommendations for each farm. In this way, the relevance and effectiveness of the recommendations in the production of quality seed for the region was evaluated in a participatory manner.

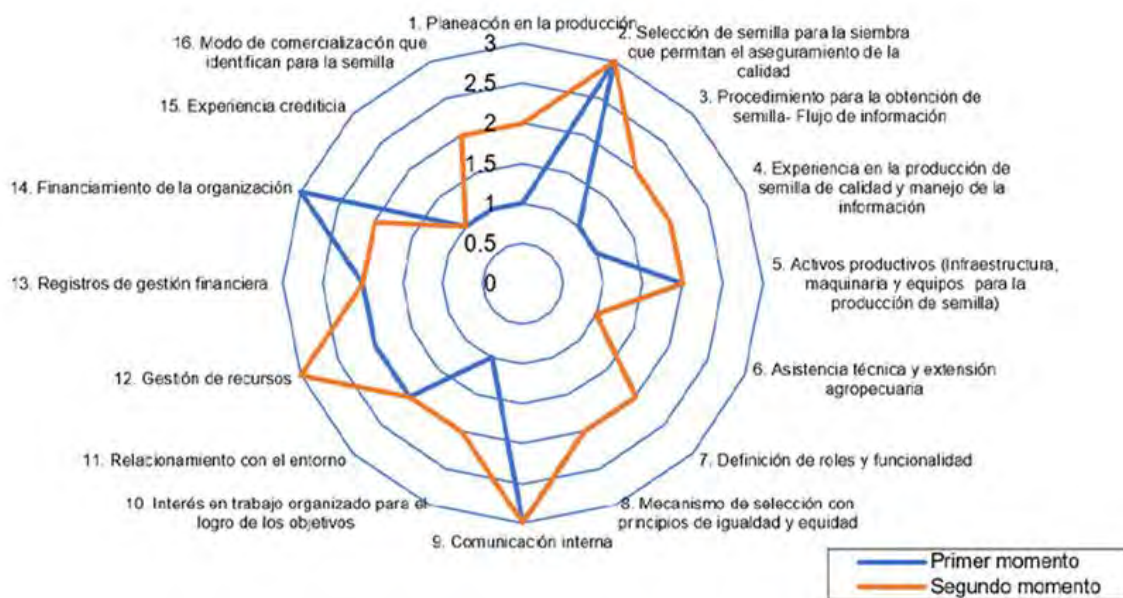
The learning plot tool is a strategy favorable to the empowerment of producers since they actively participate in all phases of productive development by monitoring and validating the cultural tasks implemented under local conditions. In addition, from the lived experience, it allows them to disseminate the results and lessons learned in the research and innovation process to their peers and other actors.

Results and discussion

Ex ante and *ex post* evaluation

Figure 3 reveals the progress made by Asofris producers regarding the knowledge related to the production of quality seed, taught by Agrosavia within the framework of the National Seed Plan project-species beans. In the technical field, there was a substantial improvement in crucial aspects, such as seed selection, processing and production. These achievements demonstrate the effectiveness of the training and the commitment of producers to adopt the best practices in crop management and the obtaining of high-quality planting material.

Figure 3. Results of the organizational profile of the Asofris association, Sibundoy (Putumayo) 2020.



As for the organizational sphere, the producers have maintained their standards in fundamental aspects, such as the definition of roles, equality and equity in the defined positions, internal communication, and the relationship with the environment. This reflects the maturity achieved in the management and operation of their organizations, key aspects for the success of their productive initiatives.

It was possible to consolidate the committee of seed producers with the creation of liaisons within the organization, who fulfill a series of functions within the collective that allow optimizing the process of producing quality seed. Figure 4 details the roles, scope, and functions that were prioritized within the organization's committee of seed producers.

Figure 4. Liaisons, roles and functions of the committee of seed producers of the Asofris organization.

Enlaces	Comercial y mercadeo	Técnico para la producción de semilla	Logístico-administrativo para la producción de semilla
Alcances	se encargará de las actividades de planeación comercial marketing para el posicionamiento de la marca dentro del territorio.	será los encargados de la zonificación, planificación y supervisión agronómica de siembras para la producción de semilla, que cumpla con los estándares de calidad en aspectos físicos, genéticos, sanitarios y fisiológicos con el fin de garantizar el autoabastecimiento de semilla y sostener una oferta a productores externos a la organización.	tendrá como objetivo orientar sus acciones en alcanzar la eficiencia y eficacia en los procesos que desarrolla el comité.
Funciones	-Realizar y actualizar bases de datos de clientes (recolectar información) -Definir posible demanda de semilla de calidad -Realizar promoción de la semilla -Distribución de semilla de calidad (definir cantidad y precio) -Rendición de cuentas comerciales.	-Definición de áreas requeridas para producir semilla -Selección de lotes óptimos para la producción de semilla (verificación de requerimientos) -Verificar la calidad de semilla para establecimiento de lotes -Seguimiento a lotes y libros de campo (Verifica buen estado de los lotes) -Seguimiento en proceso de poscosecha -Verifica la calidad de la semilla para comercializar -Rendición de cuentas técnicas	-Realizar convocatorias de reunión para el comité de semillas. -Realizar sistematización de libros de campo por semillerista -Realizar y actualizar bases de datos de clientes (sistematización de información) -Implementación de sistema de trazabilidad -Distribución de semilla de calidad (entrega de semilla)

In the economic and market sphere, the improvement in resource management stands out, which is essential for the financial sustainability of organizations. Nevertheless, as can be seen in the aforementioned diagram, the financing of organizations with public resources in the assessment period was reduced due to the limited offer of initiatives by the Ministry of Agriculture, the municipal government, and other entities, which is attributed to the Covid-19 pandemic (Rincón and Guerrero, 2024).

Faced with this situation, producers have resorted to loans to obtain resources and be able to leverage their productive initiatives. In addition, marketing improved thanks to training processes in which sales niches for the seed obtained in the learning plots were identified.

In summary, the spider diagram shows significant advances in the knowledge and capacities of producers, both in the technical field and in organizational and economic management, which lays the foundations for strengthening quality seed production in the Sibundoy Valley region (Putumayo).

As mentioned by Insuasty-Córdoba *et al.* (2020), these types of business require a series of conditions, such as the strengthening of individual capacities, favorable regulatory environment, planning and project management processes, seed storage, marketing and accounting, and technical support is crucial in the early stages; characteristics that are shared by Ramos *et al.* (2021), who, in addition to the above, highlight the importance of contributing to sustainable associative processes, with defined roles and strengthening of financial initiatives, such as revolving funds, village banks, among others that allow strengthening agribusiness initiatives.

Learning unit, training plan and traceability system

The strengthening of the capacities of the seed producers was done with a comprehensive strategy that combined theoretical and practical training. First, a training plan was defined in agreement with the selected group of seed producers, ensuring that the contents and methodologies were aligned with their needs and context, among some of these topics are the following: crop planning for seed production, planting distances for seed production, integrated pest and disease management, integrated crop fertilization, harvest and postharvest management of the seed, ICA regulations for seed production, traceability of the crop, production costs, market survey, role management, among others.

This practical experience allowed them to consolidate their knowledge in line with what Gómez (2018) points out, who mentions the importance of combining theory and practice in teaching as an effective strategy for learning and the collective construction of knowledge.

Through training and accompaniment, producers were guided in the proper use of the field book, a fundamental tool to keep a detailed record of the activities, inputs used, labor, and other factors that influence the quality of the seed obtained. It is worth mentioning that the implementation of the traceability system was fundamental in the comprehensive strategy to strengthen the capacities of seed producers (FAO, 2017).

Although its implementation is a commitment to respond to the regulatory requirements of the control entities of each country (ICA, 3168-2015; MADR, 931-2018), it is also an asset for organizations, allowing them to identify and track inventories linked in the production and conditioning processes and procedures of the final product. This was important in terms of management of activities aimed at the production and use of the product and byproducts (Cañar *et al.*, 2020).

Self-sufficiency plan (production costs, survey and business model)

For the comprehensive self-sufficiency plan, a detailed structure of production costs was built, considering the inputs, labor and operating expenses involved in the cultivation and marketing of beans. In addition, an exhaustive survey of the local and regional market was carried out, analyzing the supply, demand, prices, and existing distribution channels. These inputs made it possible to develop a robust business profile, which served as a roadmap for the effective implementation of the self-sufficiency plan by the organization.

As illustrated in Figure 3, the technical aspects associated with the production of quality seed were the ones that triggered the most progress on the part of the participants since, thanks to actively participating in the research-action process, they witnessed the benefits of the recommendations, extrapolating them to their commercial crops, which constitutes an *in-situ* validation action that favors the learning-by-doing cycle. In contrast, the variables oriented to the organizational and commercial aspects of the activity reflect less progress because the union and cooperation aspects are central challenges in these types of associations, which requires a longer accompaniment that allows the consolidation of the social fabric.

The fluctuation of marketing prices of dry beans or seeds is also a determining factor that influences producers to choose to sell their production either for the consumer segment or to guide it to specialized circuits, such as seed producers. This directly affects the consolidation process of the local seed system as it generates uncertainty in the financial sustainability of the process and the fulfillment of commercial agreements with allies and customers.

Conclusions

Local seed production systems are a central supply strategy to advance the autonomy of producers; strengthening capacities in the technical aspects associated with seed production gives farmers skills that are passed on the other crops they have and transcends in recognition of their knowledge and work as dynamic and central actors in their processes of change. It was possible to show how the supply of quality seed at the community level allows progress in the processes of awareness by segments of farmers about the importance of accessing these materials for health and obtaining better developments of their production systems, factors that were not fully understood prior to the accompaniment carried out.

Obtaining quality seed represents an opportunity for income diversification for farmers, so they identify the activity as a potential to continue developing autonomously. Nonetheless, its sustainability as an economic activity will be determined by the strategies that can be developed

aimed at guaranteeing base prices for the payment of the seed in the face of the fluctuations presented by the dry grain market. Finally, initiatives such as the National Seed Plan reflect the potential of sectoral entities to comprehensively accompany processes at the local level in segments that traditionally do not have greater technical and institutional support.

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