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PSSD Evaluation

Final report

14/02/2024

List of abbreviations

AfDB	African Development Bank
COPROSEBU	Burundi Seed Producers' Collective
DPFAFNL	Directorate of Promotion of Agricultural Sectors and Non-Timber Foresters Products
EEAS	European External Action Service
EKN	Embassy of the Kingdom of the Netherlands
EQ	Evaluation Question
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
IFAD	International Fund for Agricultural Development
GAP	Good Agricultural Practice
IFDC	International Fertilizer Development Centre
ISABU	Agro-Science Institute of Burundi
ISSD	Integrated Seed Sector Development
KII	Key Informant Interviews
KIT	Royal Tropical Institute
MTR	Mid-Term Review
NASECO	NALWEYO SEED Company (Uganda)
NGO	Non-Governmental Organization
ONCCS	National Office of Seeds Control and Certification (Burundi)
PADANE	Agricultural Development Support Project for Nutrition and Entrepreneurship (Burundi)
PSSD	Private Seed Sector Development
SETRACO	Seed Trade Company
TASAI	African Seed Access Index
ToC	Theory of Change
TWITEZIMBERE	Microfinance Company (Burundi)
VCA	Value Chain Analysis
UCODE	Union for Microfinance Cooperation and Development (Burundi)

Structure of the report

1. **Introduction:** Objective and scope of the evaluation (Slides 4-8)

2. **Methodology** and limitations (Slides 9-24)

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1. Introduction

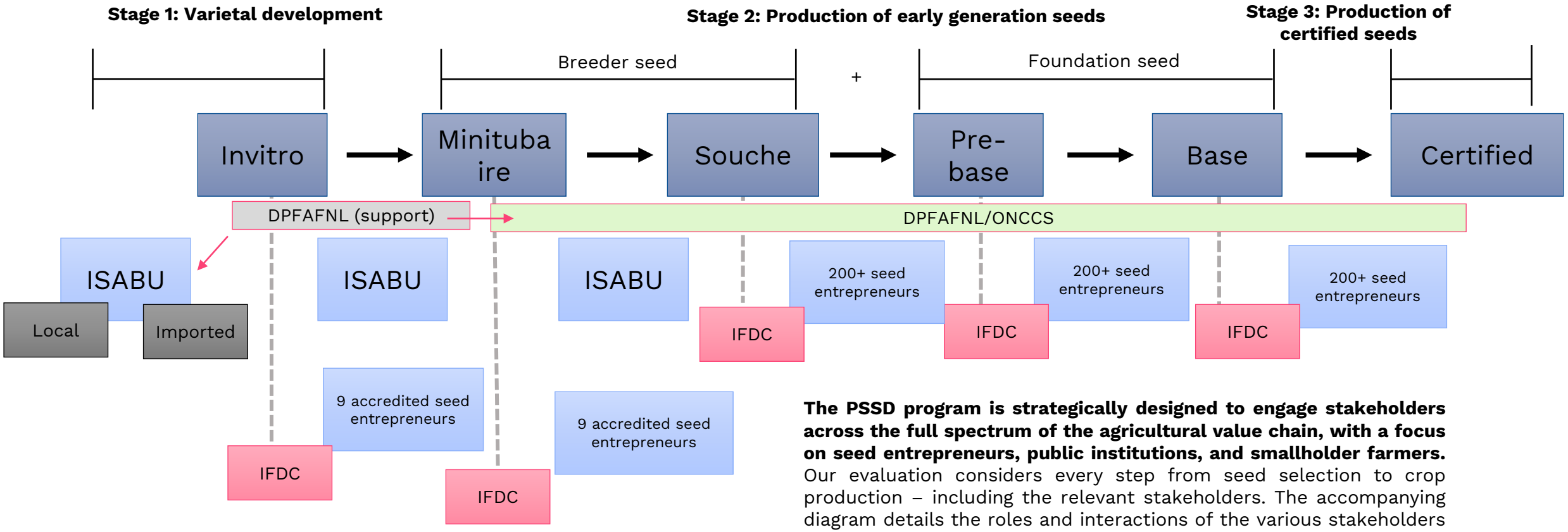
1. Introduction: Objective of the evaluation

The evaluation is aimed to measure the **Seed Production Support and Development Project (PSSD)'s impact on the income of smallholder farmers and provide descriptive data on their agricultural production**. Additionally, it sought to offer insights into the social and economic changes experienced by these farmers and their families, highlighting the commercial relationships and opportunities created by the project, as well as the households' resilience to shocks and food security.

The evaluation also intended to understand the adoption of different types of seeds, to identify factors that enable or limit the purchase of certified seeds by smallholder farmers. Furthermore, it aimed to comprehend the certified seed value chain in Burundi by identifying all involved stakeholders, their roles, functions, relations, and dynamics, and by analyzing the value chain as a whole to understand mechanisms for making the PSSD project profitable and sustainable over time. The evaluation explored the root causes of market inefficiencies or failures that prevent sustainability by gathering key information from market structures (including public structures, the institutional environment, seed producers, among others), to identify market failures or inefficiencies regarding the production, sale, and purchase of certified seeds.

In addition, the evaluation answered questions related to the **coherence, effectiveness, efficiency, impact and sustainability of the project** as a whole.

1. Introduction: Value chain from seed to crops



The PSSD program is strategically designed to engage stakeholders across the full spectrum of the agricultural value chain, with a focus on seed entrepreneurs, public institutions, and smallholder farmers. Our evaluation considers every step from seed selection to crop production – including the relevant stakeholders. The accompanying diagram details the roles and interactions of the various stakeholders within the *potato value chain*.

For the *maize and bean value chains*, while the overall structure remains broadly similar, there are notable differences. These include fewer stages of generational development and the active participation of international partners and cooperatives, such as SETRACO.

1. Overview of the PSSD programme

Enabling environment: Promote cooperation among public institutions, perform capacity building activities, provide financial support, improve certification process, and helping with pre-ordering system

Supply-side interventions

Demand-side interventions

Early generation seed entrepreneurs

- **Co-finance** of investments in agricultural capital (e.g., greenhouses, irrigation)
- **Training** of seed entrepreneurs in good agricultural practices.
- Support **accreditation** process.

Certified seed entrepreneurs

- **Training** of certified seeds entrepreneurs on **GAPs** and the setting up of demo plots
- Help to set-up **mobile and rural sales units**
- Support with **conducting advertising campaigns** through mobile agents and community radio stations
- Packaging of seeds in **small lots or micro-packages** with logos and brands
- Implementing **specialised distribution and communication channels**

Smallholder farmers

- Establishment of rural **demonstration plots** to show advantages of certified seeds
- Support to organize **field days** on demonstration plots to get trained in use of certified seeds and good agricultural practices
- Establishing **rural seed sales points** in densely populated or commercial areas
- Selling seeds in remote areas through **mobile agents**.
- Implementation of **mini seed fairs.**

- Incorporate gender dimensions into awareness-raising and coaching activities for seed companies.
- Support women-led seed companies and increasing their participation in co-financed projects.

1. Introduction: Overview Evaluation Questions

As determined during the inception phase, this evaluation addressed the following evaluation questions (EQs):

Effectiveness

1.A Did the project effectively increase the adoption of certified seeds by farmers?
1.B What were the main constraints for farmer households in adopting certified seeds?
1.C Has the increased adoption of certified seeds allowed farmers to increase their productivity?
1.D How effective was the integration of private sector partners in achieving the project objectives?
1.E Are farmers satisfied with the access created to quality seeds, and are they satisfied with the performance of these seeds?
1.F To what extent did the PSSD project take into account the gender dimension in the support and participation of seed companies in project activities?
1.G To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

Efficiency

2.A To what extent was the use of resources (budget, resources) for the implementation of the project adequate?

Impact

3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi?
3.A.1 To what extent has the PSSD streamlined collaboration between institutions and associations involved in the production and certification of certified seeds (enabling environment), and improved the speed and cost-effectiveness of the certification process?
3.A.2 Has it improved collaboration between enabling environment actors and private economic agents (entrepreneurs and seed companies)?
3.B What was the impact of the project on the income of smallholder households?

Coherence

4.A To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?
4.B To what extent did the PSSD project rely on the achievements of the implementation of the ISSD project, in order to guarantee synergies and the continuation of the project?
4.C What synergies does the PSSD seek with other projects funded by the Netherlands and other donors, and are they sufficient?

Sustainability

5.A To what extent are the government and public institutions equipped to continue investments in the seed sector in Burundi, including innovation?
5.B To what extent has the PSSD project developed an exit strategy and what conditions must be met to ensure its feasibility?
5.C How likely are farmers to continue using certified seeds after the project ends?
5.D To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

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2. Methodology

2. Methodology: Triangulation of methods and data

To address the five core evaluation questions—effectiveness (EQ1), efficiency (EQ2), impact (EQ3), coherence (EQ4), and sustainability (EQ5)—we employ a methodological triangulation approach, integrating various data sources and methods to ensure a robust analysis.

- **Desk Research:** Our comprehensive analysis encompassed a review of 45 documents. This includes internal documents from the PSSD program such as the MTR and the Impact Report. Additionally, we have examined external publications from organizations like FAO, TASAI, IFAD, KIT, and AfDB to assess the agricultural sector broadly, with a particular focus on Burundi's seed sector.
- **KII:** We have conducted more than 32 interviews with key stakeholders involved in the program. This includes discussions with implementing partners, development agencies, organizations contributing to an enabling environment, private sector companies, and local non-governmental organizations (NGOs). The list of consulted stakeholders is provided in Annex A.
- **Survey among smallholder farmers:** We conducted a comprehensive survey involving 1,769 smallholder farmers distributed across 78 hills within 25 communes, situated in 6 provinces including Ruyigi, Muyinga, Cankuzo, Makamba, Bujumbura Rural, Bururi. Further information on the survey methodology and the broader evaluation strategy will be presented later in this section, with additional specifics available in Annex B.
- **Seed entrepreneur Survey:** We surveyed a sample of 48 seed entrepreneurs participating in the PSSD program. Detailed explanations of the survey methodology and the overarching evaluation strategy will follow in subsequent sections, with comprehensive details provided in Annex C.
- **FGDs:** We conducted 4 FGDs with seed entrepreneurs and 20 FGDs with smallholder farmers. These discussions took place in the same six provinces as the smallholder farmer survey: Ruyigi, Muyinga, Cankuzo, Makamba, Bujumbura Rural, and Bururi. Further information on the FGDs and KIIs topic guides can be found in Annex D.

While desk research and Key Informant Interviews (KIIs) informed all five evaluation questions (EQs), the upcoming slide will clarify how surveys and Focus Group Discussions (FGDs) were especially instrumental in assessing specific EQs and related sub-questions within the project.

2. Methodology

This table outlines how surveys and FGDs informed the five primary evaluation questions (EQs). Rows two to five detail the specific sub-evaluation questions addressed by each data source. Detailed sub-evaluation questions can be found on slide 7 and are accessible through the interactive links on each Evaluation Question (EQ).

Evaluation Questions on	Survey		FGDs	
	Smallholder farmer	Seed entrepreneur	Smallholder farmer	Seed entrepreneur
Effectiveness (EQ1)	• Seed adoption (1A) • Constraints (1B) • Increased productivity (1C) • Satisfaction (1E) • Gender dimension (1F)	• Constraints (1B) • Private sector involvement (1D) • Access (1G)	• Seed adoption (1A) • Constraints (1B) • Increased productivity (1C) • Satisfaction (1E) • Gender dimension (1F)	• Constraints (1B) • Private sector involvement (1D)
Efficiency (EQ2)	• Resource efficiency (2A)		• Resource efficiency (2A)	
Impact (EQ3)	• Increased income (and livelihood) of smallholder farmers (3B)	• Development private seed sector (3A)	• Increased income (and livelihood) of smallholder farmers (3B)	• Development private seed sector (3A)
Coherence (EQ4)	• Coherence Burundian government (4A)	• Coherence Burundian government (4A) • Coherence ISSD (4B)	• Coherence Burundian government (4A)	• Coherence Burundian government (4A) • Coherence ISSD (4B)
Sustainability (EQ5)	• Likelihood to continue certified seeds after programme (5D)	• Likelihood to continue seed business after programme (5C)	• Likelihood to continue certified seeds after programme (5D)	• Likelihood to continue seed business after programme (5C)

2. Methodology: Data source per evaluation question

The following table indicates the data sources employed to address each sub-evaluation question. Each sub-evaluation question, indicated in the second row, is addressed by at least two data sources, expressed by the first column.

Evaluation criteria		**Effectiveness**							**Efficiency**	**Impact**		**Coherence**			**Sustainability**			
Data source		1A	1B	1C	1D	1E	1F	1G	2A	3A	3B	4A	4B	4C	5A	5B	5C	5D
Desk Research		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
KIIs					✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		
Survey	Smallholder farmers	✓	✓	✓		✓	✓		✓		✓	✓					✓	
Survey	Seed entrepreneurs		✓		✓			✓	✓	✓		✓	✓				✓	✓
FGD	Smallholder farmers	✓	✓	✓		✓	✓		✓		✓	✓					✓	
FGD	Seed entrepreneurs		✓		✓				✓	✓		✓	✓				✓	✓

2. Methodology

The remainder of this section on the Methodology of this evaluation is structured as follows:

2.1: Smallholder Farmer Survey:

- **Sampling Design**: We detail our survey design strategy to ensure rigorous evidence collection for answering the EQ's
- **Empirical Approach:** We describe how the survey will be employed to provide answers to the EQ's
- The smallholder farmer survey as source for PSSD's **results framework**
- **More extensive discussion** on the methodology and results is available in Annex B.

2.2: Seed Entrepreneur Survey: We outline the methodological framework designed to explore the specific nuances of seed entrepreneurs.

- **More extensive discussion** on the methodology is available in Annex C.

2.3: Focus Group Discussions (FGDs): We present the methodology underpinning the FGDs, detailing how they contribute to our understanding of the research context.

- More extensive discussion on the topic guides is available in Annex D.

2.4: Methodological limitations and mitigation measures

By organizing the section in this manner, we aim to provide a clear roadmap of our research methodology.

2.1 Methodology– Sampling design for smallholder farmer survey

The total sample comprises 1,755 smallholder farmers who are organized across **78 Collines** within **25 Communes**, which are in turn located within **6 Provinces:**

- 39 collines are used as **treatment collines** due to *the presence of* the PSSD programme
  - The presence includes **different interventions supported by the PSSD programme** including demonstration plots, marketing campaigns, seed fairs, mobile sales units, and rural sales outlets. We selected the Collines with the highest exposure to the PSSD programme (e.g., many different type of interventions).
- 39 collines are used as **control collines** due to *the absence of* the PSSD programme
  - To minimize **treatment spillover risks**, we chose control collines from different communes but within the same province as the treatment collines. This approach ensures similarities between treatment and control while reducing potential spillovers. The PSSD programme might still impact nearby farmer households, so control collines are from a separate Commune. While this strategy aims to reduce spillovers, they cannot be entirely eliminated, potentially enhancing the program's effectiveness by inadvertently including more beneficiaries. However, significant spillover could result in **underestimating the program's effectiveness and impact**, leading to a false negative—incorrectly concluding the program is ineffective when it actually has an effect.

Our sample consists of smallholder farmers that dedicate at least 20% of their land to growing potatoes, beans, or maize, resulting in the following distribution:

- **For maize,** we have 525 households in Makamba and Muyinga.
- **For potatoes,** there are 544 households across Bururi and Bujumbura Rural.
- **And for beans,** we have accounted for 686 households in Cankuzo and Ruyigi.

This reflects the **targeted crop focus** of the PSSD program within each respective province, with one primary crop allocated per province.

Beyond the **random sample** of 1,400 smallholder farmer households, we **purposefully sampled** 355 farmers, about 20% of the sample size, to guarantee a sufficient number of households using certified seeds for the specified crops, averaging 4 to 5 households in each colline.

- To avoid bias in our estimates, we omit the purposefully sampled smallholder farmers from some analyses – particularly if the goal of the analysis is to estimate the prevalence of certified seeds adoption. These exclusions will be noted in the figure captions.

2.1 Methodology– Sampling design for smallholder farmer survey

The table below gives an overview of the entire smallholder farmers' survey sample, segmented by crop type (potato, maize, and beans), with further disaggregation based on sampling method (random or purposeful), and classification of households into treatment or control groups by colline.

		Potato	Maize	Beans	Total
Random sample	*Treatment*	158	148	301	*1,400*
	Control	238	292	263	
Purposeful sample	*Treatment*	94	68	95	*355*
	Control	35	36	27	
Total		**544**	**525**	**686**	**1,755**

2.1 Methodology– Sampling design for smallholder farmer survey

Summary statistics of selection of key variables

	Mean	Min	Max
Household has **adopted certified seeds** for cultivating potatoes, maize, or beans between 2017 and 2022 (=1) or still uses traditional seeds (=0)	42.6%	0	1
Household was **purposefully sampled** (=1) or not (=0)	20.2%	0	1
Household lives in **treatment (=1) or control (=0) colline**	49.2%	0	1
Age of household head	45.8	18	95
Gender of household head (1= male, 0 = female)	87.0%	0	1
Household head is member of **village leadership** (=1) or not (=0)	20.2%	0	1
Number of different **crops and livestock**	1.71	1	16
International Wealth Index of household (0-100)	34.9	14.1	65.7

After inspecting and cleaning the data, we excluded 24 smallholder farmers on the basis of:

- 12 farmer households that **do not cultivate the target crops of their selected province** (e.g., farmer household in Makamba that does not cultivate maize)
- 2 farmer households with **invalid demographics** (e.g., household head is 5 years old)
- Additionally, for certain analyses, we omit observations with inconsistent outcomes (e.g., agricultural income is higher than total income). Any such exclusions are indicated in the accompanying figure notes.
- Overall, the quality of the data is reliable – considering the low number of households that need to be excluded.

2.1 Methodology– Empirical approach for smallholder farmer survey

We have three different empirical strategies to be applied on the farmer survey depending on the type of evaluation question:

1. Evaluation questions on certified seed adoption (EQ 1A) and focus on gender dimension (EQ 1F)

Objective: To evaluate the effectiveness of the PSSD program, the focus is on enhancing the adoption rates of certified seeds and good agricultural practices (i.e., irrigation, crop rotation) among smallholder farmers.

Method/Empirical Model: Linear probability model assessing adoption between 2017-2022.

Key Variables:

- **Key Dependent Variable**: Adoption of certified seeds (1 = adopted between 2017-22, 0 = not). For maize, we also consider hybrid varieties as certified seeds.
  - Extension 1: Adoption of good agricultural practices (1 = adopted between 2017-22, 0 = not) including crop rotation, weeding, irrigation, use of fertilizer, use of insecticides, intercropping.

Key independent Variables:

- **Key independent variable:** Household lives in a treatment colline under the PSSD programme (1 = yes, 0 = no).
  - Extension 1: The primary independent variable in this study is the presence or absence of PSSD (Productive and Sustainable Systems Development) interventions. This extension aims to identify which specific intervention was most effective. As an alternative independent variable, we assess the occurrence of various PSSD interventions within a colline (1= yes, 0 = no), such as demonstration plots, seed fairs, marketing campaigns, rural sales outlets, or mobile sales units.
  - Extension 2: The key independent variable is measured at colline level. However, we also have individual-level data on household participation in field training or visitation demonstration plot between 2017-22 (1 = yes, 0 = no).
  - Interaction term: We include an interaction between the key independent variable and gender to see whether there are significant differences in the effectiveness of the PSSD programme between (fe)male-headed households.
- Controls: Household demographics, crops and livestock, seasons active, income sources, land size; Provincial fixed effects; Cluster robust standard errors at colline level.

2.1 Methodology–Empirical approach for smallholder farmer survey

2. Evaluation questions on constraints for certified seed adoption and satisfaction (EQ 1B and 1E)

Objective: Identify supply- and demand-side constraints affecting adoption of certified seeds.

Method: Perception data analysis of certified seed users and non-users.

Key variables/Constraints Analyzed:

- Examples of **supply-side** constraints considered:
  - Distrust in suppliers
  - Distance to suppliers of certified seeds
  - Price comparison to other suppliers
  - Price comparison of certified versus traditional seeds per hectare of land cultivated

  Examples of **demand-side** constraints considered
  - (Dis)trust in certified seeds and retailers
  - Conviction about benefits (e.g., productivity gains) of using certified seeds versus traditional seeds
  - Financial constraints to make investment
- Furthermore, we examine whether smallholder farmers living in **treatment collines** are less likely to experience these constraints – suggesting the possible effectiveness of the PSSD programme.

2.1 Methodology smallholder farmer survey

3. Evaluation questions related to the enhancement of productivity (EQ 1C) and their corresponding impacts (EQ 3B), which include the augmentation of income and strengthening of resilience.

Objective: This empirical approach evaluates the indirect effectiveness and impact of the PSSD (Productive and Sustainable Seed Development) program, particularly through its initiative to promote the adoption of certified seeds. We proceed under the assumption that the PSSD program fosters seed adoption and subsequently investigate the ramifications of this adoption on a core set of effectiveness and impact measures, including variables such as productivity and income.

Model: OLS- and IV-regression (see appendix B for explanation)

Dependent Variables (depending on the EQs):

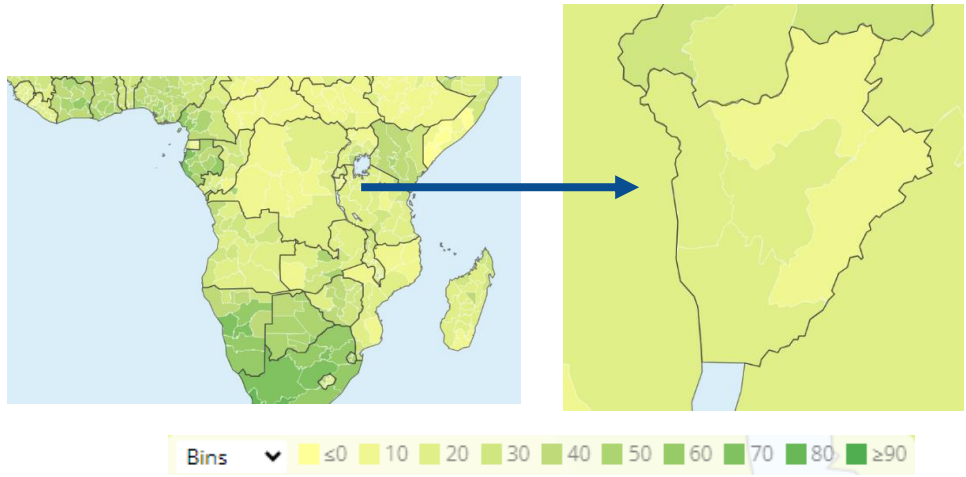
- *Set 1:* Self-assessed improvements in household's agricultural productivity, revenues, and savings
- *Set 2:* Household Income (In Burundian Francs) and wealth (using the International Wealth Index)
- *Set 3:* Resilience indicators including hunger score and exposure to agricultural/climate shocks

Independent Variables:

- ***Key independent variable:*** *Certified seed adoption between 2017-22* (1 = adopted, 0 = not);
  - *Extension 1: Instrumental variable* for certified seed adoption between 2017-22 (1 = adopted, 0 = not) mitigating endogeneity such as the inclination of higher-yielding farmers to choose certified seeds (See Annex B for extensive explanation).
  - Extension 2: Household living in treatment colline (=1) or control colline (=0) to examine possible direct effect of PSSD programme.

Controls: Same as for other analysis, with standard errors clustered at colline level

BOX: The International Wealth Index (IWI) scores households from 0 (no assets) to 100 (all assets), indicating households' socio-economic status more accurately than income. It considers more than 20 indicators on asset ownership and housing quality (which can be objectively verified by enumerators during surveys). In 2017, Burundi's average was 21.7, one of the lowest national scores.



Notes: Data comes from the Global Data Lab. Literature on usage and advantages of IWI can be found here.

2.1 Methodology – Using smallholder farmer survey for PSSD Results framework

Another key objective of this evaluation is to complete the PSSD program's results framework, which includes four outcome and impact indicators – specifically, identifying the number of households directly benefiting from the PSSD program. Using the smallholder farmer survey, which is a representative sample of the targeted farmer population, we use the estimated "treatment effects", such as the percentage of farmers adopting certified seeds due to the PSSD program, to complete the framework. The estimated treatment effect (% of farmers who directly benefits due to the PSSD programme) is then multiplied by the total number of targeted households, a figure elaborated on in the following slide

Indicator 1: Cumulative number of households *that adopted certified seeds* due to PSSD between 2017-2022

- To assess the PSSD program's impact on the adoption of certified seeds from 2017 to 2022, we multiply each province's total number of targeted households (detailed on the next slide) by the "treatment effect of the PSSD proogramme", calculated from the difference in adoption rates between treatment and control collines between 2017 and 2022. For example, if there's a 60-percentage point increase in farmers using certified seeds in treatment collines between 2017-2022 and a 20-percentage point increase in control collines over the same period, the net effect size is 40 percentage points, indicating that farmers in treatment collines are 40%-points more likely to have adopted certified seeds.

Indicator 2: Cumulative number of households that *increased productivity* due to PSSD between 2017-2022

- We calculate the impact of the PSSD programme by multiplying the total number of households using certified seeds (Indicator 1) by the percentage of farmers reporting significant productivity gains from adopting these seeds (see methodology).

Indicator 3: Cumulative number of households that *increased income* due to PSSD

- We calculate the impact of the PSSD programme by multiplying the total number of households using certified seeds (Indicator 1) by the percentage of farmers reporting significant income gains from adopting these seeds (see methodology).

Indicator 4: Cumulative number of households that *doubled productivity* due to PSSD

- We assess the PSSD programme's impact by multiplying the number of households adopting certified seeds (Indicator 1) with the percentage of demonstration plots for potatoes, maize, and beans that have experienced a doubling in yield.

2.1 Methodology – Results Framework PSSD

We follow a six-step process to calculate the PSSD program's targeted households in each province, using Kayanza's potato farmers as an example. This allows us to estimate the number of households that benefited from the program, such as those adopting certified seeds, as demonstrated in the next slide.

Step 1: Determine the population for each targeted province, using data from the 2019 Burundi census.
- For potatoes: Kayanza, Muramvya, Bujumbura Rural, Bururi, Mwaro
- For maize: Makamba, Karusi, Kirundo, Gitega, Muyinga, Rutana
- For beans: Ruyigi, Cankuzo, Myinga, Kirundo

Step 2: Extrapolate the population size for 2022 using the geometric mean for population growth in Burundi, reported as 2.66% (World Bank, 2023).

Step 3: Estimate the number of households per province based on the average number of household members, as per the Global Data Lab (2023).

Step 4: Calculate the percentage of potato (or maize/beans, if the PSSD targets those crops in a province) farmers in each province, based on data from the Enquête Nationale Agricole du Burundi de 2011-2012.

Step 5: Assess the coverage of the PSSD program in a given province, using the percentage of collines where the PSSD program is active.

Step 6: Estimate the total number of targeted households by multiplying the total number of households in a province (from Step 3, referred to as column 4) with the percentage of potato farmers (from Step 4, referred to as column 5), and then with the percentage of targeted collines

Provinces targeted by the PSSD for potato cultivation	Population in 2019	Estimated population in 2022	Estimed number of total households	% of households that cultivate	Coverage of PSSD in province	**Total number of targeted households**
Kayanza	801544	890292	158697	8.27%	47.83%	6277

2.2 Methodology: Seed entrepreneur survey

We purposefully selected 48 seeds entrepreneurs at different stages of the seed chain who actively participated in the PSSD program. The table on the right shows key characteristics of the sample.

In line with the overview table presented on slide 12, the evaluation questions addressed by the seed entrepreneur survey are the following:

- EQ1D: How effective was the integration of private sector partners in achieving the project objectives?
- EQ1B: What were the main constraints for smallholder farmer households in adopting certified seeds?
- EQ1G: To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?
- EQ3A: To what extent has the project contributed to the development of the private seed sector in Burundi?
- EQ4A: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?
- EQ5C: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

Like the smallholder farmer survey, this evaluation lacks baseline and midline data for seed entrepreneurs. Consequently, we depend largely on retrospective data and their perceptions of changes, such as income, since the PSSD programme began. The seed entrepreneur survey aims to be primarily qualitative, unlike the more quantitative smallholder farmer survey. The adjacent table provides descriptive statistics for the sampled seed entrepreneurs. It highlights that a majority, 81%, are male. These individuals were selected from the same provinces as those included in the farmer survey. Furthermore, they specialize in the production of seeds for various crops, predominantly maize.

More detailed information on the methodology and the complete results can be found in Annex C.

Variable	Mean [min-max]	Count
Respondents		48
Age	48.72 [25-70]	
Sex (1=male, 0=female)	81%	Females: 9 (19%) Males: 39 (81%)
Province		Bujumbura rural: 5 (10.42%) Bururi: 11 (22.92%) Cankuzo: 9 (18.75%) Makamba: 8 (16.67%) Ruyigi: 15 (31.25%)
Revenues 2022 (million BIF)	≅60	<10: 9 (18.75%) 10-30: 3 (6.25%) 30-60: 14 (29.17%) 60-100: 15 (31.25%) >100: 7 (14.58%)
Customers 2022	1098.1 [72-12,500]	
Customers 2018	316.9 [0,2,500]	
Crops		Maize: 42 (87.5%) Bean: 30 (62.5%) Potato: 17 (35.41%)
Type of seeds		Certified: 48 (100%) Hybrid: 10 (20.83%) Recycled: 3 (6.25%) Other: 1 (2.08%)
Yield 2022 (Kg)	35,339 [8-192,000]	

2.3 Methodology: FGDs

To obtain additional, more qualitative insights on the effect and impact of the PSSD among farmers and entrepeneurs, two types of FGDs were conducted:

1. 24 FGDs with smallholder farmers
2. 4 FGD with seed entrepreneurs

Participants were asked similar questions to the survey. Their answers contributed to a deeper understanding of the context and of the underlying reasons for some behaviours, phenomena, issues or opinions. Similarly, to the smallholder farmer survey, we make a distinction between smallholder farmers living in treatment and control collines. Below, we outline the FGDs conducted in each province, specifying whether they took place in a control or treatment colline, and detailing the types of crops examined. Further details including the complete FGD guides (e.g., FGD questionnaires) can be found in Annex D.

Farmers

		Treatment	Control	Total
N. of FGDs		18	6	24
Province	Makamba	2	2	4
	Bururi	4	0	4
	Ruyigi	3	1	4
	Cankuzo	2	2	4
	Muyinga	4	0	4
	Bujumbura rural	3	1	4
Crop	Maize	2	2	4
	Beans	5	3	8
	Potatoes	11	1	12

2.4 Methodology: Limitations and mitigating measures

Data collection method	Limitations	Mitigating measures
KII	**KIIs with CNS and MINEAGRIE were not conducted**	At the time of the field visit conducted in October in Bujumbura, the statistical visa was not yet validated by INSBU, and the evaluators were advised not to perform interviews with the CNS and MINEAGRIE because of this reason.
FGDs	**FGD data should be considered as indicative**	The information gathered through FGDs may not necessarily reflect a diverse range of views of farmers that were interviewed. Given the nature of focus groups, the data collected represents the perspectives of a specific set of participants at a given time, which may not encompass the full spectrum of opinions or experiences related to the adoption of certified seeds, which emerged more clearly from the survey responses that have been used as triangulated evidence.
Smallholder farmer survey & Empirical strategy	**Control group spillovers**	We recognize the risk of control group spillovers in our study of the PSSD program's impact on collines' farmers. To ensure a reliable comparison and reduce the risk of underestimating the treatment effect, we've selected control groups from geographically distant communes to minimize indirect program benefits among non-participant farmers..
	Missing baseline data	The evaluators lacked baseline data to assess the program's effectiveness and impact, limiting the determination of causal effects. Baseline data were instead estimated using participants' recollections of their pre-program conditions.
	An insufficiently small group of farmers using certified seeds	During the midterm review, the main concern was the inadequate number of farmers using certified seeds for a comparative analysis of productivity/income between users and non-users. In addition to random sampling, a targeted sample of smallholder farmers using certified seeds was also employed.
	Reversed causality/endogeneity	The relationship between certified seed adoption and income is bidirectional: higher income may lead to greater seed adoption, which in turn can increase income. To disentangle these effects, we must use advanced econometric methods, such as instrumental variable analysis.

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3. Findings

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3.1 Findings
Effectiveness

Evaluation questions - Effectiveness

1.A Did the project effectively increase the adoption of certified seeds by farmers?

1.B What were the main constraints for farmer households in adopting certified seeds?

1.C Has the increased adoption of certified seeds allowed farmers to increase their productivity?

1.D How effective was the integration of private sector partners in achieving the project objectives?

1.E Are farmers satisfied with the access created to quality seeds, and are they satisfied with the performance of these seeds?

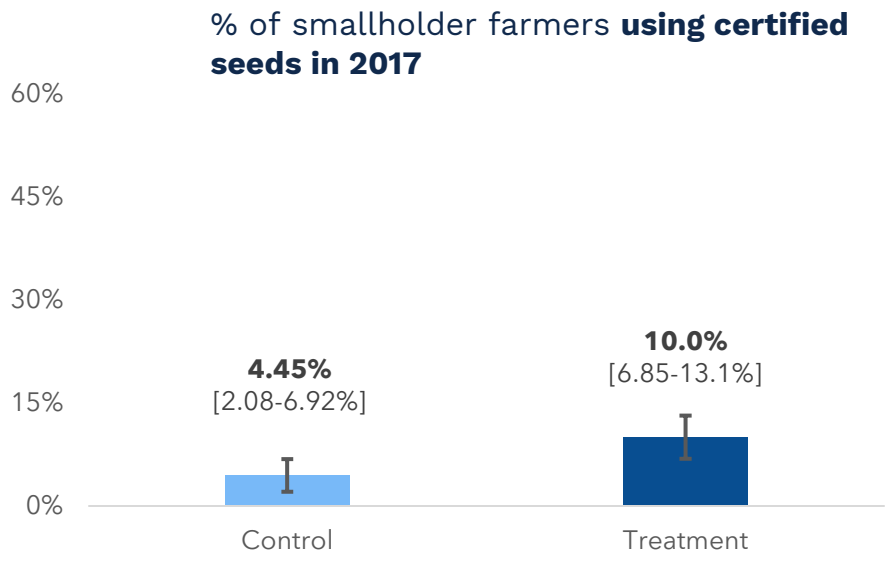
1.F To what extent did the PSSD project take into account the gender dimension in the support and participation of seed companies in project activities?

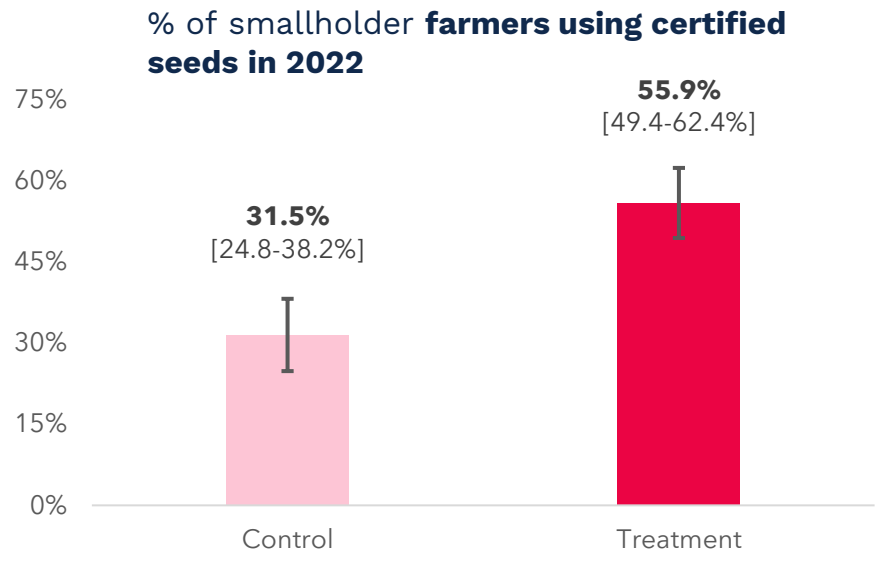
1.G To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

1.A Did the project effectively increase the adoption of certified seeds by farmers?

The PSSD programme was effective in encouraging the adoption of certified seeds among smallholder farmer households.

- Results from the smallholder farmer survey show that from 2017 (pre-intervention) to 2022 (post-intervention), the adoption of certified seeds increased by 45.9 percentage points among farmers in treated collines (from 10% to 55.9%)
- An increase in the adoption of certified seeds (+27 percentage points) was also recorded in control collines – which were not exposed to the PSSD program. This is likely due to spillover effects from neighbouring treated collines and/or to other parallel interventions, such as the support of PADANE.
- The PSSD program's impact on certified seed adoption is quantified by the difference in the percentage increase between treatment and control groups. Adoption rates in treatment collines rose by 45.9%, compared to a 27% increase in control collines. This indicates an 18-percentage point differential attributable to the PSSD program.
- KIIs with stakeholders in the 'enabling environment' and FGDs with farmers and seed entrepreneurs corroborate that the PSSD programme has led to a marked increase in the adoption of certified seeds among smallholder farmers.





Notes: Estimates presented herein are based on marginal probabilities (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the Colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysis.

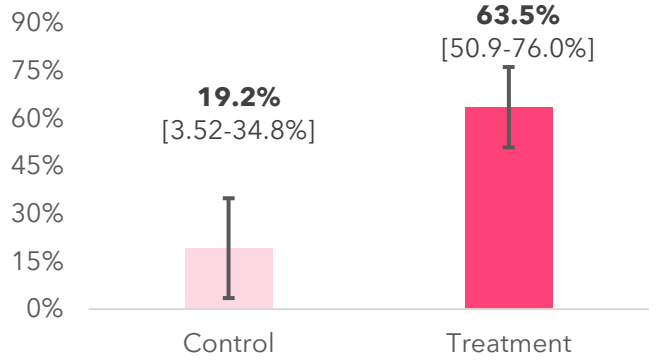
1.A Did the project effectively increase the adoption of certified seeds by farmers?

The PSSD programme significantly boosted certified seed adoption among potato growers, achieved moderate success with maize growers, but did not influence bean farmers' adoption rates. The reported effect sizes (e.g., 44.% for potatoes) will be used as input for the results framework.

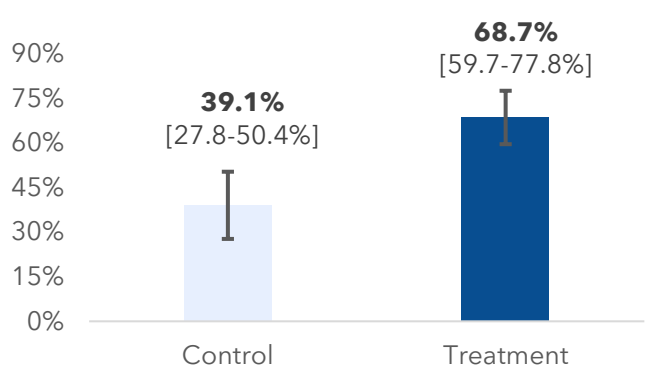
- The farmer survey shows that from 2017 to 2022, the proportion of **potato farmers** adopting certified seeds in collines that were targeted by the PSSD programme (treated areas) rose by 63.5 percentage points. In contrast, there was only a 19.2 percentage point increase in adoption among potato farmers in the control collines
- The PSSD program was slightly less effective for **maize farmers**: the share of smallholder maize farmers who adopted certified seeds between 2017 and 2022 increased by 68.7 percentage points. In this case, we observed a large increase for the control group as well (+39.1%) indicating either large spillover effects or the fact that this improvement is not entirely attributable to PSSD
- The PSSD program did not have a significant effect on **bean farmers.** Bean farmers are less convinced from the productivity gains of using certified seeds, perceive the price as too high, and most importantly, have significant distrust seed dealers – particularly that certified seeds are mixed with traditional seeds.
- According to our estimates, age and gender of household head did not have a significant impact on the previous outcomes.
- The difference in effectiveness among the three targeted crops was corroborated with FGDs among farmers.

These results contrast with the Mid-Term review, which reported significant increases in adoption of certified seeds for maize and beans, but not for potatoes.

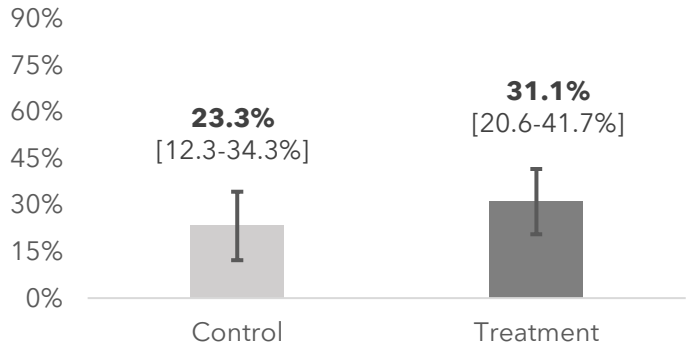
Potato farmers (N=283)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**



Maize farmers (N=365)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**



Bean farmers (N=473)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**

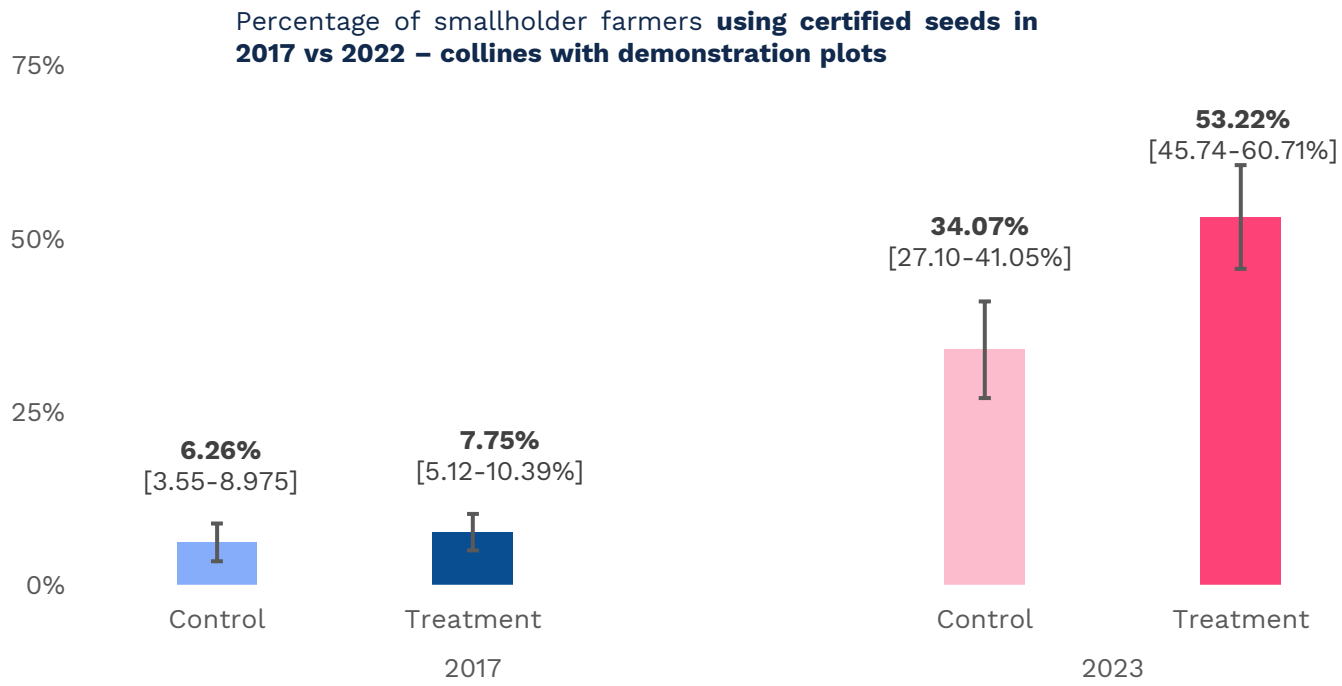


Notes: Estimates presented herein are based on marginal effects (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysis.

1.A Did the project effectively increase the adoption of certified seeds by farmers?

Results indicate that the presence of demonstration plots are the most effective PSSD intervention to promote the adoption of certified seeds among smallholder farmers. Evidence for the effectiveness of other PSSD interventions, such as mobile sales units, rural sales outlets, marketing campaigns, and seed fairs, is scant or absent.

- Results from the farmers' survey show that the presence of a **demonstration plot (Figure 1),** as also proven by the FGDs contributed the most to the adoption of certified seeds. Compared to control collines, 19.15%-points more farmers used certified seeds in treated collines when demonstration plots were present (53.22% vs. 34.07%) – corrected for the presence of other PSSD interventions. In the seed entrepreneur survey, the largest segment of seed entrepreneurs, comprising 27%, identified demonstration plots as the foremost intervention for enhancing the adoption of certified seeds (see slide 46).

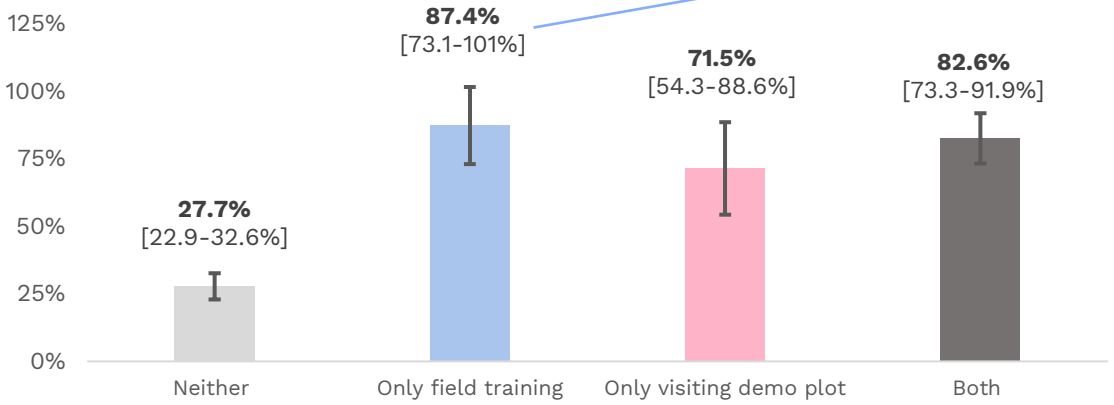


1.A Did the project effectively increase the adoption of certified seeds by farmers?

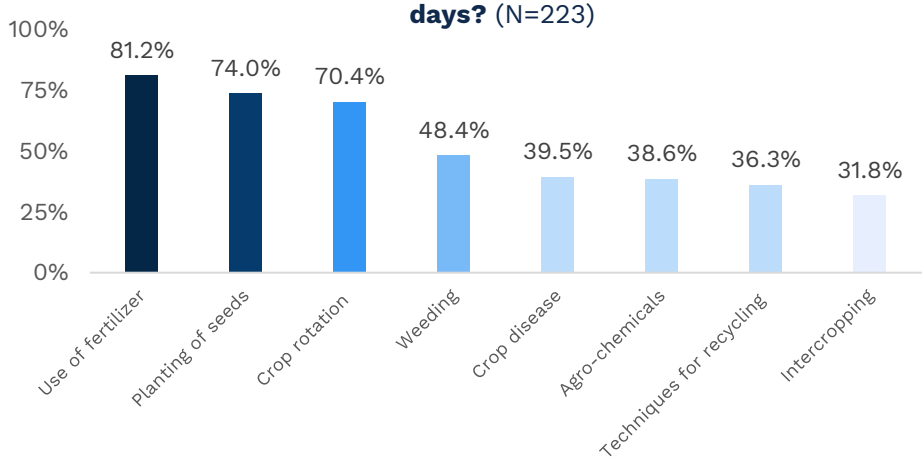
Demonstration plots and field training (on these plots) have both been effective in increasing the adoption of certified seeds among smallholder farmers. KIIs and FGDs validate this, highlighting that these methods build trust and foster relationships with seed sellers, showcasing the benefits of certified seeds firsthand. Results from the farmer survey show that smallholders involved in field days on these plots showed an 87.4% (71.5% for visiting only) increased likelihood of using certified seeds in 2022 compared to 2017.

After visiting the demonstration plots, almost 40% of the farmers were much more convinced of the advantages of certified seeds. Smallholder farmers report that the correct use of fertilizer, planting, and crop rotation are the most value skills during the field days. However, the FGDs revealed a demand for additional training and plots for better comprehension of seed benefits. A concern was raised about the absence of such training and plots in certain localities, with some FGDs reporting no participation due to this gap. Despite this, training provided by PADANE was acknowledged.

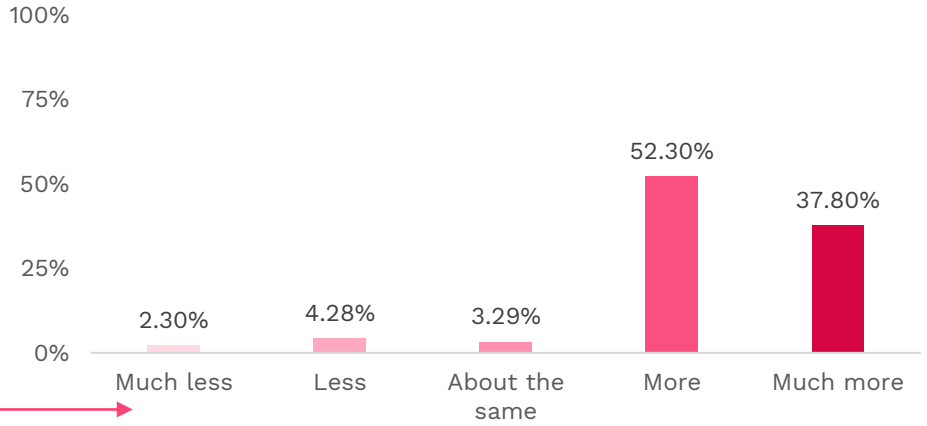
%-point increase of smallholder farmers who adopted certified seeds between 2017-2022 after **participating in field days, visiting demo plot**, or both



What were the most valuable skills or good agricultural practices you learned from **the demonstration plots/field days?** (N=223)



After visiting the **demonstration plot**, to what extent were you convinced of the advantages of certified seeds? (N=304)

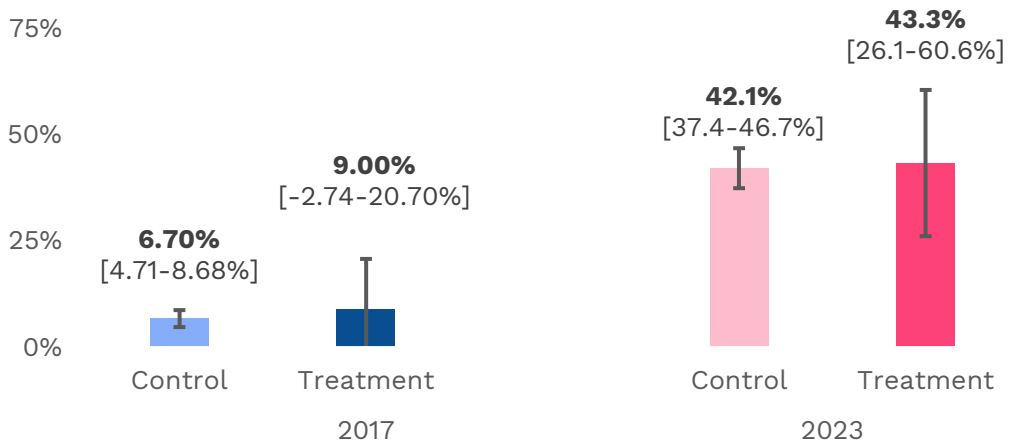


[1] Demonstration plots are (semi)permanent installations which show the quality and productivity of certified seeds and can be freely visited by farmers. Field days are trainings on certified seeds which occur at demonstration plots. In this case, seeds entrepreneurs actively train farmers.

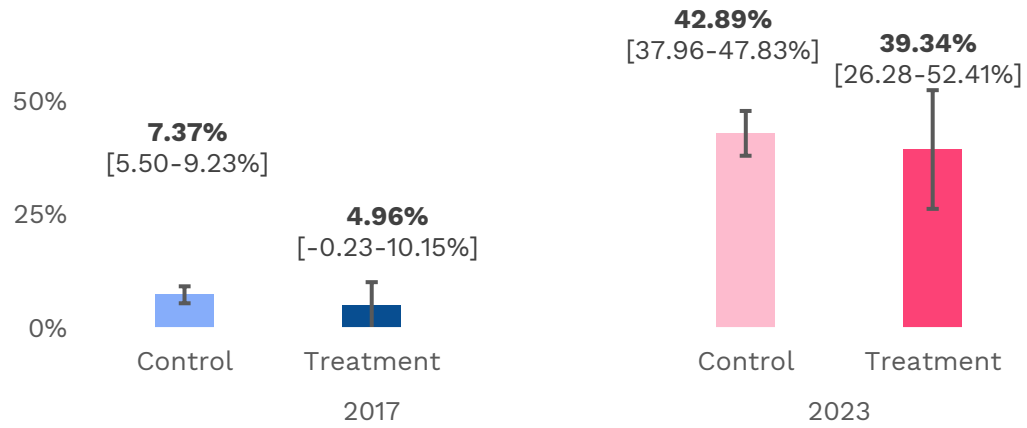
1.A Did the project effectively increase the adoption of certified seeds by farmers?

The evidence regarding the effectiveness of mobile sales units and rural sales outlets suggests that they did not contribute to the adoption of certified seeds. Results from the farmer survey (figure 2 and 3) demonstrate no substantial influence on the adoption of seeds. FGDs also failed to highlight the significance of both interventions, as their impact was less noticeable compared to demonstration plots. However, data reveals that rural sales outlets were strategically positioned in collines, where the rates of certified seed adoption were previously lower (7.37% as opposed to 4.96%). However, the survey among entrepreneurs does show that many entrepreneurs regard rural sales outlets (18%) and mobile sales units (11%) as the most impactful intervention.

Percentage of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines with mobile sale units**



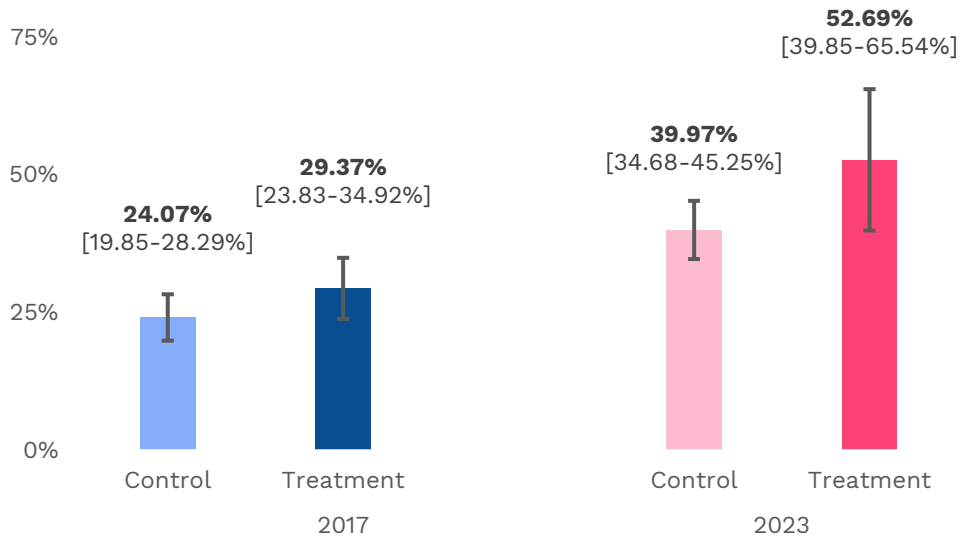
Percentage of smallholder farmers **using certified seeds in 2017 vs 2022 – collines with rural sale points**



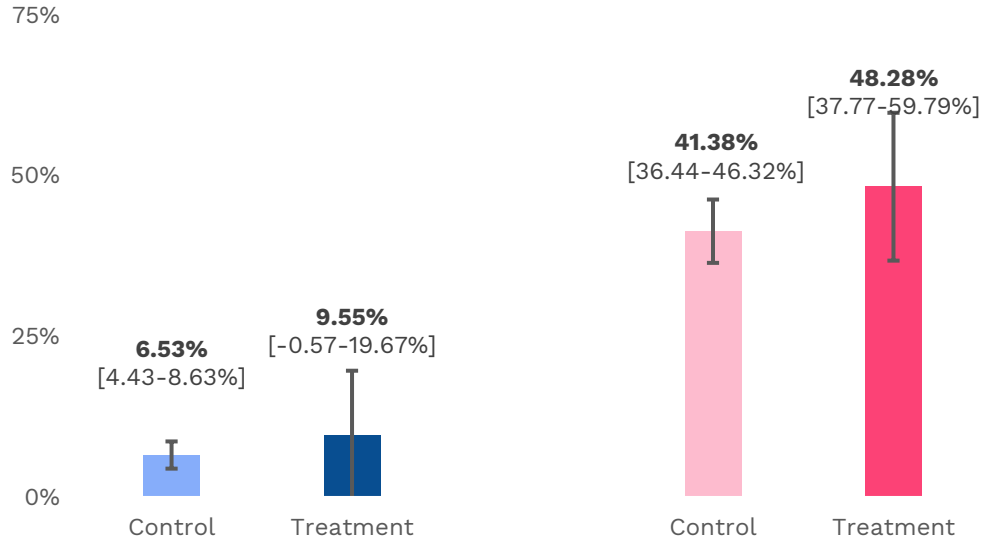
1.A Did the project effectively increase the adoption of certified seeds by farmers?

Similarly, our analysis suggests that the impact of marketing campaigns and seed fairs as part of the PSSD programme in encouraging the adoption of certified seeds is marginal and statistically insignificant. This conclusion is supported by data from the farmer survey (see below), seed entrepreneur survey, and FGDs. When we account for other interventions within the PSSD programme, such as demonstration plots, the relative ineffectiveness of these marketing campaigns and seed fairs becomes evident.

% of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines exposed to PSSD marketing campaigns**



% of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines with seed fairs**

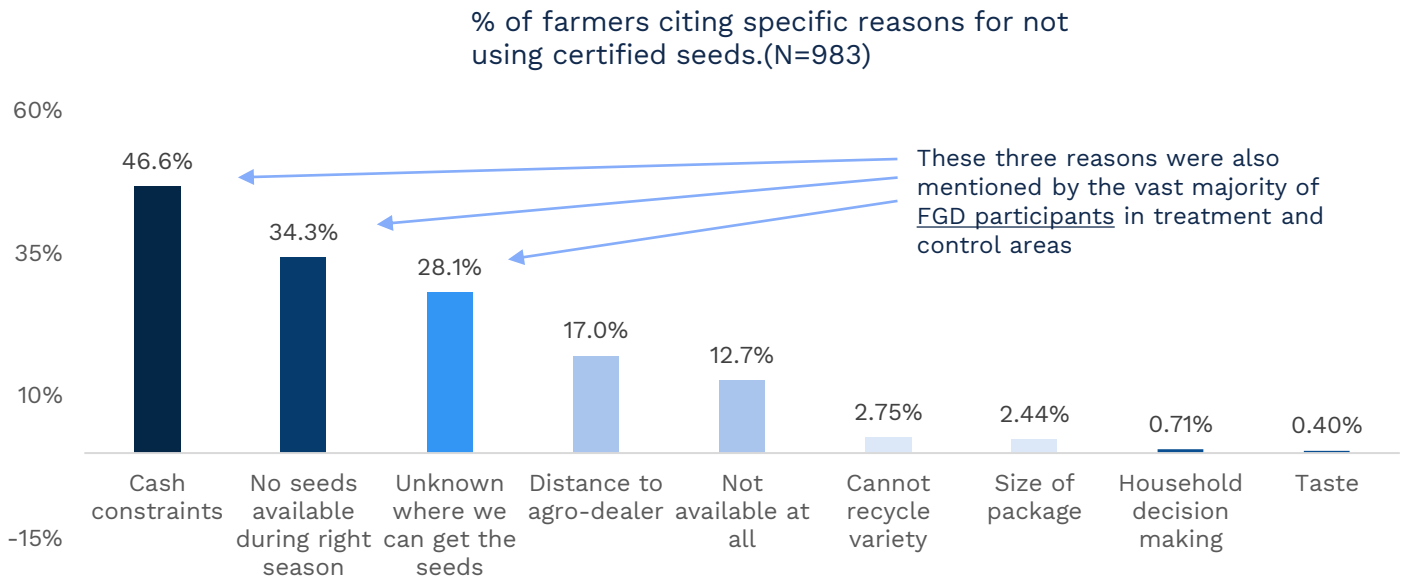


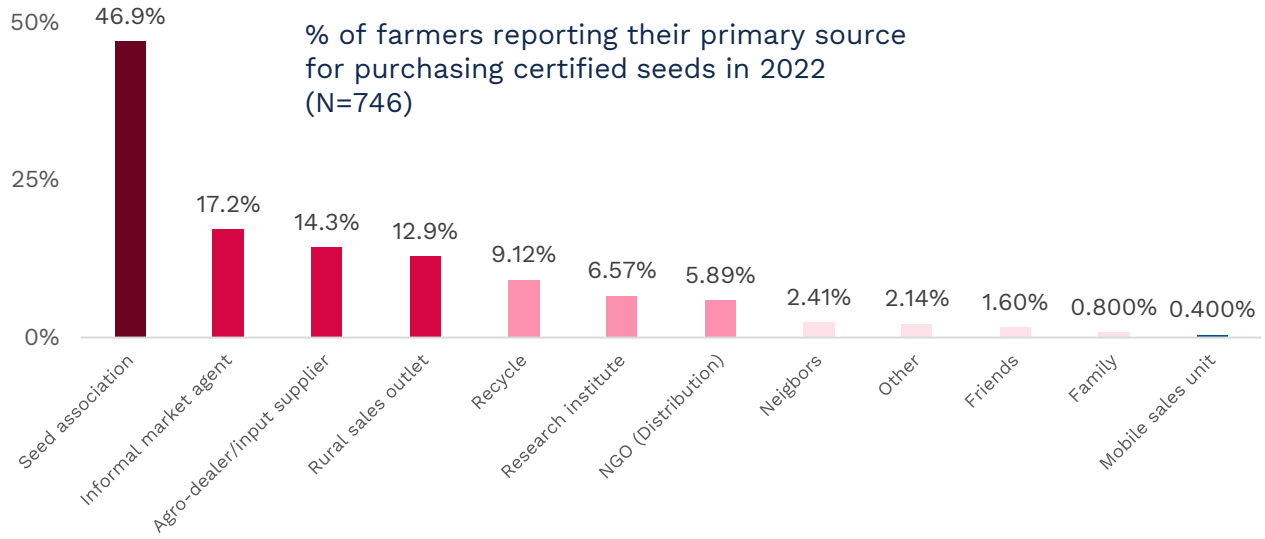
Notes: Estimates presented herein are based on marginal effects (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysis. Important controls include the presence of other PSSD interventions (e.g. the effect of marketing campaigns correct for presence of demonstration plots).

1.B What were the main constraints for farmer households in adopting certified seeds?

The primary barrier for smallholder farmers not purchasing certified seeds is financial constraints; they recognize the benefits but cannot afford the investment.

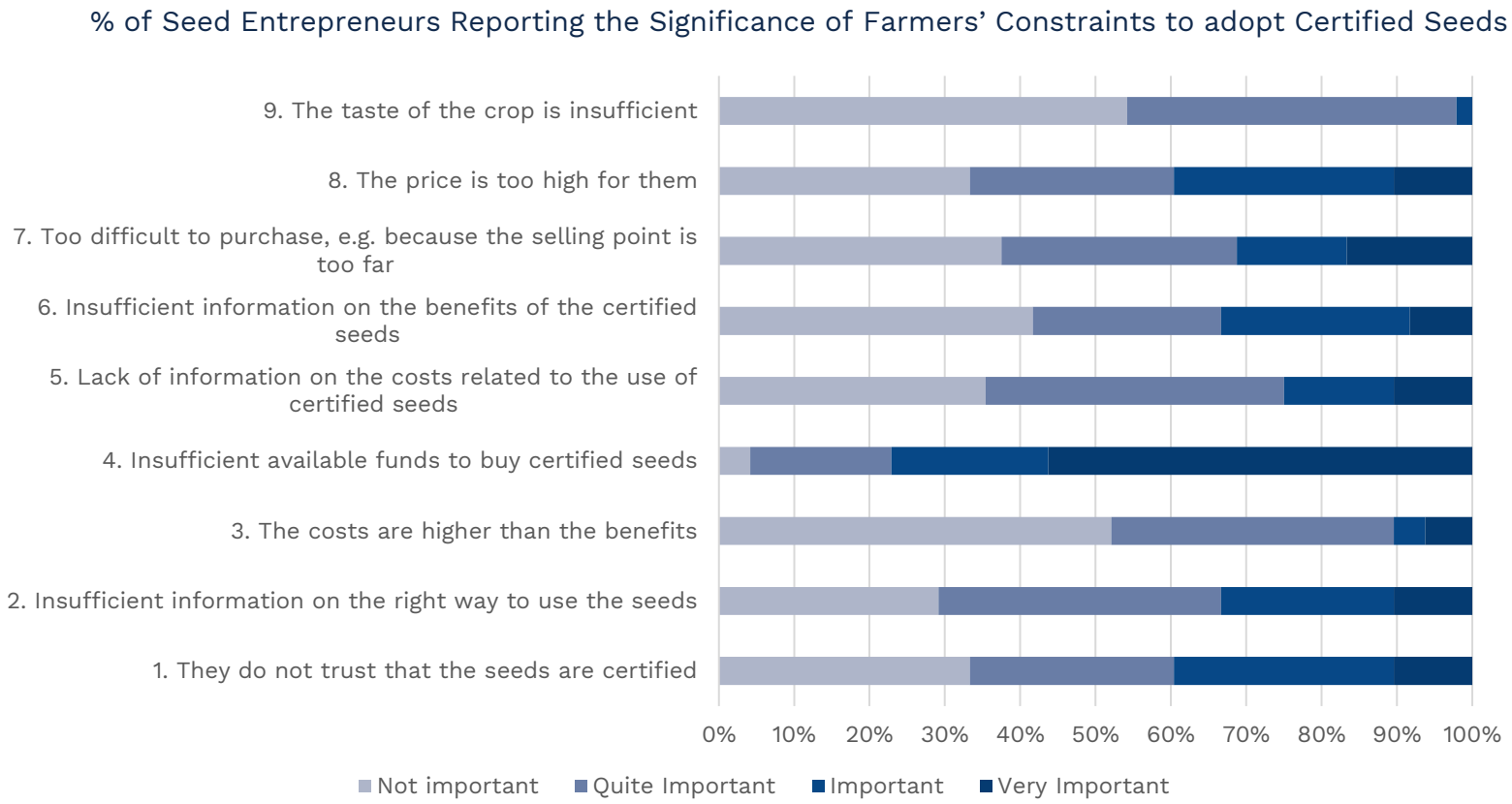
- 46% of smallholder report cash constraint as an important constraint for using certified seeds in the farmers' survey. Our results indicate that *the expenditure of certified seed users is more than double* per hectare compared to traditional seed users, with amounts of BAF 1962 for certified seeds versus BAF 877 for traditional seeds. These findings were corroborated during FGDs.
- Another important reasons is the *lack of supply* during the relevant planting season (34.3%) or throughout the year (12.7%).
- Also significant is the lack of awareness of the *locations of seed suppliers* who sell certified seeds, accounting for 28.1%, as well as *the distance to seed suppliers,* which is a concern for 17.0%.
- Proximity to certified seed suppliers, compared to traditional seed sources, was not identified as a primary factor influencing farmers' decisions against purchasing certified seeds in both the farmer survey and FGDs. For those smallholders who do buy certified seeds nearly half (46.9%) obtain them from seed associations, while others rely on informal market agents (17.2%), agro-dealers (14.3%), and rural sales outlets (12.9%). A smaller fraction (6.57%) acquire seeds from NGOs, and less than 1% from mobile sales units, which some may confuse with rural outlets.
- However, findings from the farmer survey do indicate that the PSSD program significantly decreased the average travel time for smallholder farmers to reach seed suppliers selling certified seeds by more than 15 minutes, when compared to the control collines.





1.B What were the main constraints for farmer households in adopting certified seeds?

Seed entrepreneur survey findings confirm the main obstacles to certified seed adoption identified earlier. Key issues include farmers' liquidity problems due to insufficient funds and high seed prices. Additionally, while trust issues are cited as a significant barrier to purchasing certified seeds, this concern is not expressed by the farmers who choose not to use them.



1.B What were the main constraints for farmer households in adopting certified seeds?

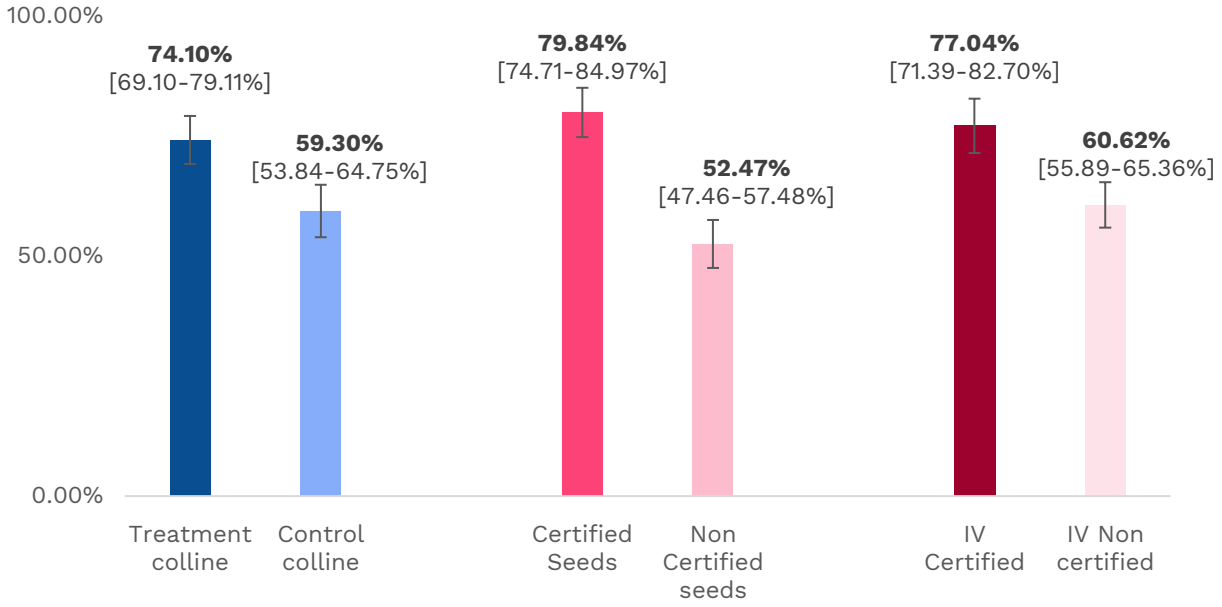
Favorable factors – mostly on the demand side	Unfavorable factors – mostly on the supply side
Smallholder farmers know about quality seeds' potential to **increase their yields** – especially for maize and potatoes as well as other beneficial characteristics of the seeds (e.g., less likelihood of disease, nutritious value, taste).	The presence of **non-certified seed entrepreneurs selling poor-quality seeds as certified** continues to generate distrust in the certification system and to thus dampen demand from potential seed buyers – particularly among bean farmers. *NB: this factor was mentioned by external actors and was not confirmed by farmers, PSSD implementers, or the enabling environment.*
According to implementers of other agricultural development projects in Burundi, one external stakeholder that was consulted explained that **smallholders acquired knowledge about certified seeds thanks to the array of projects being implemented over the years**, such as PSSD, IFAD's PIPARV-B project, PADANE, or FAO's mini-fairs.	**Limited purchasing power** of smallholders is the main deterrent for the certified seed adoption, as smallholders end up buying low quality seeds or recycling seeds they already possess.
Smallholders were able to **witness the comparative advantage** of certified seeds over conventional ones in increasing yields and overall production.	**Higher costs** associated to producing (and importing) certified seeds is one of the main deterrent for seed entrepreneurs, who cannot invest the money needed to ensure the production and certification of seeds.
Demonstration plots and field days (*journées champêtre*) were mentioned too through different set of evidence (desk review, KIIs, surveys and FGDs)	The **limited supply of certified (or non-certified) seeds** directly constrains their adoption, as seeds are reportedly not available in sufficient quantities during harvest seasons.
Reported high demand (especially if compared to pre-PSSD) of high quality (certified) seeds by seed entrepreneurs and smallholder farmers, resulting into higher exposure of certified seeds.	**Significant shortage of pre-base seeds** (which are at the beginning of the certified seed chain production) from ISABU, even with the (limited) involvement of the private sector to co-produce them.
Knowledge on **Good Agricultural Practices** including planting, harvesting, crop rotation, safe pesticide use, and **climate adaptation** practices.	The **lack of market liberalization** results in higher prices of certified seeds.
	Imported varieties remain excessively high-priced, making high-quality seeds generally overly expensive for it to be a cost-effective investment for farmers.

1.C Has the increased adoption of certified seeds allowed farmers to increase their productivity?

Although certified seeds' higher productivity was already proven by experts, this was also confirmed by results from the farmer survey and FGDs among farmers.

- **Smallholder farmers who adopted certified seeds between 2017-22 are significantly more likely (79.8% v. 52.5%, a 14.8 percentage points difference) to self-assess that their agricultural productivity increased** over the last five years in comparison to farmers who still have not adopted certified seeds (regardless of whether they live in a treatment or control colline).
- If we look at the difference between smallholder farmers living in a treatment vs. control colline (regardless whether they have adopted certified seeds), **the positive answers were significantly higher among farmers in treatment collines** (a difference of 14.8%-points compared to control collines).
- If we correct for **endogeneity** using instrumental variables, i.e., we account for the fact that richer farmers are more likely to adopt seeds, and thus also more likely to see a productivity rise, this difference is less pronounced but still statistically significant.
- To sum up, **adopting certified seeds, namely thanks to the PSSD program, has allowed farmers to experience productivity gains.**
  - These productivity gains were also mentioned by farmers consulted during FGDs, who mentioned that the higher productivity (around 50-70% increase) was the main reason to adopt certified seeds.

% of farmers who reported a significant increase in productivity between 2017-2022 for farmers in treatment vs. control collines; farmers who adopted certified seeds vs. did not adopt; adoption using IV



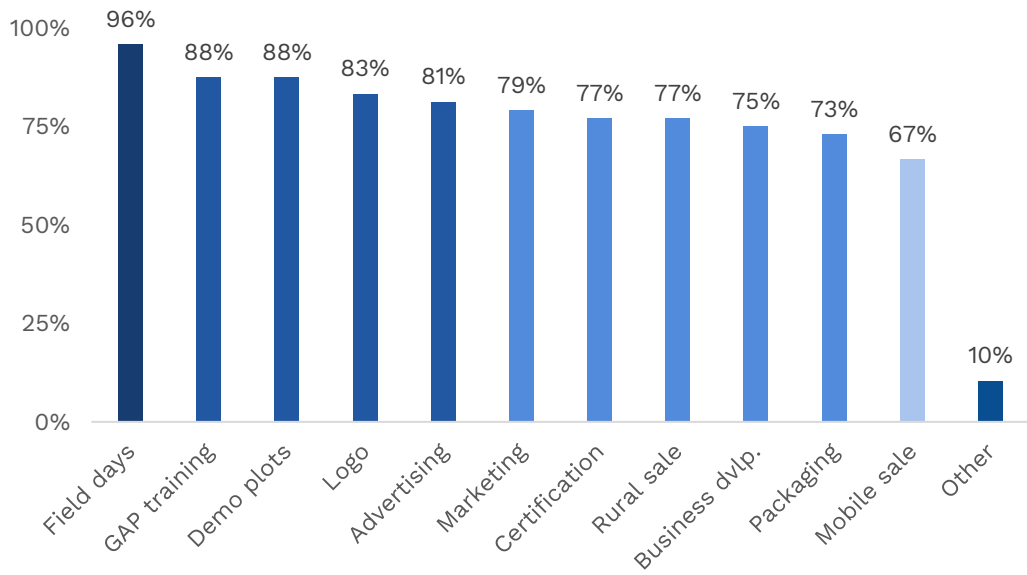
1.D How effective was the integration of private sector partners in achieving the project objectives?

Seed suppliers received both demand-side training and supply-side training from IFDC:

- Training on good agricultural practices (e.g., intercropping, integrated pest management)
- Training on demonstration plots
- Training on organizing field days
- Assistance with marketing activities (e.g., advertising)
- Business development training
- Courses on seed control and certification processes
- Establishment of sales points in rural areas
- Hiring mobile sales agents
- Advertising (e.g., market or church announcements, radio broadcasts)
- Logo/label on seed packaging
- (Micro-)seed packaging

- Results from the seed entrepreneur survey show that all **suppliers received at least one type of training** or support from IFDC
- **Training on all activities was provided to at least ¾ of suppliers**
- As reported by seed entrepreneurs, the most provided trainings were:
  - Field days organization (96%)
  - Good agricultural practices (88%)
  - Demonstration plots (88%)
- 9 out of 48 suppliers felt extremely engaged and encouraged to participate to the decision-making process during the training activities, 39 did not answer.

% of seed entrepreneurs who reported receiving (particular) assistance from IFDC between 2017 and 2022.



1.D How effective was the integration of private sector partners in achieving the project objectives?

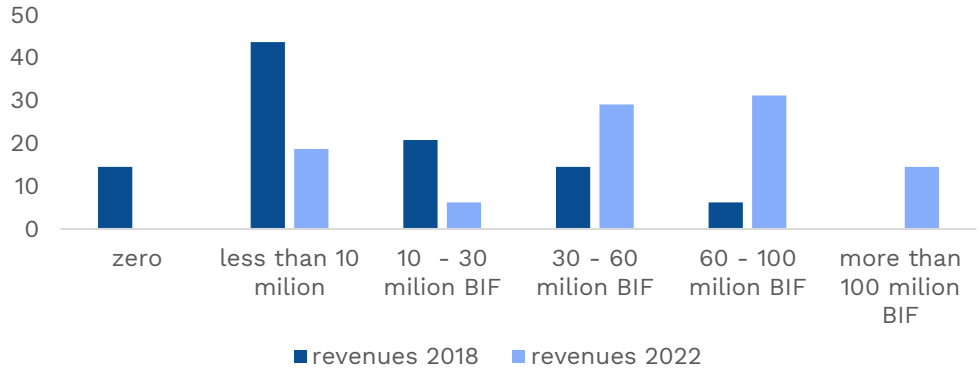
The PSSD program proved to be effective in enhancing the revenues and profits of seed entrepreneurs who participated in the program. This positive transformation was evident when comparing the pre-intervention (2017) period to the post-intervention (2022) period, as indicated by the outcomes of the seed entrepreneur survey. This corroborated with the evidence from FGDs.

The number of suppliers with a revenue lower than 30 million BIF decreased by more than half, while the opposite trend was observed for suppliers with a revenue higher than 30 million BIF, which was recorded by 75% of suppliers in 2022 (20.83% in 2017).

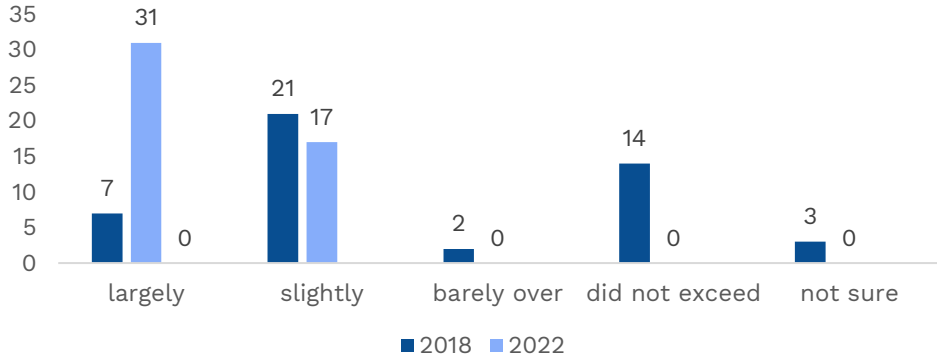
- 2 suppliers (4%) experienced a profit reduction from 2017 to 2022, but without incurring into losses (from revenues largely to slightly over costs)
- 33 suppliers (68.75%) experienced an increase in profits
- For 13 suppliers (27%) the profits remained unchanged
- The number of suppliers recoding large profits increased more than 4 times; No suppliers recorded losses in 2022
- The average number of customers per seed entrepreneur increased from 316 to 1098 between 2017 and 2022

Note: The survey results may exhibit a degree of bias arising from self-selection, as it might predominantly include seed entrepreneurs who have continued to operate successfully. However, the potential impact of this bias on the overall findings is likely mitigated by the observed substantial growth in the diversity of seed entrepreneurs during the program's intervention period, which ranged from nascent start-ups to well-established large-scale operations.

The percentage of suppliers categorizing their revenues into specific ranges for both 2022 and 2017



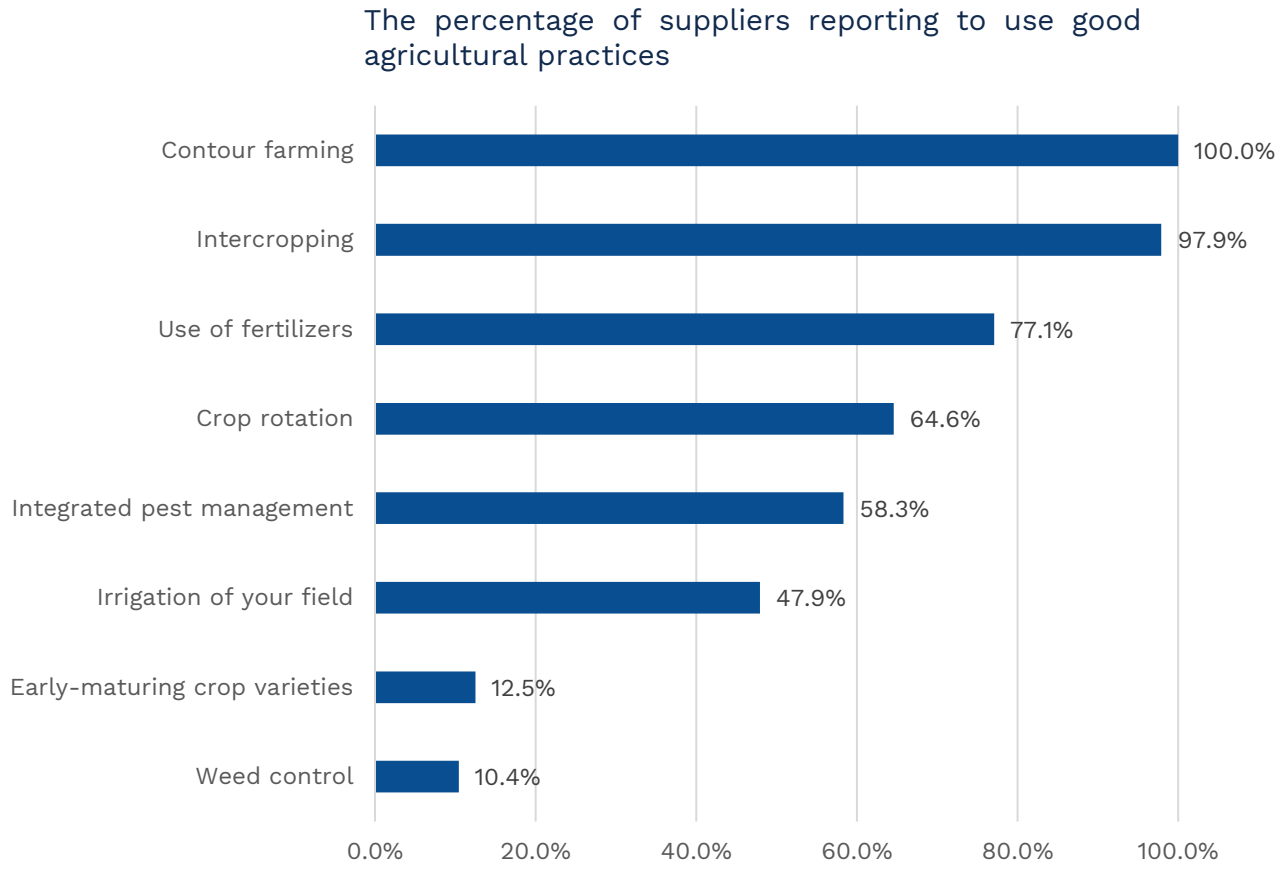
The percentage of suppliers reporting that their revenues exceeded their costs in for 2022 and 2017



Sources: SEO & MDF seed entrepreneur survey

1.D How effective was the integration of private sector partners in achieving the project objectives?

While the PSSD program demonstrated effectiveness in promoting certain essential Good Agricultural Practices among seed entrepreneurs, it was not successful in all aspects. According to the survey, all/most entrepreneurs reported adopting practices like contour farming and intercropping, which not only enhance their productivity but can also be shared with farmers. However, the majority of seed entrepreneurs indicated that they do not implement other relevant GAPs, particularly related to climate adaptation such as irrigation, which consequently limits their ability to pass on these practices to farmers.



1.D How effective was the integration of private sector partners in achieving the project objectives?

While private sector partners played a proactive role in training agro-dealers on crucial GAPs, including seed management, crop production, and conservation, resulting in reported improvements in seed entrepreneurs' agricultural practices, there remains room for enhancement in their involvement in the pre-ordering system and the production of early generation seeds. The primary findings from KIIs and FGDs revealed that:

- All private sector partners were involved in setting up demonstration plots, seed fairs and awareness campaigns, which have reportedly **increased awareness** of the importance of adopting certified seeds; it also helped seed entrepreneurs reach farmers.
- One **major bottleneck concerned the pre-ordering system**, which did not function as effectively as expected. Many seeds were not available for pre-order in the right season or in the desired quantity.
- Private sector partners (for hybrid maize) mentioned the high competition with imported seeds, lack of support from the Government to foster local seed production and the resistance from seed entrepreneurs to buy their seeds (and preferring imported seeds) to be the main difficulties in their work.
- Inefficiencies and distrust regarding the **seed pre-ordering system** significantly hampers smallholders' access to certified seeds.
  - The system is reportedly not working because some smallholders do not receive the quantity they had ordered and purchased, resulting in a financial loss.
  - According to other agencies, some smallholders do not believe seed multipliers to be professional or trustworthy
  - Private sector partners (for hybrid maize) also mentioned that not knowing the quantities needed by seed entrepreneurs and farmers is an important negative factor in the development of their seed sector activities.
- PSSD facilitated the extension of **pre-base seed harvesting** from ISABU alone to 9 seed entrepreneurs countrywide (for potato seeds); this increased pre-base seed production and thereby fostered seed multiplication (as well as a better outreach to smallholders).

1.D How effective was the integration of private sector partners in achieving the project objectives?

However, findings from the survey and FGDs among entrepeneurs have revealed several significant challenges faced by seed entrepreneurs that hinder their supply and were not improved by the PSSD programme:

- **Limited Production** Scale: Seed entrepreneurs encounter difficulties in scaling up their production due to a shortage of essential inputs.
- **Inadequate Access to Inputs:** Stakeholder interviews confirmed that seed entrepreneurs struggle to access vital agricultural inputs like fertilizers, pesticides, and herbicides, which are crucial for safeguarding their crops and enhancing productivity.
- **Importing restrictions:** Importing seed materials from other countries is both expensive and time-consuming due to stringent controls and checks. Consequently, seed entrepreneurs often refrain from importing such genetic material.
- **Lack of Climate Adaptation:** Entrepreneurs grapple with the challenge of adapting to changing climatic conditions. Climate change leads to increased seasonal variability and extreme weather patterns, such as periods of heavy rain followed by drought. Unfortunately, many entrepreneurs lack the capacity or necessary infrastructure, such as irrigation systems, to effectively address these climate-related events.
- **Risk of Infectious Parasites:** The unpredictability of climate change can also exacerbate the spread of infectious parasites that damage crops lacking resistance.

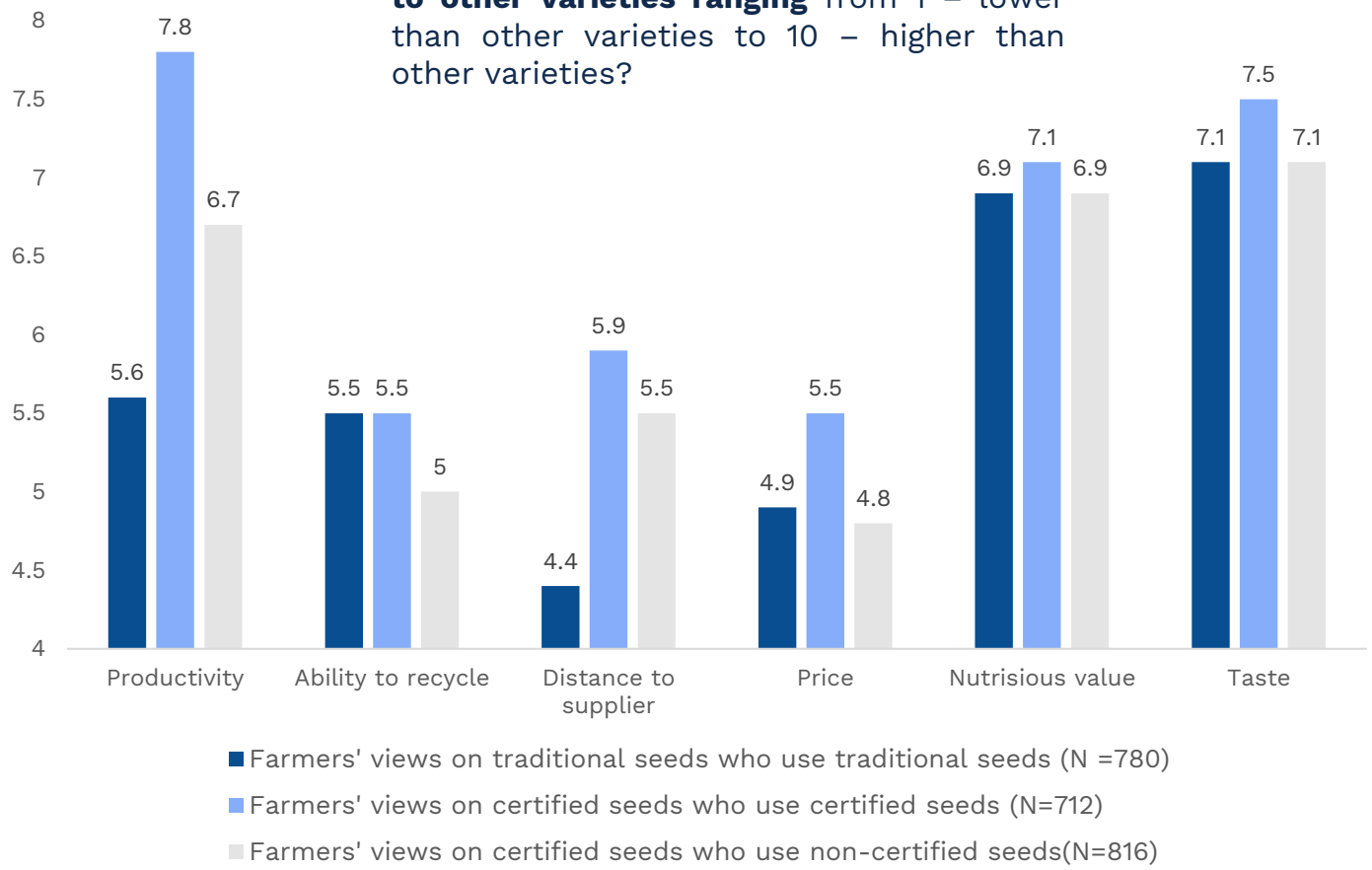
1.E Are farmers satisfied with the access created to quality seeds, and are they satisfied with the performance of these seeds?

In general, farmers who adopted certified seeds are more satisfied with the performance and quality compared to those who still use traditional seeds.

Results from the farmer survey indicate that smallholders who have adopted certified seeds are content about the enhance *agricultural productivity* relative to traditional seeds (7.8 vs 5.6). We surveyed farmers who use traditional and certified seeds, rating the performance of certified seeds and traditional seeds on characteristics like productivity (positive characteristics) and price or distance to supplier (negative characteristic) from 1 to 10. Additionally, we asked the views of non-users on these characteristics for certified seeds. KIIs and FGDs confirm that certified seed users are content about their increase in yields. Other important criteria to be satisfied were decreased likelihood of disease.

However, the FGDs and surveys highlighted several areas where user satisfaction was notably lower. Users of certified seeds expressed dissatisfaction due to insufficient knowledge or training regarding their proper utilization. Additionally, there was a lack of awareness about good agricultural practices. Concerns were also raised about the poor quality of packaging and the high price of these seeds.

How do you rate the **seed variety relative to other varieties ranging** from 1 – lower than other varieties to 10 – higher than other varieties?

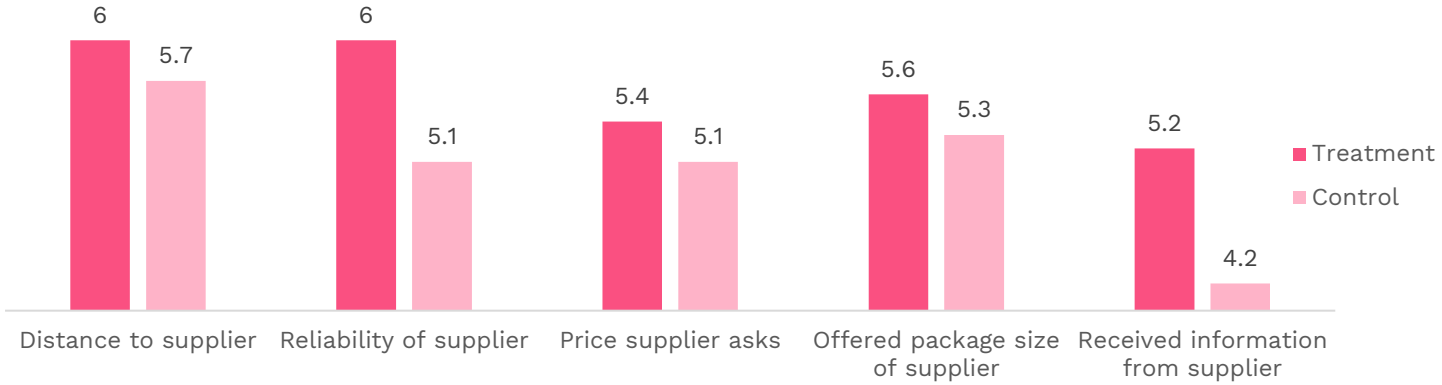


1.E Are farmers satisfied with the access created to quality seeds, and are they satisfied with the performance of these seeds?

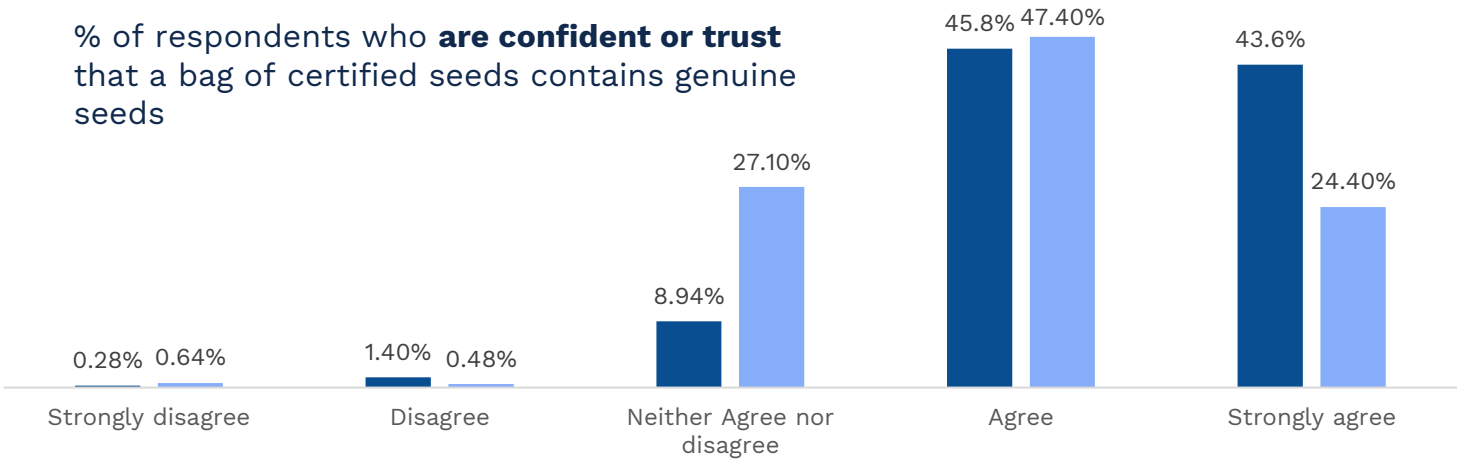
Findings from the farmer survey and FGDs indicate that the level of satisfaction among smallholders using certified seeds with their suppliers is marginally sufficient. This satisfaction is somewhat higher in the collines treatment group. However, concerns have been raised by users regarding the pricing set by suppliers and the inadequacy of information provided on the use of these seeds.

Nevertheless, the survey and FGDs revealed that both users and non-users of certified seeds hold a strong belief in the integrity of suppliers, trusting that they provide authentic certified seeds without mixing them with traditional varieties.

Satisfaction with seed supplier of smallholder farmers who have adopted certified seeds on a scale from 1 dissatisfied to10 satisfied in treatment and control collines (N=743)



% of respondents who **are confident or trust** that a bag of certified seeds contains genuine seeds



1.F To what extent did the PSSD project take into account the gender dimension in the support and participation of seed companies in project activities?

Although partners implementing the program have made concerted efforts to embed gender considerations within their training initiatives (based on KIIs) — particularly in the cultivation of crops like maize and beans, predominantly managed by women — the data from the FGDs and the farmer survey indicates that women in charge of households have not experienced more benefits from the program compared to their male counterparts.

- The field trainings are designed to engage entire households, thereby encouraging both women and men to take part. Nonetheless, challenges persist in altering entrenched traditional roles and practices, which could adversely affect gender equality in Burundi's agricultural sector.
- The findings from the FGDs suggest a relatively balanced gender representation in the access to and utilization of certified seeds, which implies a fair distribution between male and female farmers. The instances of household disagreements leading to disparities are noted to be infrequent.
- Additionally, it was observed that discrepancies, when they do occur, are primarily attributed to a lack of training or understanding of the advantages of using specific seeds. The consensus is that, should certified seeds be readily accessible, there would likely be no disparity in access or usage between men and women.

1.G To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

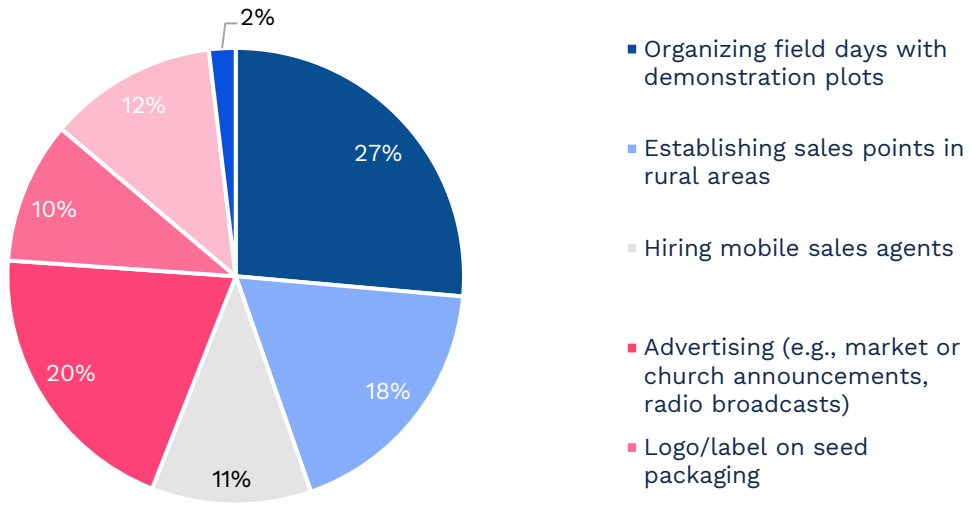
The project played a pivotal role in improving seed entrepreneurs' access to farmers – as we can conclude on the basis of KIIs and FGDs/surveys with seed entrepreneurs. Through a combination of strategic initiatives, including comprehensive training programs and innovative marketing strategies, the project significantly bolstered the reach and effectiveness of seed entrepreneurs in connecting with farmers.

- 27% of the seed entrepreneurs report that the field training was the most effective intervention to increase access. Entrepreneurs that the main benefit was that farmers could see the clear benefits of certified seeds firsthand. These events not only highlighted the seed performance but also offered practical insights into their use. These activities acted as a bridge, building trust between seed suppliers and smallholder farmers and fostering meaningful engagement.
- Furthermore, the programme has reduced the average travelling time between farmers and suppliers of certified seeds with approximately 15 minutes (see question 1A).

While the effectiveness of promoting certified seed adoption may have been somewhat limited (see 1A), the establishment of rural sale points and marketing campaigns significantly enhanced access between farmers and entrepreneurs.

- Establishing rural sale points was a key link, offering farmers easy access to certified seeds. This strategy addressed logistical challenges, making certified seeds widely accessible and significantly increasing overall access.
- Additionally, the project's advertising campaigns played a crucial role in raising farmers' awareness about certified seeds. These campaigns not only promoted but also disseminated valuable information, educating farmers about the numerous benefits of using certified seeds in their agriculture.

% of suppliers who declared which activity contributed the most to increase adoption by farmers



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3.2 Findings
Efficiency

2.A To what extent was the use of resources (budget, resources) for the implementation of the project adequate?

Effectiveness data indicates that demonstration plots and field trainings are particularly resource-efficient for maize and potato farmers, expanding the programme's reach and having the highest value for money. Yet, potato farmers represent a smaller fraction in Burundi, about 10%, compared to 40-50% for maize and bean farmers in the target province, which narrows the focus for potato-related interventions.

- Other PSSD interventions, namely mobile sales units and rural sale points, were not as effective (See slides 27-28). For instance, demonstration plots were 5-10x more effective than other interventions.

FGDs among seed entrepreneurs confirm that the low-hanging fruit (e.g., highest value for money) for further improvements of the programme are supply - rather than demand - side interventions.

- Farmers recognize the benefits of certified seeds, but supply constraints from seed entrepreneurs hinder availability. Increasing supply could lower prices and enhance accessibility. See recommendations for potential supply-side interventions.

KIIs with private sector partners have identified various inefficiencies in the budgeting and planning system of the PSSD programme:

- Contracting issues with private sector partners do not allow continuity (budget must be reconfirmed every year).
- Role of NGOs vis-à-vis the subcontracting to seed entrepreneurs is sometimes not clear to entrepreneurs, resulting in limited control of their own work.
- Short-term framework contracts with the implementing NGOs do not allow for an adequate planning of activities and resources.

2.A To what extent was the use of resources (budget, resources) for the implementation of the project adequate?

Total budget for the programme: €12.48 mln

According to our estimates, the cost associated with inducing a single farmer household to adopt certified seeds amounts to €145.41. These estimates present a higher bound since they do not account for positive spillover effects on neighbouring collines of the programme, which appear to be present (considering the increase in certified seed use in control collines). Additionally, if the program is sustainable, the costs may decrease over time, improving the overall efficiency of the project.

Outcome	Number of reached farmers	Cost per farmer
Certified seeds adopted due to PSSD between 2017-2022	85,826	€145.41
Productivity increased due to PSSD between 2017-2022	66,120	€188.74
Income increased due to PSSD between 2017-2022	29,189	€427.55
Productivity doubled due to PSSD between 2017-2022	5,407	€2308.12

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3.3 Findings
Impact

Evaluation questions - Impact

3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi?

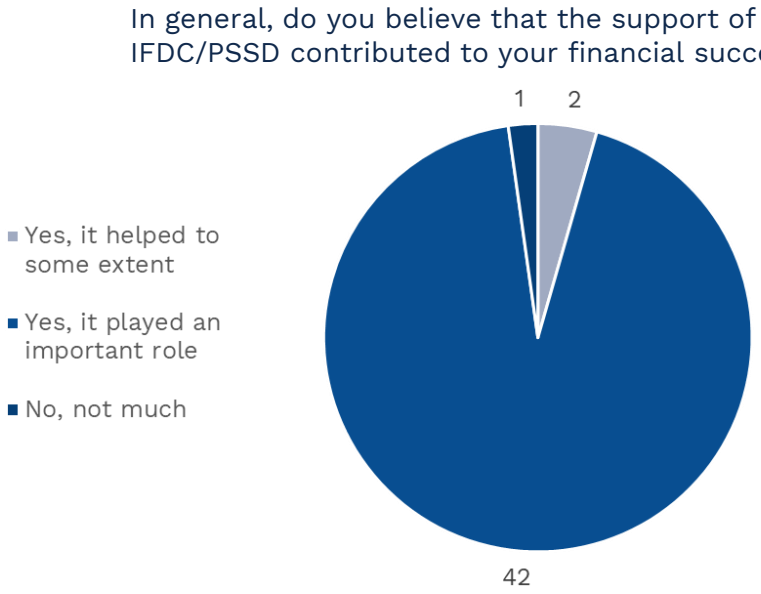
- 3.A.1 To what extent has the PSSD streamlined collaboration between institutions and associations involved in the production and certification of certified seeds (enabling environment), and improved the speed and cost-effectiveness of the certification process?
- 3.A.2 Has it improved collaboration between enabling environment actors and private economic agents (entrepreneurs and seed companies)?

3.B What was the impact of the project on the income of smallholder households?

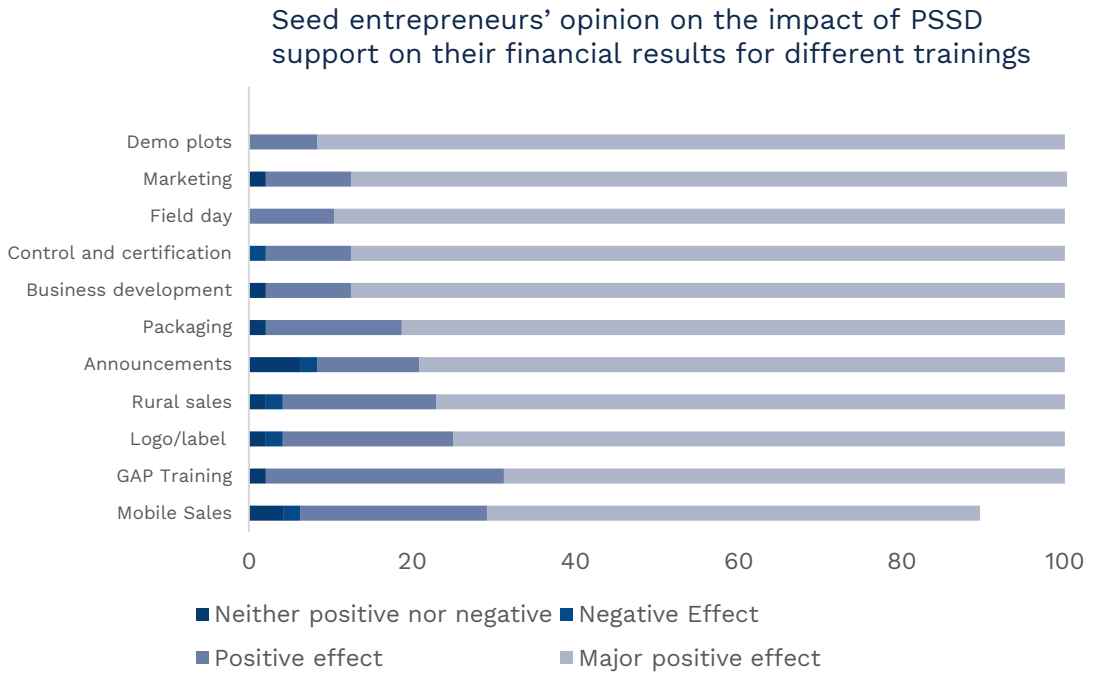
3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi?

Evidence suggests that suppliers are satisfied with the IFDC intervention and mostly attribute their financial success to the PSSD program. None of the interviewed seed entrepreneurs incurred in losses and 69% experienced a surge in profits.

93% of suppliers believed that PSSD played an important role in their business' success.



Suppliers reported that all activities had a major positive effect on their financial results, especially the training on demonstration plots and field day implementation trainings. Very few suppliers reported negative effects of an activity.



3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi?

3.A.1 To what extent has the PSSD streamlined collaboration between institutions and associations involved in the production and certification of certified seeds (enabling environment), and improved the speed and cost-effectiveness of the certification process?

Evidence from desk research and KIIs

- **IFDC** (through ISSD and PSSD) is considered to have **considerably supported and improved the capacity of public institutions** in charge of seed research and certification, by providing financial resources and technical support.
- The support of PSSD to **COPROSEBU** transitioned efficiently from ISSD (where support was at a more administrative level, to scale up their work) to PSSD, where IFDC focused on professionalizing COPROSEBU members (seed entrepreneurs). COPROSEBU has increased its membership from around 30 to 300 seed entrepreneurs during the project implementation period.
  - Despite the provided support, human resources are deemed insufficient, as well as logistical capacity to strengthen the work at provincial level.
- Despite the support to **ONCCS** in training private inspectors (35) to support them in the certification process, stakeholders agree that **ONCSS still faces capacity issues** as it is essentially centrally managed, which leads to delays in the seed certification process – subsequently also causing delays in the sale of certified seeds, which are often not available to farmers during planting season.

3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi?

3.A.1 To what extent has the PSSD streamlined collaboration between institutions and associations involved in the production and certification of certified seeds (enabling environment), and improved the speed and cost-effectiveness of the certification process?

Enabling environment (2)

Evidence from KIIs

- Collaboration between seed multipliers and **ISABU** (by identifying 9 large seed entrepreneurs who can grow and distribute early generation seeds –EGS- for potatoes) is a major PSSD-facilitated accomplishment: these entrepreneurs now account for 50% of EGS for potatoes (in addition to ISABU). Nonetheless, EGS quantities produced reportedly remain far below demand.
- The **DPFAFNL** was reported to act as a secretariat, centralizing data, issuing orders to seed multipliers, and managing the seed database. It also oversees the seed multipliers to ensure compliance with standards, conducting checks even after ONCSS has completed its verifications, with technicians carrying out these inspections.
- While private sector stakeholders mentioned the positive collaboration with public institutions such as ONCCS and ISABU, and the (slow) improvement of their services, they have underlined the lack of support and involvement from the Government (**MINEAGRIE**) to foster local seed production, regulate imports/exports and control the apparent liberalization of the seed market.
  - In fact, the government is reportedly concerned about seed market liberalisation, which would let seed entrepreneurs set potentially high prices.
  - Additionally, national seed sector commitments are lacking, and government budgets are inconsistent: this hinders the quality of public services and the resources allocated to the institutions in charge of research and certification (ISABU and ONCCS in primis).
  - While seeds are partly subsidised for smallholders, this does not benefit those most in need, nor those with insufficient purchasing power to access certified seeds. All in all, seed subsidies are deemed insufficient to bolster demand.
- To be considered also that there are reported negotiations between seed multipliers and the Government to obtain fields that are state-owned, and that the private sector could use to expand seed production.

3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi? For example:

3.A.2 Has it improved collaboration between enabling environment actors and private economic agents (entrepreneurs and seed companies)?

Pre-ordering (1)

Evidence from desk research and KIIs

The pre-ordering system managed by MINEAGRIE, with contributions from PSSD, appears to be ineffective in practice.

- The pre-ordering system has faced challenges. While cooperatives participate in pre-orders, smaller seed entrepreneurs and farmers lack confidence in the system and its benefits. Without advance payments, it is difficult for entrepreneurs to produce without a guarantee of sales.
- The lack of seeds is closely related to inadequate pre-ordering; seed entrepreneurs are hesitant to increase production without a reliable forecast of future demand
- A lack of first-generation seeds for potatoes (pre-base) is also a compounding factor. MINEAGRIE is reportedly not sufficiently involved in providing information about quantities and varieties of seeds needed.
- While the pre-order of potato seeds (managed by ISABU) is generally working (although quantities are below demand), SETRACO does not pre-order hybrid corn, which limits their capacity to plan ahead and produce higher quantities.
- For seeds that are pre-ordered and sold to smallholders, traceability is lacking, as quantities that are sold are unknown – resulting in a lack of understanding of the demand/supply figures in Burundi.
- Stakeholders blamed a lack of crop insurance for this: users (smallholder farmers) often did not get the full order amount from seed entrepreneurs and were not compensated for their loss.
- A stakeholder cited corruption, a lack of engine fuel for transport, and climate-change-induced losses as possible reasons for the system's unreliability for smallholder farmers.
- A KIT article further cites several issues with the pre-ordering system, such as a mismatch between ordered and delivered quantities of seeds; the distance to the seed pickup point being too large for buyers; non-compliance and fraud by seed entrepreneurs; a significant number of certified seeds leaving the certified market and being sold as conventional.

3.A To what extent has the project contributed to the development of the private seed sector (including farmers) in Burundi? For example:

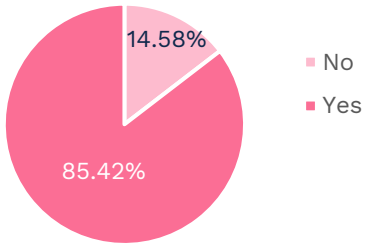
3.A.2 Has it improved collaboration between enabling environment actors and private economic agents (entrepreneurs and seed companies)?

Pre-ordering (2)

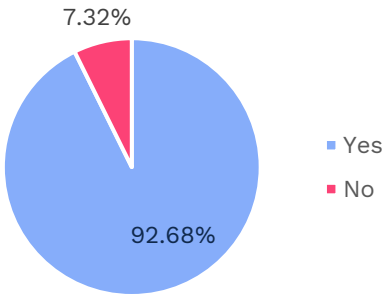
Evidence from suppliers' survey

- 85% of seed entrepreneurs pre-orders their seeds, and out of them, 92.68% always pre-orders them.
- 73% of suppliers are satisfied or very satisfied with the pre-order
- The main causes of dissatisfaction (expressed by 10/48 suppliers) are related to the quality or quantity of certified seeds.

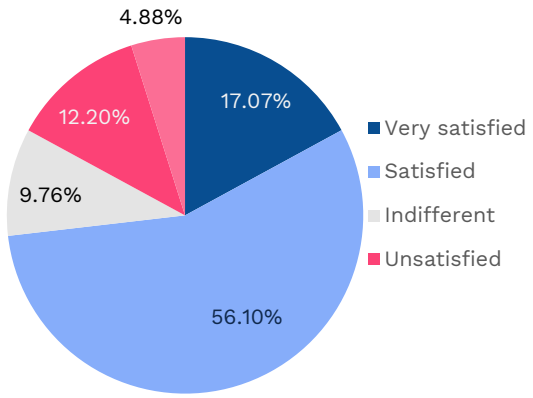
Have you preordered certified seeds in the past?



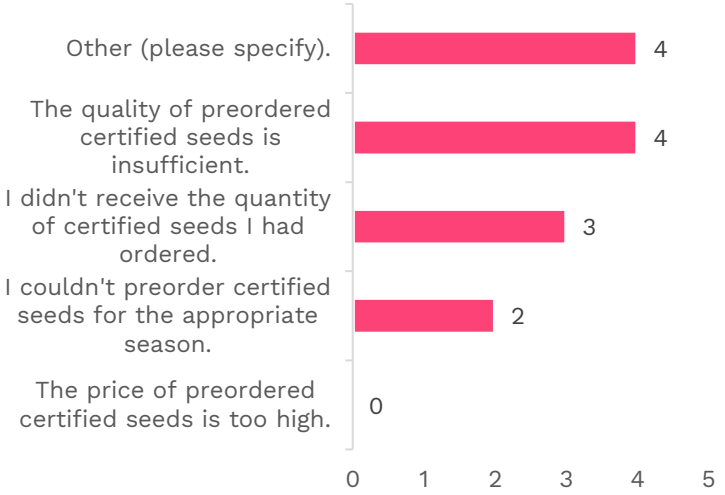
Do you always preorder certified seeds?



Pre-ordering satisfaction



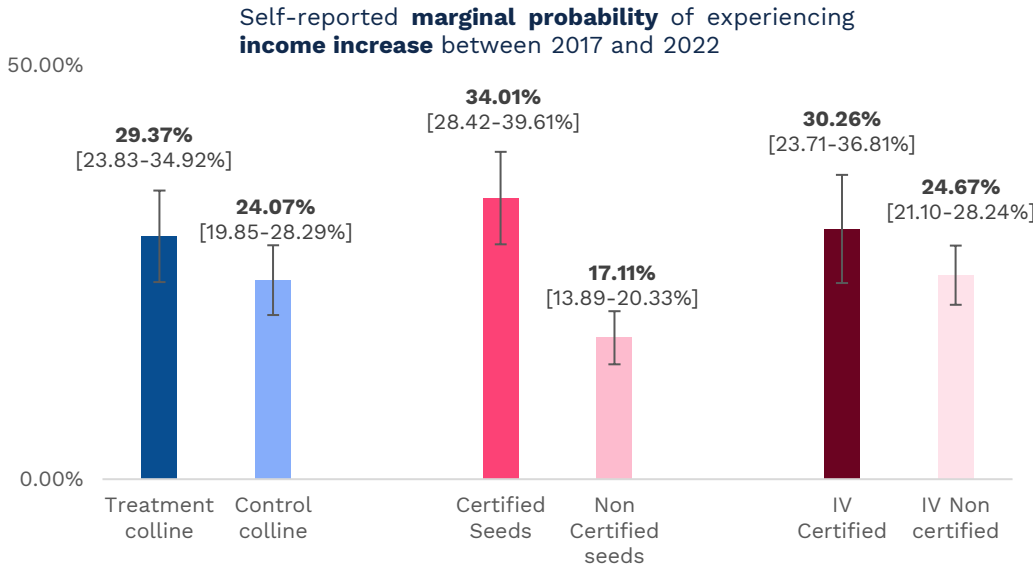
Reasons for dissatisfaction with seed pre-ordering

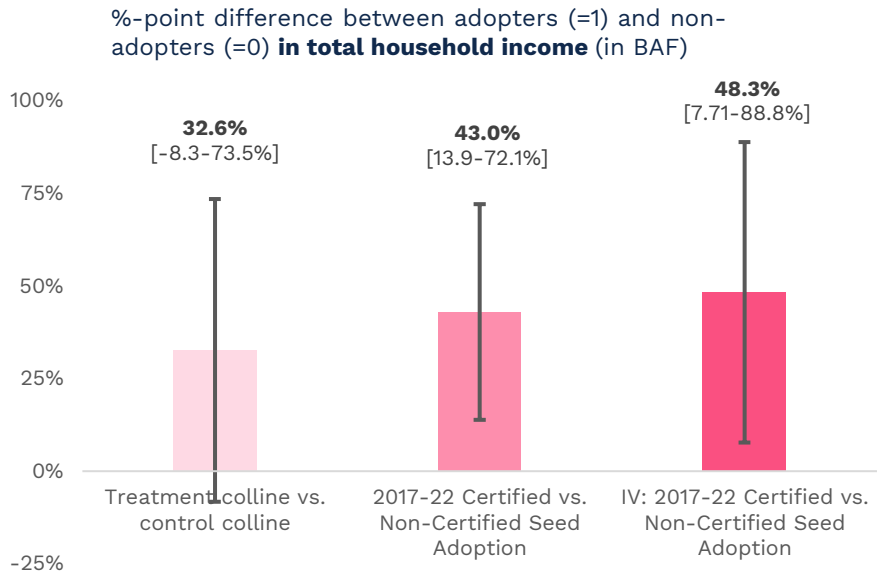


3.B What was the impact of the project (on the income) of smallholder households?

The PSSD programme indirectly impacted smallholder farmers' incomes by encouraging the adoption of certified seeds, as detailed in the effectiveness slides. Evidence from the farmer survey illustrates that smallholders who adopted certified seeds (perceive that) their incomes significantly improved between 2017 and 2022.

- Figure on the left: smallholders who adopted certified seeds between 2017-2022 are 16.90 percentage points more likely to report a significant increase in income than farmers who did not adopt certified seeds (34.01% vs. 17.11%).
- Figure on the right: Smallholder farmers who adopted certified seeds between 2017-2022 have a total household income (in BAF) that is 43.0% higher in 2022 compared to farmers who did not adopt certified seeds.
- These results hold even if we correct for endogeneity - smallholder farmers with higher incomes are more likely to adopt certified seeds – using instrumental variables. Furthermore, FGDs among farmers confirm these results.





3.B What was the impact of the project on the income of smallholder households?

Focus group discussions revealed that the PSSD programme has positively impacted farmers' lives, often leading to increased income from higher crop prices and sales volume, which typically outweighs the higher costs of inputs and seeds.

- This has enabled many farmers to experience improved productivity, poverty reduction, and better educational opportunities for their children.

However, some farmers reported that earnings from their crops do not always cover the additional costs of certified seeds and the necessary quality inputs.

- These inputs not only include the seeds but also more fertilizer and greater maintenance, which raises expenses.
- Consequently, for a segment of smallholder farmers, the investment becomes economically impractical. Despite this, for those who could afford it, certified seeds have resulted in substantially higher revenues because of improved productivity and crop quality, enhancing their financial well-being.

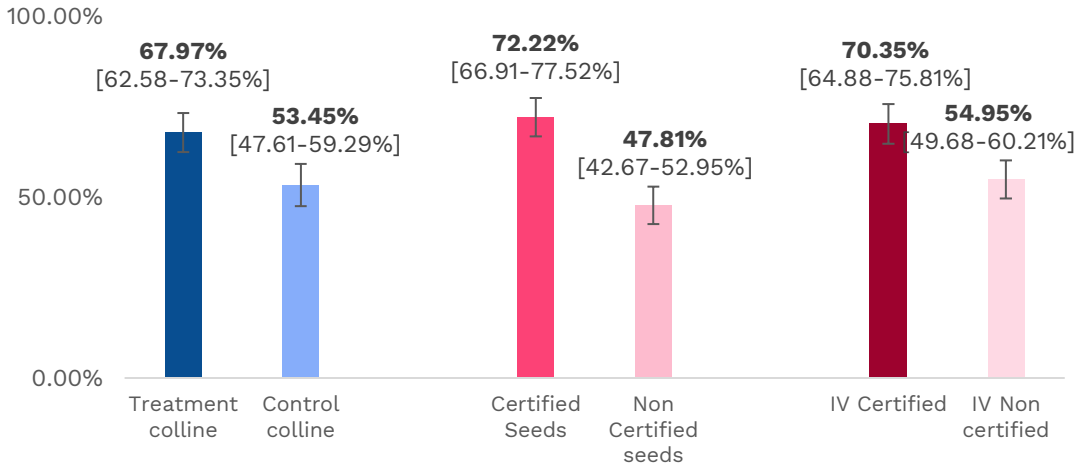
Nevertheless, the perceived riskiness of investing in certified seeds, coupled with the uncertainties of climate change, means that some farmers still find themselves facing high costs with uncertain returns.

3.B What was the impact of the project on (the income of) smallholder households?

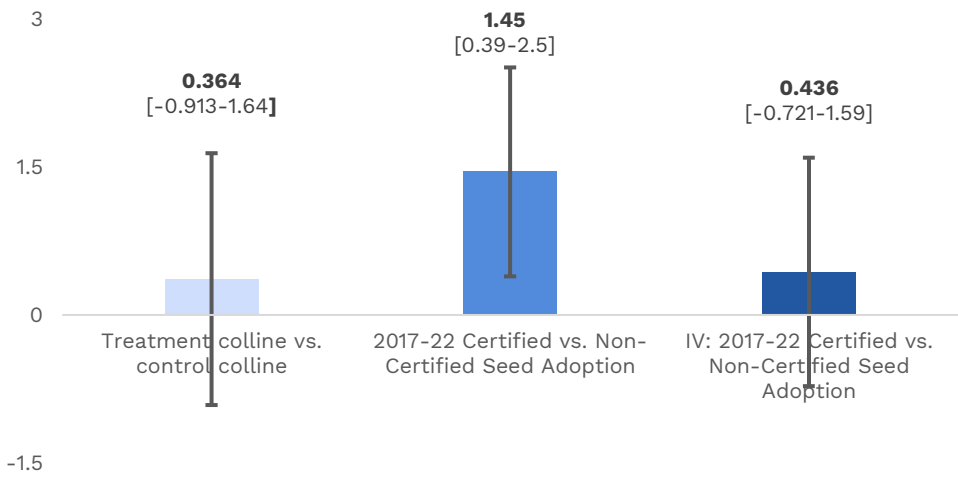
Evidence from the farmers' survey suggest that the PSSD programme had an indirect impact on the resilience (in the form of savings and wealth) of smallholder farmers – through the promotion of certified seeds. Although the evidence is less strong than for changes in income.

- Figure on the left: Farmers who adopted certified seeds between 2017-2022 are 24.41 percentage points more likely to report an increase in savings than farmers who did not adopt certified seeds (72.22% vs. 47.81%).
- Figure on the right:
  - **Our analysis shows a modestly stronger resilience in certified seed users, as indicated by the International Wealth Index (IWI).** The IWI measures household wealth on a scale from 0 to 100, with 100 reflecting ownership of key assets like a car and good housing, and 0 indicating no asset ownership. In our sample, the average IWI score was 34.5, with a high of 65.7.
  - Certified seed users had an average IWI score 1.45 points higher than non-users, comparable to the ownership of a bicycle. However, these differences were not statistically significant after adjusting for endogeneity. However, the program's recent conclusion might not have allowed enough time to see a noticeable improvement in household wealth – a variable that only changes over a longer time span.

Self-reported **marginal probability** of experiencing **an increase in savings** between 2017 and 2022



Wealth score-difference between adopters (=1) and non-adopters (=0) in **International Wealth Index** (0-100)

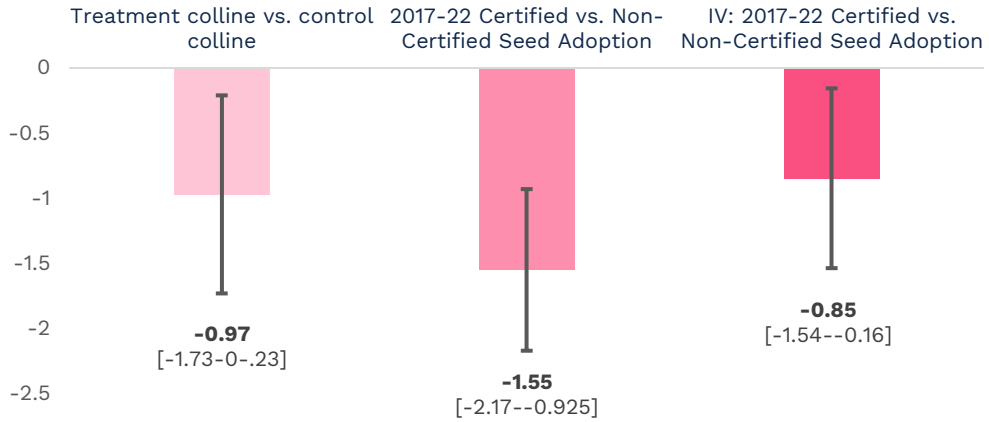


3.B What was the impact of the project on (the income of) smallholder households?

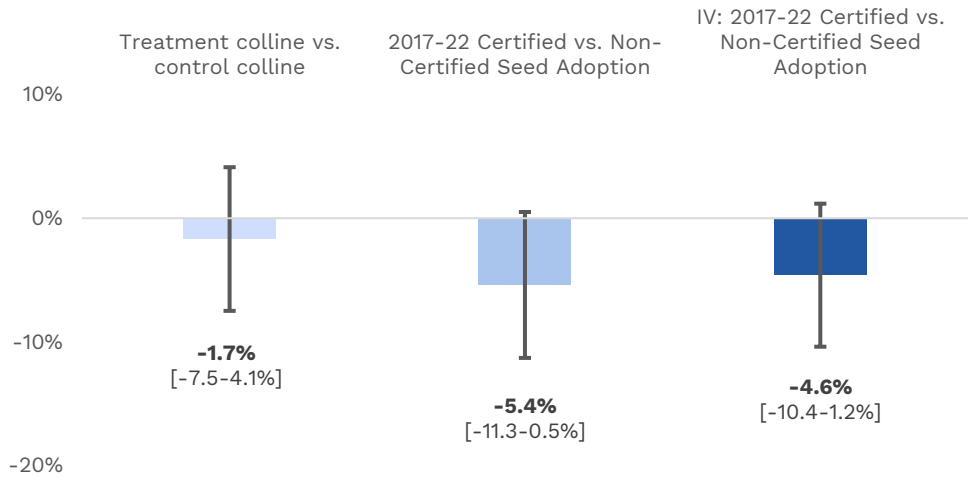
The survey among smallholder farmers indicates that smallholder farmers using certified seeds from 2017 to 2022 reported significantly less extreme hunger compared to non-adopters. The hunger metric, spanning -15 to 15, reflects changes in extreme hunger incidence, with -15 denoting substantial reduction over the last five years. The mean change in hunger score in our dataset is -3, suggesting a general decrease in extreme hunger compared to five years ago. Farmers using certified seeds have an average score 1.55 points lower being approximately -4.55 signifying greater resilience to hunger. These findings remain consistent after addressing potential endogeneity with instrumental variable techniques.

Similarly, adoption of certified seeds is correlated to reduced susceptibility **to income shocks from agricultural adversities** like diseases and pests, showcasing enhanced resilience in agriculture. However, these findings are slightly less precise and only significant at a 10%-confidence interval.

Hunger score-difference between adopters (=1) and non-adopters (=0) **in experienced hunger scores** for period 2017-2022



%-point difference in likelihood of **experiencing agricultural shock** (e.g., crops failure) for period 2017-2022 between adopters (=1) and non-adopters (=0)



Notes: see earlier figures. For this analysis we included the purposely sampled smallholder farmers (and added controls accordingly)

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3.4 Findings
Coherence

Evaluation questions - Coherence

4.A To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

4.B To what extent did the PSSD project rely on the achievements of the implementation of the ISSD project, in order to guarantee synergies and the continuation of the project?

4.C What synergies does the PSSD seek with other projects funded by the Netherlands and other donors, and are they sufficient?

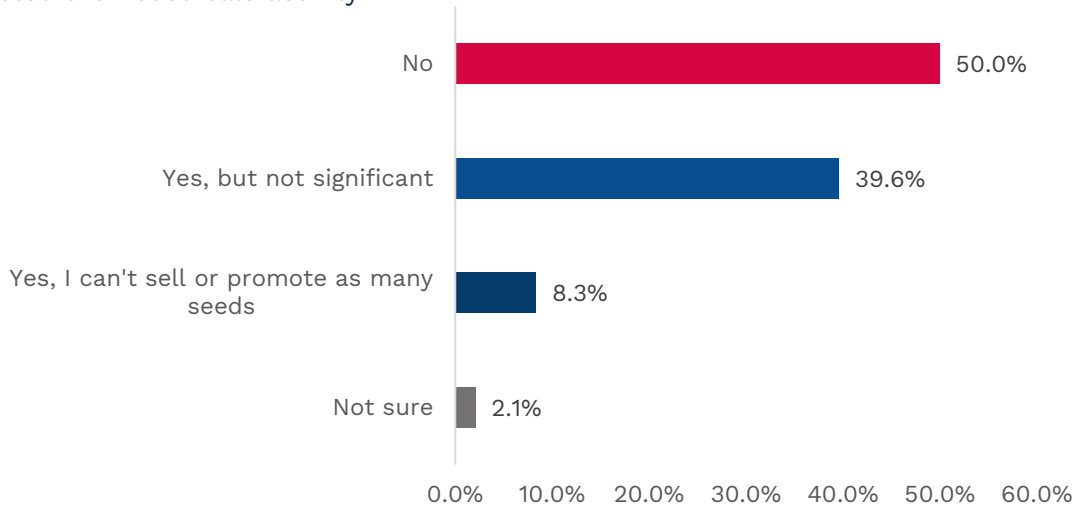
4.A To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

- KIIs with the enabling environment have reported that MINEAGRIE is in favor of and supports the privatization of the seed sector in Burundi, and **PSSD advocacy activities were reported as successful**.
  - Despite this the Government also supports a seed subsidy programme with IFAD, which supports farmers in accessing quality seeds for commercial rice and bean multiplication and imports hybrid corn seeds. These efforts, if compared to the objective of PSSD to increase local production, do not seem to be aligned.
- There is a significant **mismatch of objectives** and activities in support to the seed/food security sector in Burundi from IFDC and other development/humanitarian agencies.
  - While agencies such as the FAO and IFAD have supported public institutions to strengthen their work, this support does not seem to have continued and the practices of distributing seeds to farmers are evidently not aligned with the seed privatization efforts.
  - Some other agencies do not believe the seed sector is ready to become privatized, referring to the lack of capacity and resources of public institutions to support such objective.
  - At the same time, other donors and agencies consider food insecurity and malnutrition to be more of a priority in Burundi, mentioning that the investments in the private sector for seed production are premature.

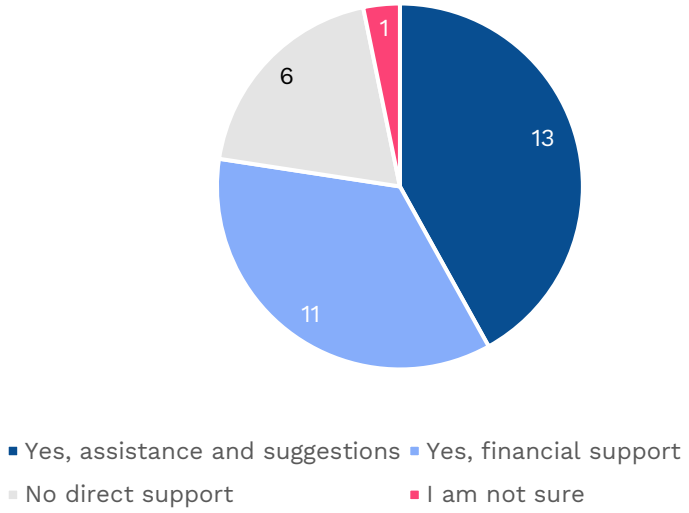
4.A To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

- The seed suppliers' survey results indicate that the free distribution of seeds to the farmers by the government or other organizations did not have an impact on half of the suppliers, but it somehow affected 48% of suppliers (it had a minor impact for 39.6% of suppliers and it had a stronger negative effect on 8.3% of suppliers.
- Out of the suppliers who declared being negatively impacted, 77% were assisted by IFDC in coping with the negative consequences, through financial support and/or suggestions.

% of suppliers who declared whether the humanitarian free distribution of seeds by the government or other organizations affected their seed sale activity



Number of suppliers who received support from IFDC to cope with the negative consequences of free seed distribution



4.B To what extent did the PSSD project rely on the achievements of the implementation of the ISSD project, in order to guarantee synergies and the continuation of the project?

- Public institutions have mentioned that they see the PSSD program as being a **continuation of the ISSD program**, as the ISSD program set out the basis for their work (administrative support) while the PSSD program was more focused on strengthening (and decentralising) their work.
- PSSD **built on the ISSD project's achievements** with seed multipliers, despite excluding rice and banana crops from its interventions.
  - ISSD supported local emerging seed entrepreneurs and led an initial professionalisation; PSSD targeted established seed producers to scale PPPs
  - It employed ISSD's tried and tested approach to capacity building and technical assistance for seed multipliers
- The PSSD project **built on ISSD's pre-ordering system**, which ultimately did not function in practice.

4.C What synergies does the PSSD seek with other projects funded by the Netherlands and other donors, and are they sufficient?

- PSSD does seem to somewhat **overlap with other agricultural development projects** implemented by the AfDB, IFAD and FAO in particular.
  - Through its PADCAE and AEFPF projects, the AfDB also aims to provide assistance to seed multipliers (technical and capacity building), support R&D and seed certification (ISABU/ONCCS) and build capacity for intensive foundation seeds production (ISABU)
  - The FAO-implemented component of the PIPARV-B project (IFAD) includes support to the production of climate-resistant seeds for cooperatives and individual seed entrepreneurs.
  - The PADANE project implemented by SNV, which includes trainings about good agricultural practices.
- This being said, there is a general **perception that agencies do not know each other's programmes**, and that the Government does not play a significant role in fostering collaboration and synergies in the food security/agricultural sector.
  - As mentioned before, the difference in objectives sought (food security, or agricultural production) seem to have a direct effect on the level of synergies pursued by agencies working in these fields.

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3.5 Findings
Sustainability

Evaluation questions - Sustainability

5.A To what extent are the government and public institutions equipped to continue investments in the seed sector in Burundi, including innovation?

5.B To what extent has the PSSD project developed an exit strategy and what conditions must be met to ensure its feasibility?

5.C How likely are farmers to continue using certified seeds after the project ends?

5.D To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

5.A To what extent are the government and public institutions equipped to continue investments in the seed sector in Burundi, including innovation?

- The public institutions overseeing seed production, registration and distribution **lack the financial and human resources** to function effectively.
  - All stakeholders interviewed noted ISABU's lack of human and financial resources as a major constraint to the development of the seed sector.
  - It was also argued that the ONCSS needs more resources and to be decentralized across Burundi's provinces to be able to fully control seed quality, and allow for a quicker seed certification process.
    - While the identification of private inspectors has somewhat positively influenced the certification reach at province level, the (slow) speed of certification is still deemed inadequate considering the demand.
  - As was hinted at by another stakeholder, corruption is also a root issue.
- The **lack of decentralised reach from public institutions** is a major concern regarding the sustainability of their activities.
- Public institutions are willing to foster seed exports with neighbouring countries, especially for crops like potatoes.
- While COPROSEBU is now part of ASTA, their participation to meetings and conferences, which would strengthen their understanding of good practices across the region, is limited.
- In terms of innovation, the **lack of a digitalized system** to know prices and availability of seeds across provinces is a significant negative factor for the sustainability of the seed production.

5.B To what extent has the PSSD project developed an exit strategy and what conditions must be met to ensure its feasibility?

- The current key focus is on empowering entrepreneurs to ensure the **sustainability** of the sector. The co-financing mechanism within the PSSD framework is designed with this aim in mind.
- Even after the end of IFDC support, entrepreneurs have remained committed in the past – it was observed that of those that received support through the ISSD, 54% have sustained their operations.
- There is **no clear exit strategy yet** as the seed sector development, and more specifically the public institutions including the regulatory framework, need to continue being supported to start seeing returns on investments. The second phase of PSSD will reportedly include a clearer and more elaborate exit strategy.

5.C How likely are farmers to continue using certified seeds after the project ends?

- FGDs revealed that farmers put forth **training** (especially demonstration plots, training on good agricultural practices and advertising/awareness campaigns on benefits), **availability of seeds** (presence of sale points, or mobile sale agents), **and affordability** as key factors to encourage the continued use of certified seeds by farmers.
- Certified seeds are appreciated for their good yields, despite challenges like climatic uncertainties.

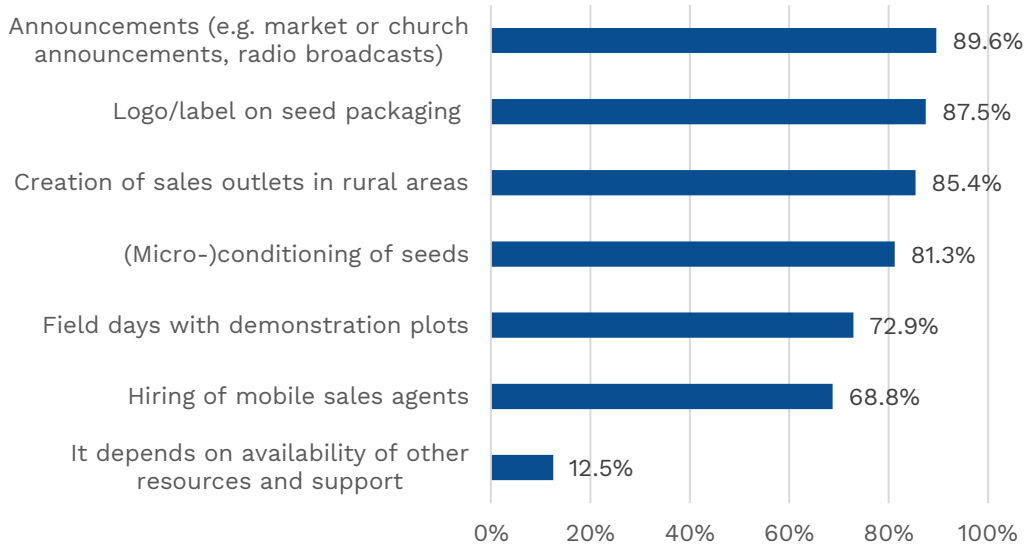
Enabling and limiting factors for continued certified seeds adoption

Enabling factors	Limiting factors
Higher awareness and knowledge: Farmers are more likely to continue using certified seeds if they are encouraged through demonstration plots, advertising to cooperatives on the benefits, and sensitization campaigns on the disadvantages of traditional seeds. **Higher productivity of certified seeds** was the main reason why farmers purchased and declared they will continue to use them. Many farmers experienced **poverty reduction and livelihood benefits** thanks to the higher revenues of certified seeds. Seed suppliers (survey) also mentioned the **consistent quality and performance of seeds**, establishing **strong and trustworthy relationship with farmers** and offering **additional support beyond seeds** as being the main reasons for continued certified seeds adoption.	**Limited government** and/or seed suppliers' **support**. **High Price:** the price of certified seeds is too high for many farmers even if they are convinced of the benefits. For some smallholders, the relatively high price of certified seeds represented a serious constraint in their adoption. **Inconsistent Monitoring:** Improper crop monitoring/maintenance can facilitate the development of diseases and germs, and generally yields are not as high. **Supply constraints:** many farmers report that certified seeds are available in insufficient quantities to meet their demand. **Access/availability constraints:** A lack of multipliers in the proximity generates difficulties in accessing certified seeds. **Lack of knowledge/know-how:** gap in training and knowledge about modern agricultural practices, including the use of certified seeds and their benefits. Farmers express a need for more training and demonstration plots to better understand the benefits and usage of these seeds.

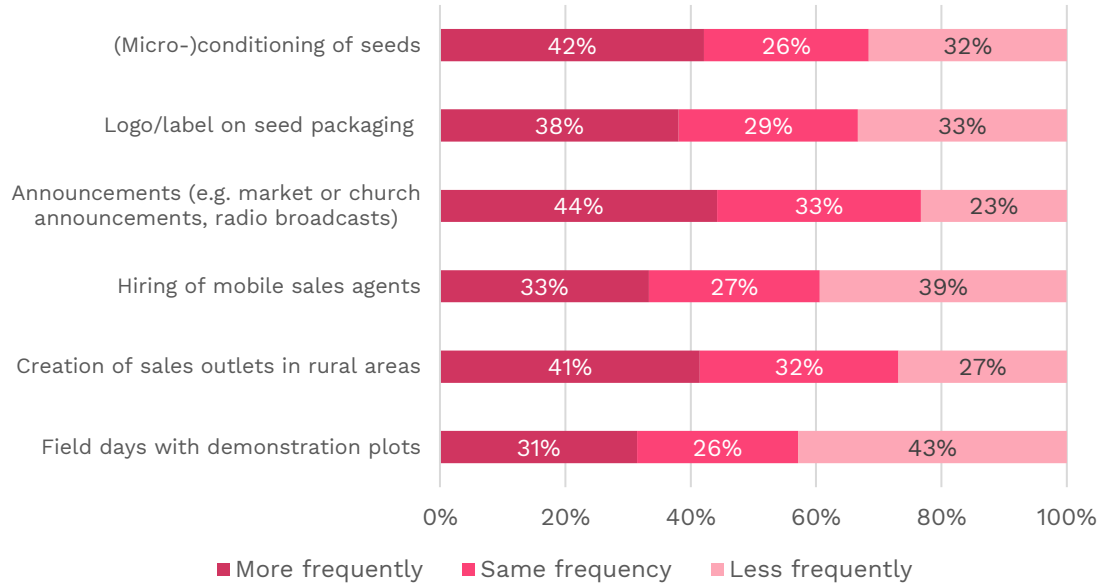
5.D To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

The majority of supported seed entrepreneurs are profitable, indicating that the private seed sector can be a sustainable business, as shown by the survey results on the slide. Consequently, most suppliers would maintain at least one sales or marketing activity for certified seeds even without the project's support—except for one, whose decision depends solely on the availability of other resources (figure on the left). Survey data and FGDs corroborate this, with most suppliers confident they would sustain or even increase their production and sales activities. However, about one-third might reduce their efforts, as suggested by the survey response (figure on the right) diverse responses from the FGDs.

Percentage of seed entrepreneurs who report they would continue with heretofore promoted activities if the PSSD program were discontinued.



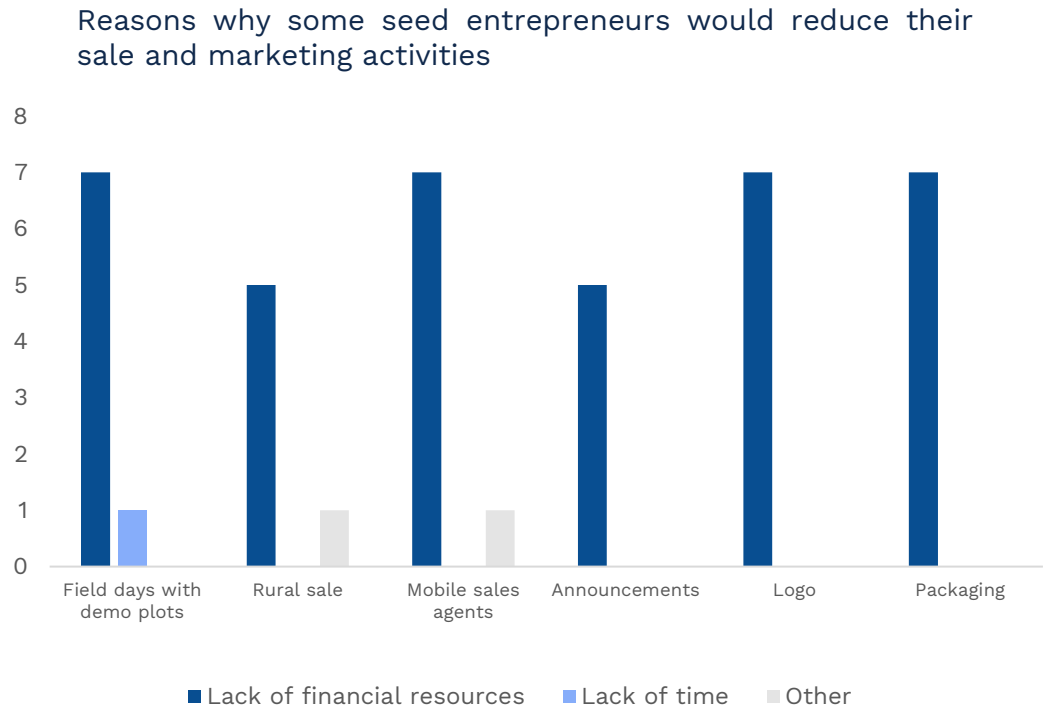
Percentage of seed entrepreneurs reporting the frequency at which they would persist with heretofore promoted activities if the PSSD program were to be discontinued.



5.D To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

15 suppliers out of 48 suppliers consulted in the survey would reduce the frequency of sale activities, the main reason being the lack of financial resources (38/41 answers for all activities). This is also likely the reason why demand exceeds supply at the moment, as it was also confirmed by suppliers during the FGD.

Evidence from the suppliers' survey



Evidence from the suppliers' FGD

Enabling factors	Limiting factors
Certified seed production is already profitable due to **high demand exceeding supply.** Some seed entrepreneurs believe they will continue seed production regardless of challenges due to the **profitable nature of the business**.	**Bad agricultural practices by farmers** (insufficient crop upkeep, e.g. weeding and pesticides, lack of training in soil fertility and soil preparation) which prevents farmers from experiencing the benefits of certified seeds, which then prevents/reduces further demand **"Unfair competition":** other seed producers selling fake certified seeds or a mix with traditional seeds at a lower price **Lack or short supply of fertilizers** **Lack of modern farming equipment** and **high-quality inputs** (especially fertilizer) for some entrepreneurs **Limited coverage or delay of training** sessions due to farmers' absence or delay

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PSSD Results Framework

5. PSSD Results Framework

	Realized in 2022
Cumulative number of smallholder farmer households **that adopted certified seeds** due to PSSD between 2017-2022	85,826
Cumulative number of smallholder farmer households **that increased their productivity** due to PSSD between 2017-2022	66,120
Cumulative number of smallholder farmer households **that increased their income** due to PSSD between 2017-2022	29,189
Cumulative number of smallholder farmer households **that doubled their productivity** due to PSSD between 2017-2022	5,407

5. PSSD Results Framework - assumptions

- Average annual population growth of 2.66% between 2019 and 2022 (based on World Bank estimates)
- The percentage of collines in a province where the PSSD program operates is a measure of the program's reach within that province. For instance, in Kayanza, the PSSD is operational in 47% of the collines. Consequently, the maximum proportion of potato farmers in Kayanza who can benefit directly from the PSSD is capped at 47%.
- The yield data from the demo plots, comparing certified to traditional seeds, reliably demonstrate the potential for farmers to double their productivity.
  - If on 50% of the demonstration plots the yield of certified seeds (more than) double the yields of traditional seeds, we can assume that for that crops 50% of the farmers can double their productivity by using certified seeds.
- Self-reported data on income and productivity growth over five years serve as reliable estimates of actual earnings increases. Alternatively, we employ data from demonstration plots for a more precise assessment of productivity enhancements.

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Findings
FGD findings and MSC

Most **S**ignificant **C**hange quotes from farmers

"The most important change that the use of certified seed has brought to our households is the increase in production. We are able to cope with the family's expenses and balance the food supply by obtaining what we don't have."

"If the harvest has been good, we go to the market less often. Hunger is reduced, and the money we make from the harvest is used to send children to school."

"The use of certified seed has made a big difference to our household lives. Living conditions have changed remarkably. Some of us have been able to buy plots of land and livestock, and our health has improved too."

"The most important change from certified seed is that many of our households have benefited from better production or they could buy other livestock from the sale of seeds."

"The use of certified seeds has had a significant impact on our household income, because 2 years ago we could almost produce what we ate, but now we not only produce what we eat but also what we sell."

"The use of certified seeds has had a significant effect on total income because financial resources have increased, and we have been able to send our children to good schools."

Suggestions from farmers

In general farmers said that **lower seed prices, increase training and demonstration plots, enhance the availability of seeds, and provide better access to agricultural inputs** are important actions to **improve the viability of certified seeds.**

We asked them what could seed entrepreneurs do to encourage farmers to continue using certified seeds, and this is what they said:

- “Promote the availability of seeds and reduce their price so that many households are able to buy them.”
- “It would be better if they gave us sufficient training, also in agricultural practices”
- “They could continue to produce more and ensure that the certified seed meets the required standards. For us in our locality, it's important that there is training on how to practice modern agriculture.”
- “Producers should put more energy into training farmers in the use of certified seed, making this seed available and selling it at a price that is affordable and favorable to farmers. Seed entrepreneurs should also place these certified seeds in a location closer to our locality. It is important that seed entrepreneurs continue to organize demonstration plots and certified seed fields.”
- “Producers of certified seed should produce more so that there are no stock-outs, and in due course there should be plenty of field days, demonstration plots and training.”
- “Seed entrepreneurs should train farmers in agricultural techniques and practices and make certified seed available to avoid shortages.”

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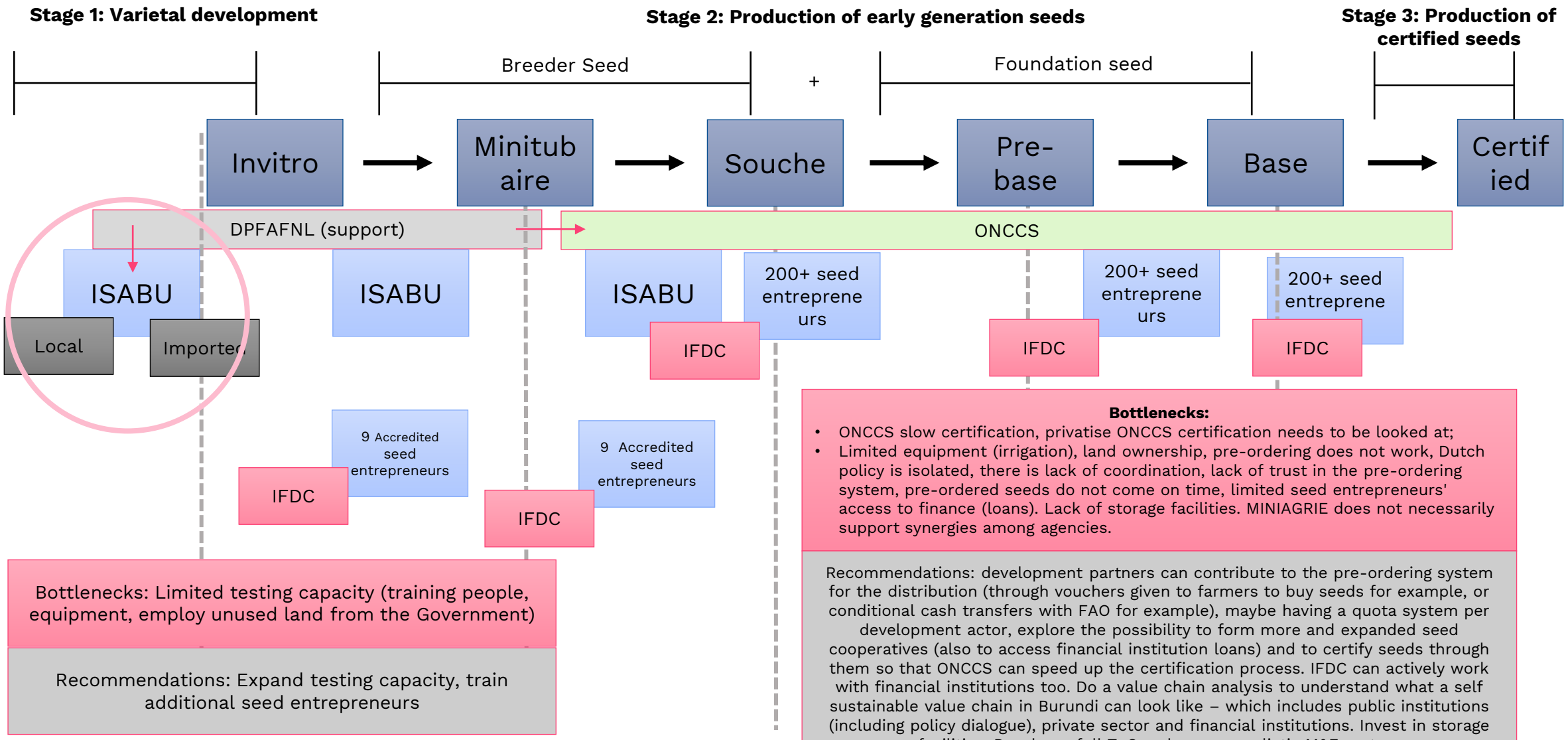
Recommendations

From seed to crops (potato)



Recommendations

1. **Increase coordination and synergies among development partners**

- Improve **coordination** and create synergies with other development partners. Without this, the private seed sector in Burundi is highly unlikely to be sustainable.
  - The initiatives of certain development partners may inadvertently hinder the sustainable development of a private seed sector, for example when they distribute imported seeds at no cost.
  - To counteract this, the EKN in Burundi could usefully facilitate the alignment of these activities with the objectives of Private Sector Development (PSD) in the short term. In particular, it can (a) encourage development partners to source seeds from local, small-scale entrepreneurs; and (b) encourage other development partners to provide vouchers or conditional cash transfers to farmers, with which they can purchase certified seeds (see slide 85).
  - More generally, the EKN in Burundi can take the lead in coordinating objectives and activities of development partners regarding private seed sector development in Burundi (in cooperation with IFDC and the Burundi government)
- Reinvigorate efforts to increase involvement and coordination on the agricultural/seed/food security sector of **MINEAGRIE**.
- Increase **policy dialogue** and application of seed regulations supporting private entrepreneur, in coordination with IFDC and other development partners.

Recommendations

2. Invest in varietal development

- Help **expand ISABU's externalised testing capacity** by helping ISABU to hire and train additional private experts, as well as acquiring more equipment or using unused government land
  - Testing capacity is low at this stage in seed development, and ISABU lacks the human resources and capital to fully uphold its mandate
  - Boosting ISABU's externalised capacity in this regard can thus be effective in increasing the number of in vitro seeds introduced upstream in the value chain
- Advocate for a **streamlined varietal development process** and **liberalise invitro seed prices**
  - Varietal development is overseen by ISABU and can currently take up to 3 years; narrowing this timeline would help improve upstream efficiency
  - The government enforces invitro prices which limits financial incentives to develop them
  - These points can be brought up and discussed with MINEAGRIE

Recommendations

3. Strengthen production of Early Generation Seeds (EGS) – Breeder seeds

- Increase the number of accredited seed entrepreneurs involved in breeder seed production
  - There are just 9 accredited seed entrepreneurs at the moment
  - Working with ISABU/MINEAGRIE to help increase this number could increase the availability of breeder seeds (*minitubaire* and *souche*)
  - Work can be done on increasing the number of licences available for EGS production, and in co-financing the high fixed costs needed to become a producer (e.g. greenhouses, specialised irrigation)

4. Invest in production and storage of all types of seeds

- Invest and increase seed entrepreneurs' capacity to plant and grow first generation seeds from ISABU (i.e. hothouses).
- Finance and support the use of machineries by seed entrepreneurs to grow higher volumes of seeds at a higher speed.
- Expand **storage facilities** (warehouses and silos) and train seed entrepreneurs on their maintenance, including against climate hazards.
- Significantly invest in **irrigation options** for seed entrepreneurs and multipliers, allowing them to grow during the three planting seasons**.**

Recommendations

5. Significantly strengthen the production, sale and certification process of certified seeds

- Revamp the seed pre-ordering system using a **voucher** or **conditional cash transfer (CCT) system**, and involving other development partners (e.g. FAO, USAID, IFAD):
  - Farmers could pre-order seeds from entrepreneurs using 'vouchers' given by PSSD/IFDC, entitling them to a given number of certified seeds. This way, even if the order is not fully met, farmers do not lose money: such vouchers would effectively be a financial insurance tool against losses (due to e.g. an unexpected drought, disease/bacteria, …).
  - Another possibility is a (semi-)conditional cash transfer: some money is sent directly to farmers, and at least a part of it (or the entire amount) must be spent on pre-ordered certified seeds.
  - To help initiate and establish the system, other development partners could commit to buying a certain % of certified seeds from it early on (e.g., for all of their programmes, USAID and FAO commit to buying 20% of the certified seeds they need from the pre-ordering system).
  - Utilizing a voucher system/CCT offers several advantages over subsidizing seeds. One key benefit in terms of sustainability is that it ensures farmers receive valuable knowledge about the market dynamics, such as the location of seed entrepreneurs and a deeper understanding of how the market operates.
  - One notable drawback of employing a voucher system or CCT is the substantial administrative load it carries. This burden often escalates the risk of fraud, particularly when there is insufficient capacity for monitoring and evaluation (M&E). However, an effective countermeasure to mitigate these risks involves the active participation of local communities in the distribution process. Additionally, strengthening the capacities of these communities has proven to be a crucial strategy in mitigating such challenges.

Recommendations

6. Continue working with MINIAGRIE on regulating development programmes nationally and making them aligned with the development of a sustainable value chain

- A directive was recently passed to force other partners to buy certified seeds (from entrepreneurs and companies)
- Continuing to regulate aid in this way ensures other interventions do not hinder the development of a value chain
- Discussion should continuously occur at the monthly meetings managed by MINEAGRIE

7. Launch partnerships with financial institutions, to work on improving seed entrepreneurs' access to finance

- More closely partnering with financial institutions (banks, microfinance institutions) would ensure that entrepreneurs or seeds cooperatives that have identified an investment need (e.g. an irrigation system) can access the funds needed
- Discussing with such financial institutions and promoting seed entrepreneurship as a viable industry can lower the perceived financial risks for banks/MFIs of investing in the seed sector
- Another idea is to co-finance loans together with financial institutions, to lower financial risks for them and potentially catalyse further investments
- Establish a revolving fund with capital from MFA and additional private investors to foster program sustainability and fund seed entrepreneurs
  - Benefits:
    - Syndicated loans reduce individual risk for financier.
    - Engages the market, enhancing financial institutional capacity.
    - Since the fund is replenished it is a sustainable option. Furthermore, a revolving fund can leverage initial capital to support multiple rounds of lending, thereby amplifying the impact of the original investment.
  - Key considerations:
    - Willingness to provide initial capital (e.g., MFA-funded). However, profits from the fund can be used to replenish initial investment.
    - Ability to find private financial partners to co-finance fund. Development Banks like FMO might be a good option.
    - Clear target group definition and usage criteria for seed entrepreneurs that are linked to enhanced profitability (e.g., productivity, climate resilience) to prevent misuse and combat corruption. Clear conditions should have as main goal to reduce adverse selection (e.g., the most risky seed entrepreneurs will ask for fund)
    - While monitoring costs are high to reduce risks (e.g., to reduce moral hazard), the seed sector's profitability should counteract this.
    - Investment in financial literacy is required to ensure borrowers understand the terms and conditions
    - Non-traditional conditions are required for default rates and conditions, as well as interest rates (e.g., flexible vs. fixed), to fit the developmental context and account for fluctuations in political institutions. For instance, interest rates should be lower than market rates to reflect the revolving fund's better capacity to cope with information asymmetries, moral hazard, and adverse selection. Yet, the fund's rates should be high enough to recoup the initial investment and reduce the risk of market distortions.

Recommendations

8. Significantly strengthen the production, sale and certification process of certified seeds

- Conduct a thorough **Value Chain Analysis (VCA)** to understand what a self-sustaining seed value chain can look like
  - An idea is to map out each stakeholder involved in certified seed production, from varietal development to certified seed sales (e.g. EGS producer, entrepreneurs, companies), as well as supporting actors in the public sector (e.g. ONCCS, MINEAGRIE) and private sector (e.g. financial institutions, NGOs).
  - Then, after outlining dynamics and relationships among them, IFDC can better identify where its impact can be maximised along the chain (e.g. by targeting a specific weak link in seed production, or through policy dialogue with MINEAGRIE)
  - This analysis can be kept alive and updated throughout the project's timeline
  - Examine and track the development of trust relationships between bean farmers and seed suppliers to identify and address potential concerns.

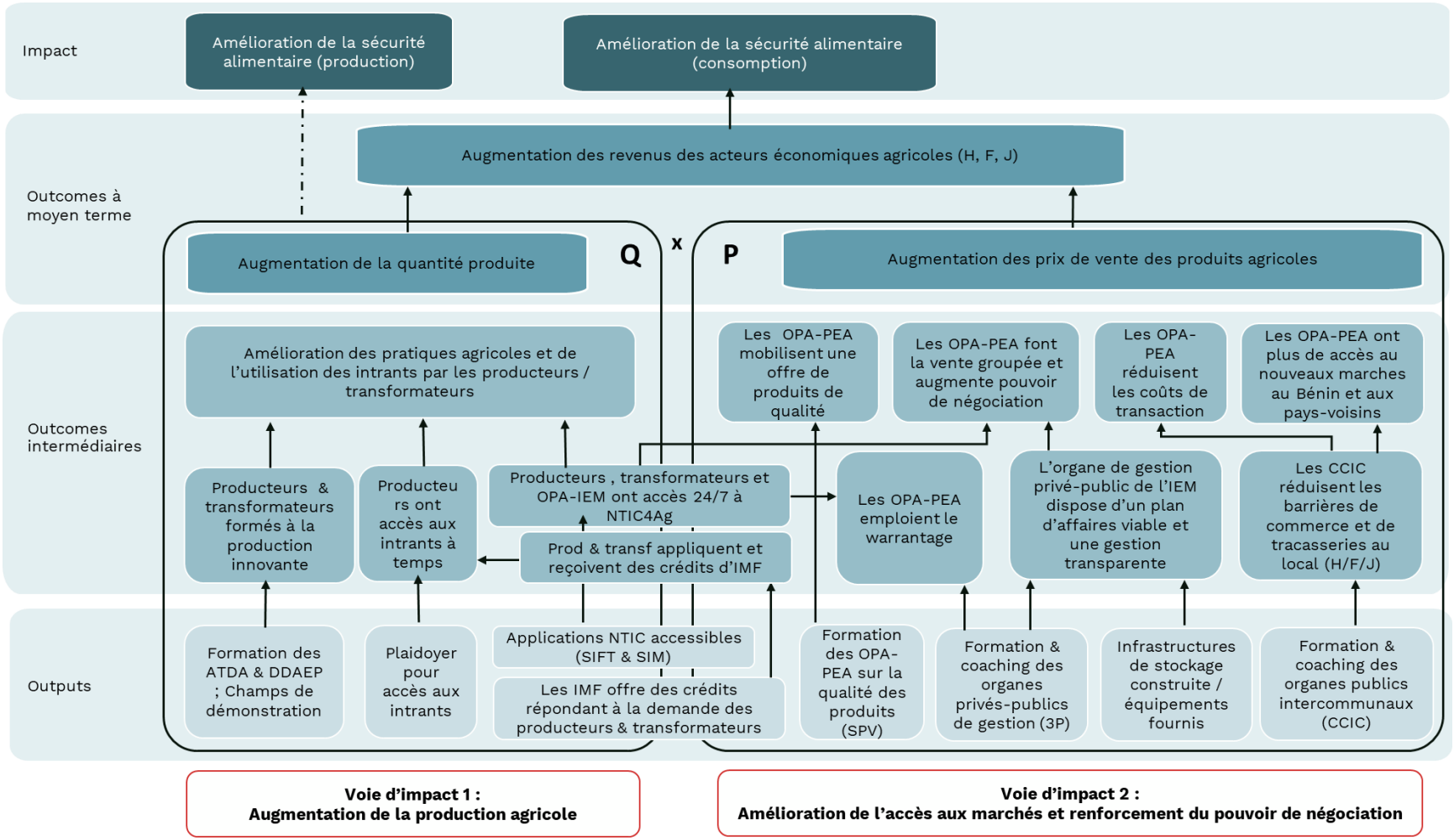
Recommendations

9. Develop a full Theory of Change (ToC) – see next slide - and a coherent M&E system

- A full-fledged ToC maps out all impact pathways, intervention activities, project assumptions, and intended outputs and outcomes clearly and in detail.
- This would let all project stakeholders clearly see and agree on project aims (e.g. target indicators), goals (project ambition), the actors supported, and the intervention logic

- An M&E system should be developed in close juxtaposition with this ToC
  - Output/outcome/impact M&E indicators could all be tied to a 'step' in the ToC logical framework, to ensure all are directly relevant and useful
  - Targets and expectations should be more realistic
  - Attention should shift away from numbers of people reached or affected, and towards understanding whether the value chain as a whole functions (e.g. seed production at each stage of the value chain by private actors, ISABU's technological capital and human resources, …)
- The monitoring component could include a continuous (yearly) assessment of GAP adoption
  - Are GAPs actually adopted by entrepreneurs/farmers?
  - Also, it could include farmers' actual productivity gains from using certified seeds (this would be useful to know, since such gains are necessarily lower than gains in 'ideal' lab conditions)

Example of a Theory of Change (ToC):



ToC suggested by SEO and MDF for the ACMA2 programme implemented by IFDC in Bénin

Improved M&E system examples

- **Develop clear objectives and indicators in the Results Framework:** The indicators in the current Results Framework are difficult to measure (heavily relying on estimations), and do not capture well enough the range of activities implemented through the programme. IFDC could consider establishing specific, measurable, achievable, relevant, and time-bound (SMART) indicators for the program to track progress effectively, also in terms of results of the demonstration plots, trainings, field days, support to public institutions.
- **Strengthen data collection and management:** Implement robust data collection methods and tools that ensure accuracy and reliability of data.
  - Train young professionals (that IFDC has already hired) on regular data collection activities to monitor the implementation from implementing partners, conduct FGDs with farmers and interview seed entrepreneurs to have regular feedback on the availability of seeds and seasonality elements.
  - Organise bi-annual review meetings with ONCCS and ISABU to go through their workplans and assess the programme's progress. This will allow them to feel accountable towards IFDC and create a culture of learning within the institution.
- **Utilize Technology:** Incorporate technology solutions, like mobile data collection apps or management information systems, to streamline data gathering, analysis, and reporting processes. Kobo Toolbox is an opensource platform that is user friendly and intuitive, and that could be used for that purpose.
- **Ensure knowledge management, transparency and accountability:** Make M&E findings accessible to the M&E and programme teams within IFDC, and store data into regular reports, as well as share it during meetings and periodic reviews to stimulate discussions about what works and what does not (learning), and be more accountable towards IFDC management and the donors.

Recommendations

10. Improve the certification process and bolster the co-financing for ONCCS to facilitate the recruitment of additional staff, including privatized personnel, for the inspection and certification of seeds, with a particular focus on expanding these activities at the provincial level.

- Alternatively, increase the decentralization of ONCCS inspectors by appointing provincial-level agronomists that can also supervise early-generation seeds production from ISABU, among others.
- Agree on a system with ONCSS to **allow large seed companies to conduct the first two rounds of inspections themselves (after proper training)**, to let ONCCS inspectors assess and validate the third and last round of inspections only – which would allow certification processes to happen more quickly and in bulk.

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Annexes

Annexes

- Annex A: List of consulted stakeholders
- Annex B: Extensive methodology and results of Smallholder farmers survey
- Annex C: Extensive methodology and results of seed entrepreneurs survey
- Annex D: KII and FGD guides

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Annex A: List of consulted stakeholders

Annex A: List of consulted stakeholders

Implementing and development partners

Stakeholder	Key informant	Position
IFDC	Claudine Murerwa	PSSD Team Leader
	Cyriaque Simbashizubwoba	PSSD Deputy Team Leader
	Déogratias Bizabityo	M&E expert
	Janat Namirembe	Regional MELS specialist
KIT	Boudy van Schagen	Senior advisor agriculture
	Peter Gildemacher	Head of Sustainable Economic Development & Gender
	Oumou Diallo	Advisor
IFAD	Jaffar Rushgaje	Agronomist
	Sandra Nyambuza	Country coordinator
	Elie Buzova	PIPARBB Project manager 2nd component
	Damase Ntiranybagira	PIPARBB Project Coordinator
	Corneille Ntakiyiruta	PIPARBB Operation Manager
EEAS	Jean-Marc Pascal Arnold	Rural development Officer
FAO	Alain Ndakoze	Technical assistant
	Appolinaire Masuguru	Assistant to FAO representative
Belgian Embassy	Sanne de Mayer	Deputy Head of Cooperation
AfDB	Jean Claude Nsabinama	Responsible for the social projects in the agricultural sector
	Jean Paul Bitoga	Project director, PRODEFI
Enabel	Joost Noordholland	Co-director
TASAI	Mainza Mugoya	Program Coordinator

Enabling environment, private companies and local NGOs

Stakeholder	Key informant	Position
ONCCS	Fidèle Gahungu	Director General
ISABU	Jonas Ndikumana	“Corn” Program Manager
	Astère Bararyenya	“Vegetables” Program Manager
DPFAFNL	Médard Ndayikengurukiye	Director
COPROSEBU	Richard Hatungimana	President
	Marc Bacanamwo	Secretary
SETRACO	Françoise Muterateka	Executive Director
NASECO	Léa Ndirubusa	Coordinator
TWITEZIMBERE	Ladislas Kabwa	Technical Director
	Pontien Bikebako	Director General
UCODE	Charles Nahimana	Director
	Dieudonné Ndikumana	M&E Manager

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Annex B: Extensive methodology and results of smallholder farmers survey

Annex B: Overview

Part 1: Sampling & Methodology: Survey among Smallholder Farmers

- Sampling and Data Cleaning: What choices have been made?
- Methodology: How do we rigorously answer the research questions (RQs) presented below?

Part 2: Results of Survey on Smallholder Farmers

- RQ1: Was the PSSD programme effective in encouraging farmer households to adopt certified seeds?
- RQ2: What were the main constraints for farmer households in adopting certified seeds?
- RQ3: Has adopting certified seeds increased the productivity, income, and resilience of farmer households?

Part 3: Updated Timeline - Final Report Including:

- Results from a survey among seed entrepreneurs.
- Results from focus group discussions among smallholder farmers and seed entrepreneurs.

Annex B: Overview of Evaluation Questions that will be addressed with the smallholder survey

Effectiveness

1.A Did the project effectively increase the adoption of certified seeds by farmers?
1.B What were the main constraints for farmer households in adopting certified seeds?
1.C Has the increased adoption of certified seeds allowed farmers to increase their productivity?
1.E Are farmers satisfied with the access created to quality seeds, and are they satisfied with the performance of these seeds?
1.F To what extent did the PSSD project take into account the gender dimension in the support and participation of seed companies in project activities?
1.G To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

Efficiency

2.A To what extent was the use of resources (budget, resources) for the implementation of the project adequate?

Impact

3.B What was the impact of the project on the income of smallholder households?

Coherence

4.A To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development

Sustainability

5.C How likely are farmers to continue using certified seeds after the project ends?

Main findings

Finding 1: The PSSD programme was highly effective in promoting the use of certified seeds. This was particularly so for smallholder farmers who cultivate potatoes and maize, but not for bean farmers. Furthermore, the most effective intervention to promote the adoption of certified seeds were demonstration plots whereas other type of interventions did not appear to be effective. Furthermore, there was no evidence in the survey that the programme was more effective for farmers of a certain gender or age. Furthermore, the programme was not particularly effective in transmitting good agricultural practices.

Finding 2: The primary barriers preventing farmers from adopting certified seeds appear to be supply-side issues. These include the high cost of certified versus traditional seeds (more than twice as expensive per hectare), unreliable supply chains, and the great distances farmers must travel to reach agro-dealers. Despite these challenges, the majority of farmers recognized the superiority of certified seeds over traditional varieties. Furthermore, the PSSD programme was effective in reducing the average distance for farmers to suppliers of certified seeds.

Finding 3: Survey respondents who adopted certified seeds between 2017 and 2022 reported being more productive, having a higher income, and being more resilient to agricultural shocks. For instance, agricultural incomes of adopters of certified seeds were estimated to be 40% higher than incomes of non-adopters. These results suggest that the PSSD had a positive impact on the livelihoods of smallholder farmers through its promotion of certified seed adoption. However, results for other indicators than income including changes in household wealth are less robust.

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Appendix B: Smallholder Farmers Survey

Sampling and methodology

Annex B: Methodology– Sampling design for smallholder farmer survey

The total sample comprises 1,755 smallholder farmers who are organized across **78 Collines** within **25 Communes**, which are in turn located within **6 Provinces:**

- 39 collines are used as **treatment collines** due to *the presence of* the PSSD programme
  - The presence includes **different interventions supported by the PSSD programme** including demonstration plots, marketing campaigns, seed fairs, mobile sales units, and rural sales outlets. We selected the Collines with the highest exposure to the PSSD programme (e.g., many different type of interventions).
- 39 collines are used as **control collines** due to *the absence of* the PSSD programme
  - To minimize **treatment spillover risks**, we chose control collines from different communes but within the same province as the treatment collines. This approach ensures similarities between treatment and control while reducing potential spillovers. The PSSD programme might still impact nearby farmer households, so control collines are from a separate Commune. While this strategy aims to reduce spillovers, they cannot be entirely eliminated, potentially enhancing the programme's effectiveness by inadvertently including more beneficiaries. However, significant spillover could result in **underestimating the program's effectiveness and impact**, leading to a false negative—incorrectly concluding the program is ineffective when it actually has an effect.

Our sample consists of smallholder farmers that dedicate at least 20% of their land to growing potatoes, beans, or maize, resulting in the following distribution:

- **For maize,** we have 525 households in Makamba and Muyinga.
- **For potatoes,** there are 544 households across Bururi and Bujumbura Rural.
- **And for beans,** we have accounted for 686 households in Cankuzo and Ruyigi.

This reflects the **targeted crop focus** of the PSSD program within each respective province, with one primary crop allocated per province.

Beyond the **random sample** of 1,400 smallholder farmer households, we **purposefully sampled** 355 farmers, about 20% of the sample size, to guarantee a sufficient number of households using certified seeds for the specified crops, averaging 4 to 5 households in each colline.

- To avoid bias in our estimates, we omit the purposefully sampled smallholder farmers from some analyses – particularly if the goal of the analysis is to estimate the prevalence of certified seed adoption. These exclusions will be noted in the figure captions.

Annex B: Sampling design for smallholder farmer survey

The table below gives an overview of the entire smallholder farmers' survey sample, segmented by crop type (potato, maize, and beans), with further disaggregation based on sampling method (random or purposeful), and classification of households into treatment or control groups by colline.

		Potato	Maize	Beans	Total
Random sample	*Treatment*	158	148	301	*1,400*
	Control	238	292	263	
Purposeful sample	*Treatment*	94	68	95	*355*
	Control	35	36	27	
Total		**544**	**525**	**686**	**1,755**

Annex B: Methodology– Sampling design for smallholder farmer survey

Summary statistics of selection of key variables

	Mean	Min	Max
Household has **adopted certified seeds** for cultivating potatoes, maize, or beans between 2017 and 2022 (=1) or still uses traditional seeds (=0)	42.6%	0	1
Household was **purposefully sampled** (=1) or not (=0)	20.2%	0	1
Household lives in **treatment (=1) or control (=0) colline**	49.2%	0	1
Age of household head	45.8	18	95
Gender of household head (1= male, 0 = female)	87.0%	0	1
Household head is member of **village leadership** (=1) or not (=0)	20.2%	0	1
Number of different **crops and livestock**	1.71	1	16
International Wealth Index of household (0-100)	34.9	14.1	65.7

After inspecting and cleaning the data, we excluded 24 smallholder farmers on the basis of:

- 12 farmer households that **do not cultivate the target crops of their selected province** (e.g., farmer household in Makamba that does not cultivate maize)
- 2 farmer households with **invalid demographics** (e.g., household head is 5 years old)
- Additionally, for certain analyses, we omit observations with inconsistent outcomes (e.g., agricultural income is higher than total income). Any such exclusions are indicated in the accompanying figure notes.
- Overall, the quality of the data is reliable – considering the low number of households that need to be excluded.

Annex B: Methodology–Empirical approach for smallholder farmer survey

We have three different empirical strategies to be applied on the farmer survey depending on the type of evaluation question:

1. Evaluation questions on certified seed adoption (EQ 1A) and focus on gender dimension (EQ 1F)

Objective: To evaluate the effectiveness of the PSSD program, the focus is on enhancing the adoption rates of certified seeds and good agricultural practices (i.e., irrigation, crop rotation) among smallholder farmers.

Method/Empirical Model: Linear probability model assessing adoption between 2017-2022.

Key Variables:

- **Key Dependent Variable**: Adoption of certified seeds (1 = adopted between 2017-22, 0 = not). For maize, we also consider hybrid varieties as certified seeds.
  - Extension 1: Adoption of good agricultural practices (1 = adopted between 2017-22, 0 = not) including crop rotation, weeding, irrigation, use of fertilizer, use of insecticides, intercropping.

Key independent Variables:

- **Key independent variable:** Household lives in a treatment colline under the PSSD programme (1 = yes, 0 = no).
  - Extension 1: The primary independent variable in this study is the presence or absence of PSSD (Productive and Sustainable Systems Development) interventions. This extension aims to identify which specific intervention was most effective. As an alternative independent variable, we assess the occurrence of various PSSD interventions within a colline (1= yes, 0 = no), such as demonstration plots, seed fairs, marketing campaigns, rural sales outlets, or mobile sales units.
  - Extension 2: The key independent variable is measured at colline level. However, we also have individual-level data on household participation in field training or visitation demonstration plot between 2017-22 (1 = yes, 0 = no).
  - Interaction term: We include an interaction between the key independent variable and gender to see whether there are significant differences in the effectiveness of the PSSD programme between (fe)male-headed households.
- Controls: Household demographics, crops and livestock, seasons active, income sources, land size; Provincial fixed effects; Cluster robust standard errors at colline level.

Annex B: Methodology–Empirical approach for smallholder farmer survey

2. Evaluation questions on constraints for certified seed adoption and satisfaction (EQ 1B and 1E)

Objective: Identify supply- and demand-side constraints affecting adoption of certified seeds.

Method: Perception data analysis of certified seed users and non-users.

Key variables/Constraints Analyzed:

- Examples of **supply-side** constraints considered:
  - Distrust in suppliers
  - Distance to suppliers of certified seeds
  - Price comparison to other suppliers
  - Price comparison of certified versus traditional seeds per hectare of land cultivated

  Examples of **demand-side** constraints considered
  - (Dis)trust in certified seeds and retailers
  - Conviction about benefits (e.g., productivity gains) of using certified seeds versus traditional seeds
  - Financial constraints to make investment
- Furthermore, we examine whether smallholder farmers living in **treatment collines** are less likely to experience these constraints – suggesting the possible effectiveness of the PSSD programme.

Annex B: Methodology smallholder farmer survey

3. Evaluation questions related to the enhancement of productivity (EQ 1C) and their corresponding impacts (EQ 3B), which include the augmentation of income and strengthening of resilience.

Objective: This empirical approach evaluates the indirect effectiveness and impact of the PSSD (Productive and Sustainable Seed Development) program, particularly through its initiative to promote the adoption of certified seeds. We proceed under the assumption that the PSSD program fosters seed adoption and subsequently investigate the ramifications of this adoption on a core set of effectiveness and impact measures, including variables such as productivity and income.

Model: OLS- and IV-regression (see next slide)

Dependent Variables (depending on the Eqs):

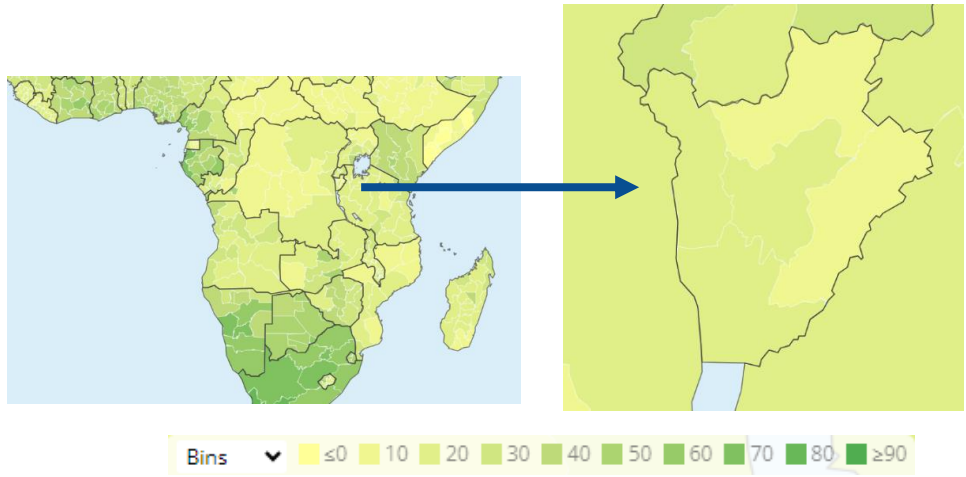
- *Set 1:* Self-assessed improvements in household's agricultural productivity, revenues, and savings
- *Set 2:* Household Income (In Burundian Francs) and wealth (using the International Wealth Index)
- *Set 3:* Resilience indicators including hunger score and exposure to agricultural/climate shocks

Independent Variables:

- ***Key independent variable:*** *Certified seed adoption between 2017-22* (1 = adopted, 0 = not);
  - *Extension 1: Instrumental variable* for certified seed adoption between 2017-22 (1 = adopted, 0 = not) mitigating endogeneity such as the inclination of higher-yielding farmers to choose certified seeds (See next slidesfor extensive explanation).
  - Extension 2: Household living in treatment colline (=1) or control colline (=0) to examine possible direct effect of PSSD programme.

Controls: Same as for other analysis, with standard errors clustered at colline level

BOX: The International Wealth Index (IWI) scores households from 0 (no assets) to 100 (all assets), indicating households' socio-economic status more accurately than income. It considers more than 20 indicators on asset ownership and housing quality (which can be objectively verified by enumerators during surveys). In 2017, Burundi's average was 21.7, one of the lowest national scores.



Notes: Data comes from the Global Data Lab. Literature on usage and advantages of IWI can be found here.

Annex B: Empirical strategy to estimate the effect of certified seed adoption on productivity, income, and resilience.

For our empirical strategy (e.g., Eqs 1C, 3B), we investigate the impact of adopting certified seeds from 2017 to 2022 on key outcomes and impacts such as agricultural productivity, income, and resilience of smallholder farmer households. Our empirical analysis assesses the significant influence of certified seed adoption (Cic) on these factors for each household (i) within a colline (c). We evaluate the following variables (Ric):

$$R_{ic} = B_0 + B_1 C_{\mathrm{ic}} + \mathrm{B}_2 \mathrm{Z}_{\mathrm{ic}} + \partial + e_{ic}$$

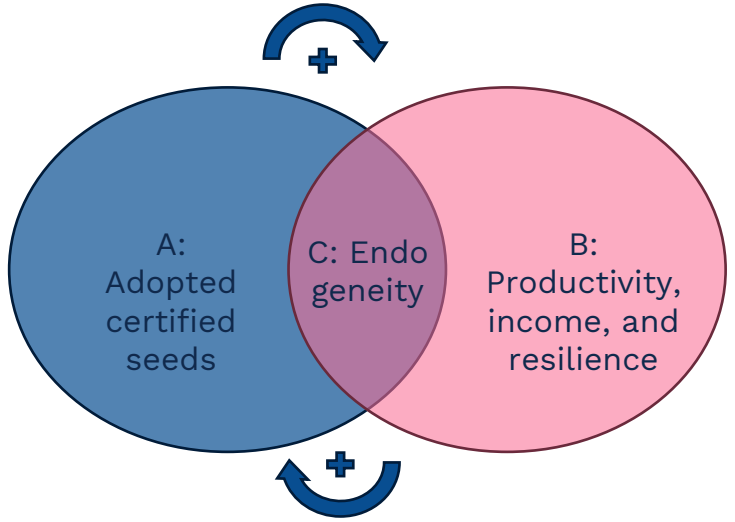
- **Self-assessment:** households evaluate if there has been a significant improvement in their productivity, income, or savings (indicating resilience) over the past five years.
- **Revealed income and wealth**: we measure agricultural income in Burundian Francs and household wealth using the International Wealth Index.
- **Revealed resilience:** we assess changes in the experienced hunger score and the incidence of agricultural shocks as indicators of resilience.

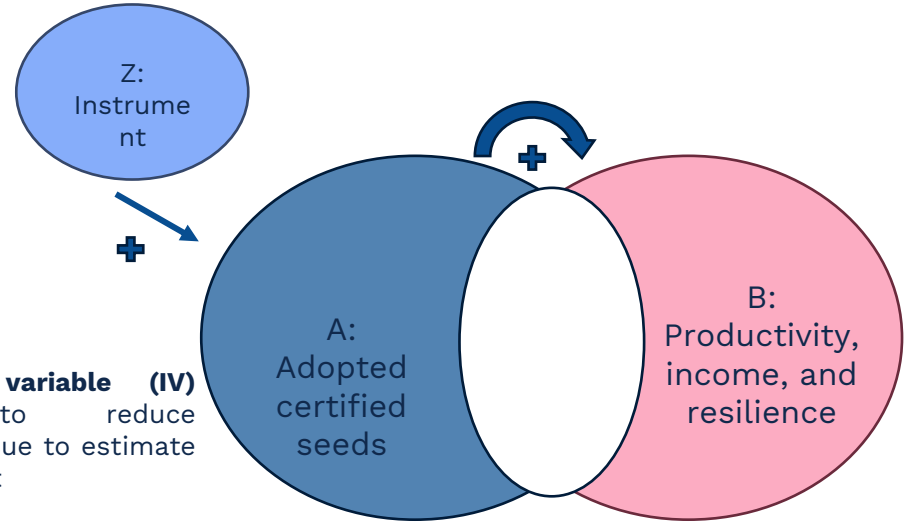
To assess the PSSD program's effectiveness, we consider three options as **explanatory variables (Cic):**

- **Main Variable:** We record whether smallholder farmers adopted certified seeds (=1) or continued using traditional seeds (=0) between 2017 and 2022.
- **Extension 1:** To address potential endogeneity (e.g., more productive farmers may be more inclined to adopt certified seeds), we employ an instrumental variable method as detailed in the figures. This approach meets the necessary conditions and effectively minimizes the risk of overestimating the impact of certified seed adoption on factors like productivity, revenue, and resilience. The logic of the IV-approach is that you estimate the likelihood of farmers adopting certified seeds using an instrument that only affects the productivity, income, and resilience of farmers through its effect on certified seed adoption.
- **Extension 2:** We examine whether residing in a treatment (=1) or control colline (=0) affects the productivity, income, or resilience of households, independent of the farmers' use of certified seeds.

As for all analyses, we incorporate a comprehensive set of controls at the household and provincial levels, and we cluster standard errors at the colline level.

Endogeneity **problem using standard** method – overestimation of effect of certified seeds on outcome variables





Instrumental variable (IV) approach to reduce endogeneity issue to estimate unbiased effect

Annex B: Methodology – Using smallholder farmer survey for PSSD Results framework

Another key objective of this evaluation is to complete the PSSD program's results framework, which includes four outcome and impact indicators – specifically, identifying the number of households directly benefiting from the PSSD program. Using the smallholder farmer survey, which is a representative sample of the targeted farmer population, we use the estimated "treatment effects", such as the percentage of farmers adopting certified seeds due to the PSSD program, to complete the framework. The estimated treatment effect (% of farmers who directly benefits due to the PSSD programme) is then multiplied by the total number of targeted households, a figure elaborated on in the following slide

Indicator 1: Cumulative number of households *that adopted certified seeds* due to PSSD between 2017-2022

- To assess the PSSD program's impact on the adoption of certified seeds from 2017 to 2022, we multiply each province's total number of targeted households (detailed on the next slide) by the "treatment effect of the PSSD proogramme", calculated from the difference in adoption rates between treatment and control collines between 2017 and 2022. For example, if there's a 60-percentage point increase in farmers using certified seeds in treatment collines between 2017-2022 and a 20-percentage point increase in control collines over the same period, the net effect size is 40 percentage points, indicating that farmers in treatment collines are 40%-points more likely to adopt certified seeds.

Indicator 2: Cumulative number of households that *increased productivity* due to PSSD between 2017-2022

- We calculate the impact of the PSSD programme by multiplying the total number of households using certified seeds (Indicator 1) by the percentage of farmers reporting significant productivity gains from adopting these seeds (see methodology).

Indicator 3: Cumulative number of households that *increased income* due to PSSD

- We calculate the impact of the PSSD programme by multiplying the total number of households using certified seeds (Indicator 1) by the percentage of farmers reporting significant income gains from adopting these seeds (see methodology).

Indicator 4: Cumulative number of households that *doubled productivity* due to PSSD

- We assess the PSSD programme's impact by multiplying the number of households adopting certified seeds (Indicator 1) with the percentage of demonstration plots for potatoes, maize, and beans that have experienced a doubling in yield.

Annex B: Methodology – Results Framework PSSD

We follow a six-step process to calculate the PSSD program's targeted households in each province, using Kayanza's potato farmers as an example. This allows us to estimate the number of households that benefited from the program, such as those adopting certified seeds, as demonstrated in the next slide.

Step 1: Determine the population for each targeted province, using data from the 2019 Burundi census.
- For potatoes: Kayanza, Muramvya, Bujumbura Rural, Bururi, Mwaro
- For maize: Makamba, Karusi, Kirundo, Gitega, Muyinga, Rutana
- For beans: Ruyigi, Cankuzo, Myinga, Kirundo

Step 2: Extrapolate the population size for 2022 using the geometric mean for population growth in Burundi, reported as 2.66% (World Bank, 2023).

Step 3: Estimate the number of households per province based on the average number of household members, as per the Global Data Lab (2023).

Step 4: Calculate the percentage of potato (or maize/beans, if the PSSD targets those crops in a province) farmers in each province, based on data from the Enquête Nationale Agricole du Burundi de 2011-2012.

Step 5: Assess the coverage of the PSSD program in a given province, using the percentage of collines where the PSSD program is active.

Step 6: Estimate the total number of targeted households by multiplying the total number of households in a province (from Step 3, referred to as column 4) with the percentage of potato farmers (from Step 4, referred to as column 5), and then with the percentage of targeted collines

Provinces targeted by the PSSD for potato cultivation	Population in 2019	Estimated population in 2022	Estimed number of total households	% of households that cultivate	Coverage of PSSD in province	**Total number of targeted households**
Kayanza	801544	890292	158697	8.27%	47.83%	6277

Annex B: Sampling and data cleaning – smallholder farmer survey

Summary statistics of selection of key variables

	Mean	Min	Max
Household has **adopted certified seeds** for cultivating potatoes, maize, or beans between 2017 and 2022 (=1) or still uses traditional seeds (=0)	42.6%	0	1
Household was **purposefully sampled** (=1) or not (=0)	20.2%	0	1
Household lives in **treatment (=1) or control (=0) colline**	49.2%	0	1
Age of household head	45.8	18	95
Gender of household head (1= male, 0 = female)	87.0%	0	1
Household head is member of **village leadership** (=1) or not (=0)	20.2%	0	1
Number of different **crops and livestock**	1.71	1	16
International Wealth Index of household (0-100)	34.9	14.1	65.7

After inspecting and cleaning the data, we excluded 24 smallholder farmers on the basis of:

- 12 farmer households that **do not cultivate the target crops of their selected province** (e.g., farmer household in Makamba that does not cultivate maize)
- 2 farmer households with **invalid demographics** (e.g., household head is 5 years old)
- Additionally, for certain analyses, we omit observations with inconsistent outcomes (e.g., agricultural income is higher than total income). Any such exclusions are indicated in the accompanying figure notes.
- Overall, the quality of the data is reliable – considering the low number of households that need to be excluded.

Beyond the **random sample** of 1,414 smallholder farmer households, we **purposefully sampled** 355 farmers, about 20% of the sample size, to guarantee a sufficient number of households using certified seeds for the specified crops, averaging 4 to 5 households in each colline.

- To avoid bias in our estimates, we omit the purposefully sampled smallholder farmers from some analyses – particularly if the goal of the analysis is to estimate the prevalence of certified seed adoption. These exclusions will be noted in the figure captions.

Annex B: Methodology–Empirical approach for smallholder farmer survey

We have three empirical strategies to be applied on the farmer survey depending on the type of evaluation question

1. Evaluation questions on certified seed adoption (EQ 1A) with focus on gender dimension (EQ 1F). Further explanation can be found on slide 103.

Objective: To evaluate the effectiveness of the PSSD program, the focus is on enhancing the adoption rates of certified seeds and good agricultural practices (i.e., irrigation, crop rotation) among smallholder farmers.

Method/Empirical Model: Linear probability model assessing adoption between 2017-2022.

Key Variables:

- Dependent Variable: Adoption of certified seeds (1 = adopted between 2017-22, 0 = not). For maize, we also consider hybrid varieties as certified seeds.
- Key independent Variables:
  - Household in a treatment colline under the PSSD programme (1 = yes, 0 = no).
  - Participation in field training or visitation demonstration plot between 2017-22 (1 = yes, 0 = no).
- Controls: Household demographics, crops and livestock, income sources, land size; Provincial fixed effects; Cluster robust standard errors at colline level.

2. Evaluation questions on constraints for certified seed adoption and satisfaction (EQ 1B and 1E)

Objective: Identify supply- and demand-side constraints affecting adoption of certified seeds.

Method: Perception data analysis of certified seed users and non-users.

Key variables/Constraints Analyzed:

- Examples of **supply-side** constraints considered:
  - Distrust in suppliers
  - Distance to suppliers of certified seeds
  - Price comparison to other suppliers
  - Price comparison of certified versus traditional seeds to other seed per hectare of land cultivated with res
- Examples of **demand-side** constraints considered
  - Distrust in certified seeds
  - Conviction about benefits (e.g., productivity gains) of using certified seeds versus traditional seeds
  - Financial constraints to make investment
- Furthermore, we examine whether smallholder farmers living in **treatment collines** are less likely to experience these constraints – suggesting the possible effectiveness of the PSSD programme.

Annex B: Methodology smallholder farmer survey

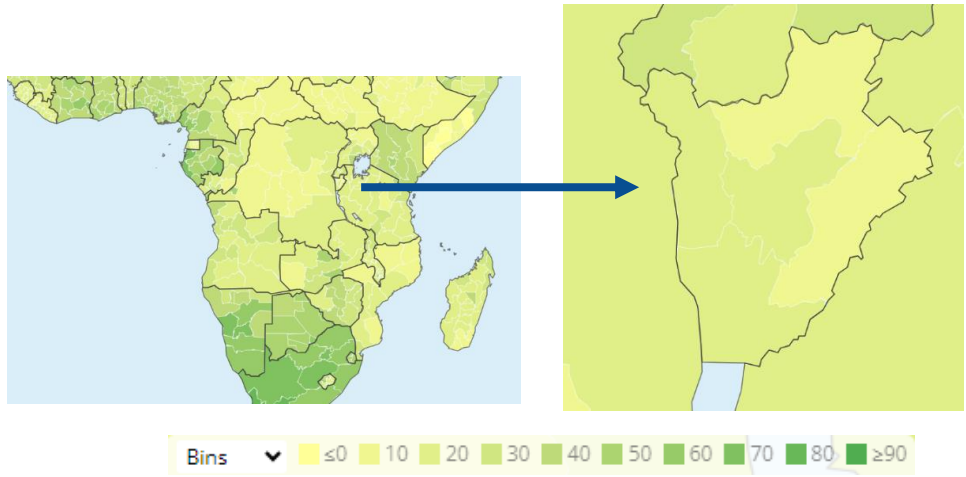
3. Evaluation questions related to the enhancement of productivity (EQ 1C) and their corresponding impacts (EQ 3B), which include the augmentation of income and strengthening of resilience.

Objective: Assess impact of certified seed adoption from 2017 to 2022 on agricultural productivity, income, and various forms of resilience of smallholder farmers. This

Empirical Analysis:

- Dependent Variables:
  - *Set 1:* Self-assessed improvements in household's agricultural productivity, revenues, and savings
  - *Set 2:* Household Income (In Burundian Francs) and wealth (using the International Wealth Index)
  - *Set 3:* Resilience indicators including hunger score and exposure to agricultural/climate shocks
- Independent Variables:
  - *Certified seed adoption between 2017-22* (1 = adopted, 0 = not);
  - *Instrumental variable* for certified seed adoption between 2017-22 (1 = adopted, 0 = not) mitigating endogeneity such as the inclination of higher-yielding farmers to choose certified seeds. See next slide for further explanation.
  - Household living in treatment colline (=1) or control colline (=0) to examine possible direct effect of PSSD programme.
- Controls: Same as for other analysis, with standard errors clustered at colline level.

BOX: The International Wealth Index (IWI) scores households from 0 (no assets) to 100 (all assets), indicating households' socio-economic status more accurately than income. It considers more than 20 indicators on asset ownership and housing quality (which can be objectively verified by enumerators during surveys). In 2017, Burundi's average was 21.7, one of the lowest national scores.



Notes: Data comes from the Global Data Lab. Literature on usage and advantages of IWI can be found here.

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Appendix B: Smallholder Farmers Survey

Findings

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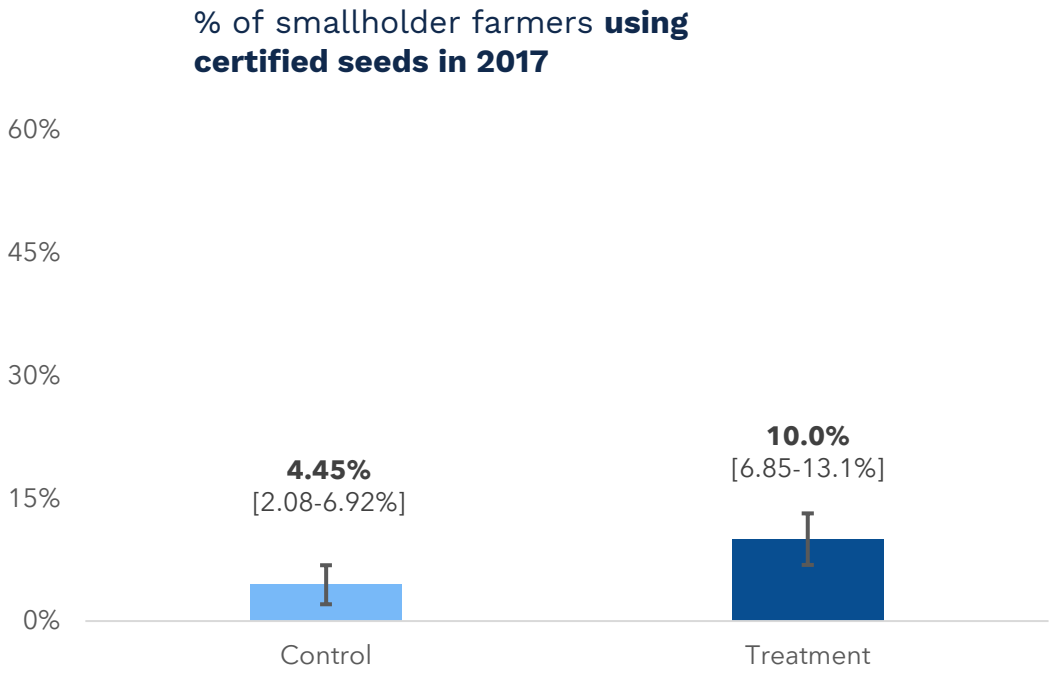
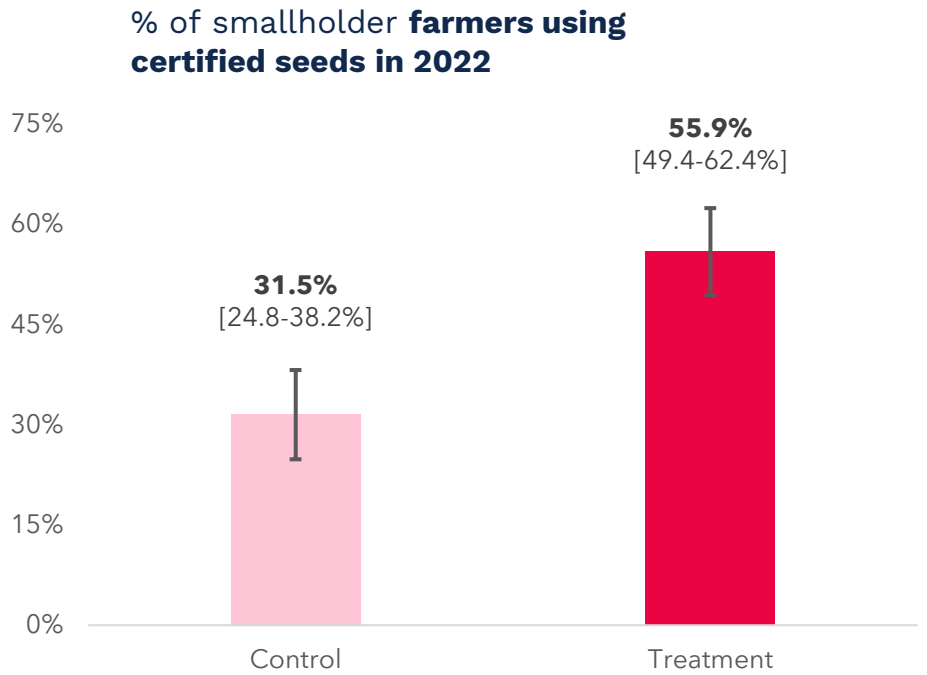
Appendix B: Smallholder Farmers Survey

1. Findings: Effectiveness

Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

The survey results suggest that the PSSD programme was effective in encouraging the adoption of certified seeds among smallholder farmer households. 55.9% of the smallholder farmers living in treated collines – exposed to the PSSD programme - were using certified seeds in 2022 whereas only 10.0% were doing so in 2017, an increase of 45.9%-points [95%CI: 36.3-55.5%]. At the same time the increase in certified seed adoption among smallholder farmers in control collines was significantly lower, being 27.1%-points from 4.45% in 2017 to 31.5% in 2022.



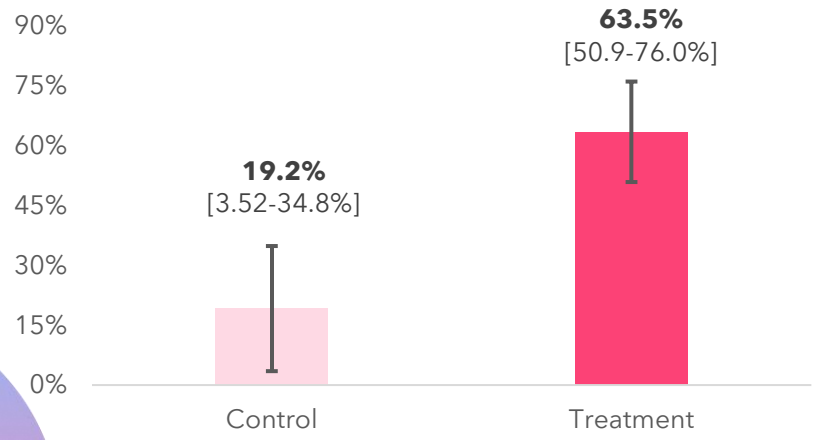


Notes: Estimates presented herein are based on marginal probabilities (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysus.

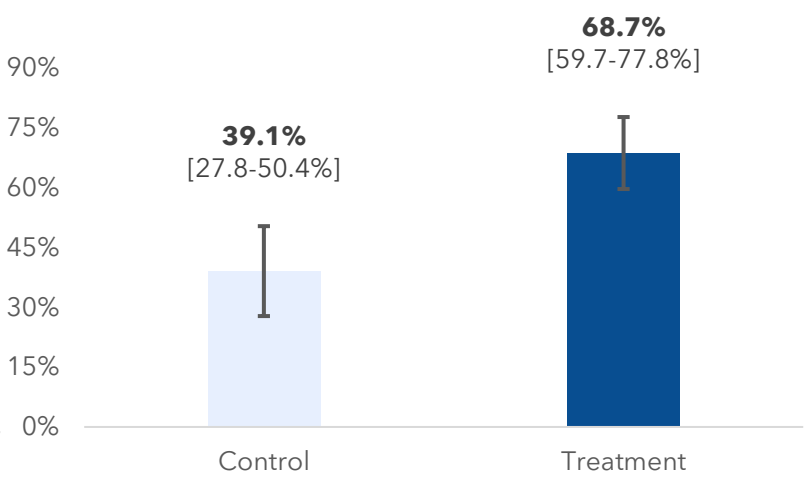
Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

Preliminary results suggest that the PSSD programme was particularly effective in increasing adoption of certified seeds among potato farmers. In 2022 relative to 2017, 63.5%-points more *potato farmers* adopted certified seeds in treatment collines whereas this increase was significantly less in control collines, being 19.2%. For *maize farmers,* we observe a similar degree of effectiveness of the PSSD program considering the significant difference between treatment and control collines, although being slightly less (as per graphic below). However, for *bean farmers* there is no significant differences between treatment and control collines. However, we do not find any significant differences in the effectiveness of the PSSD programme for *female* (vs male) headed households or household heads who are *younger* (vs older). For instance, male-headed households are 2.57% [95%:-13.5-18.7%] more likely to adopt certified seeds in treatment regions in comparison to female-headed households – but the effect is not significant.

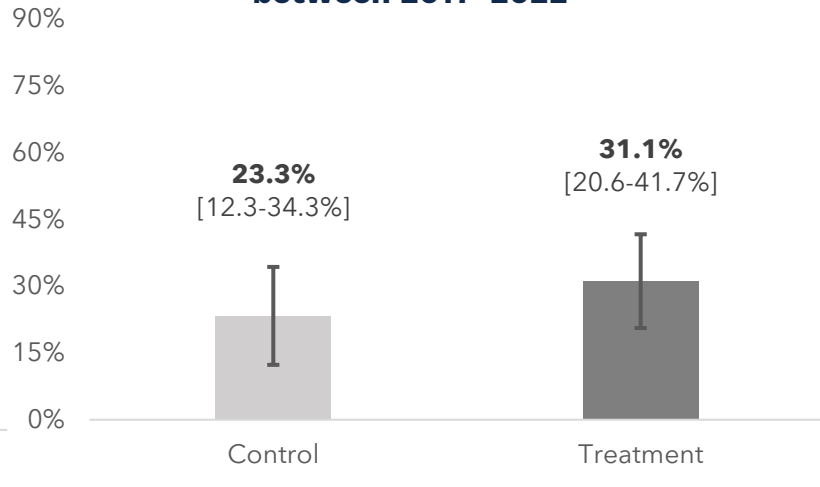
Potato farmers (N=283)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**



Maize farmers (N=365)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**



Bean farmers (N=473)
%-point increase of smallholder farmers who adopted certified seeds **between 2017-2022**

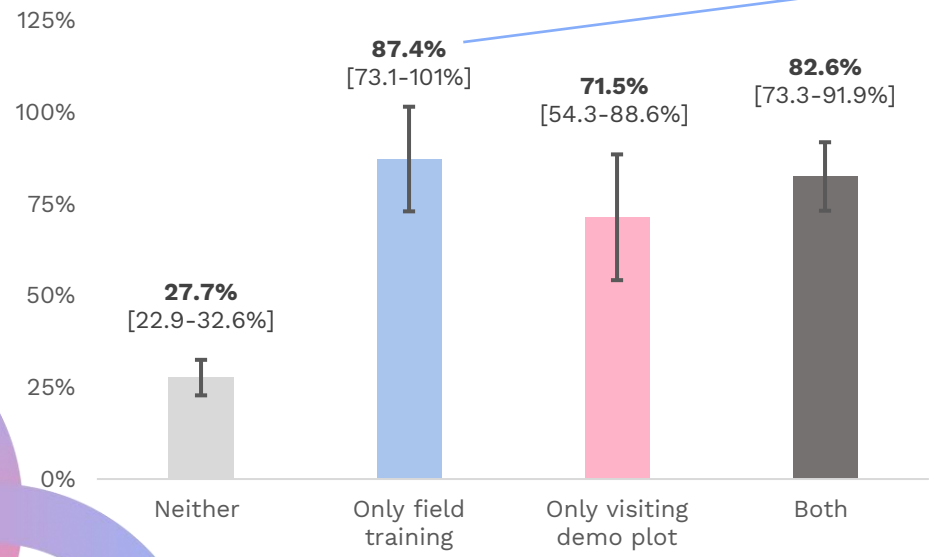


Notes: Estimates presented herein are based on marginal effects (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysis.

Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

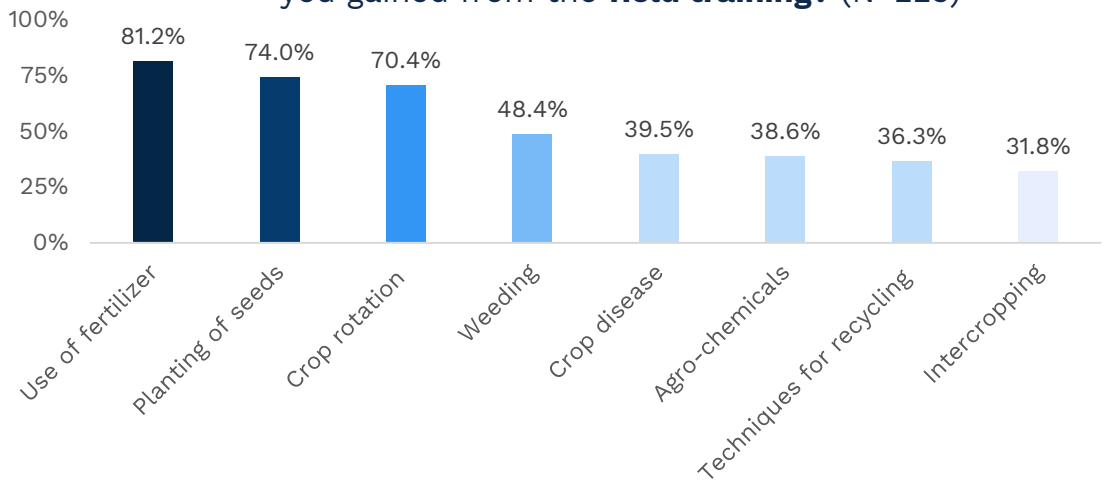
Participating in field training and visiting demonstration plots – two key interventions of the PSSD programme – were equally effective in promoting certified seeds among smallholder farmers. Smallholder farmers who participated in field trainings (demo plots) were 87.4% (71.5%) more likely to adopted certified seeds in 2022 relatively to 2017 than farmers who did not participate. During *field trainings*, smallholder farmers were mostly training in the use of fertilizers, planting techniques, and crop rotation techniques. The *demonstration plots* were effective in convincing smallholder farmers from the advantage of certified seeds.

%-point increase of smallholder farmers who adopted certified seeds between 2017-2022 after **participating in field training, visiting demo plot**, or both

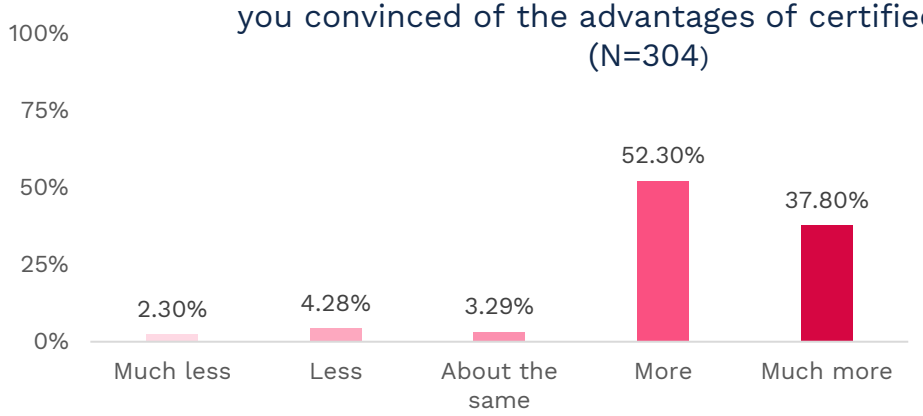


Notes: see previous slide

What were the most valuable skills or lessons you gained from the **field training?** (N=223)



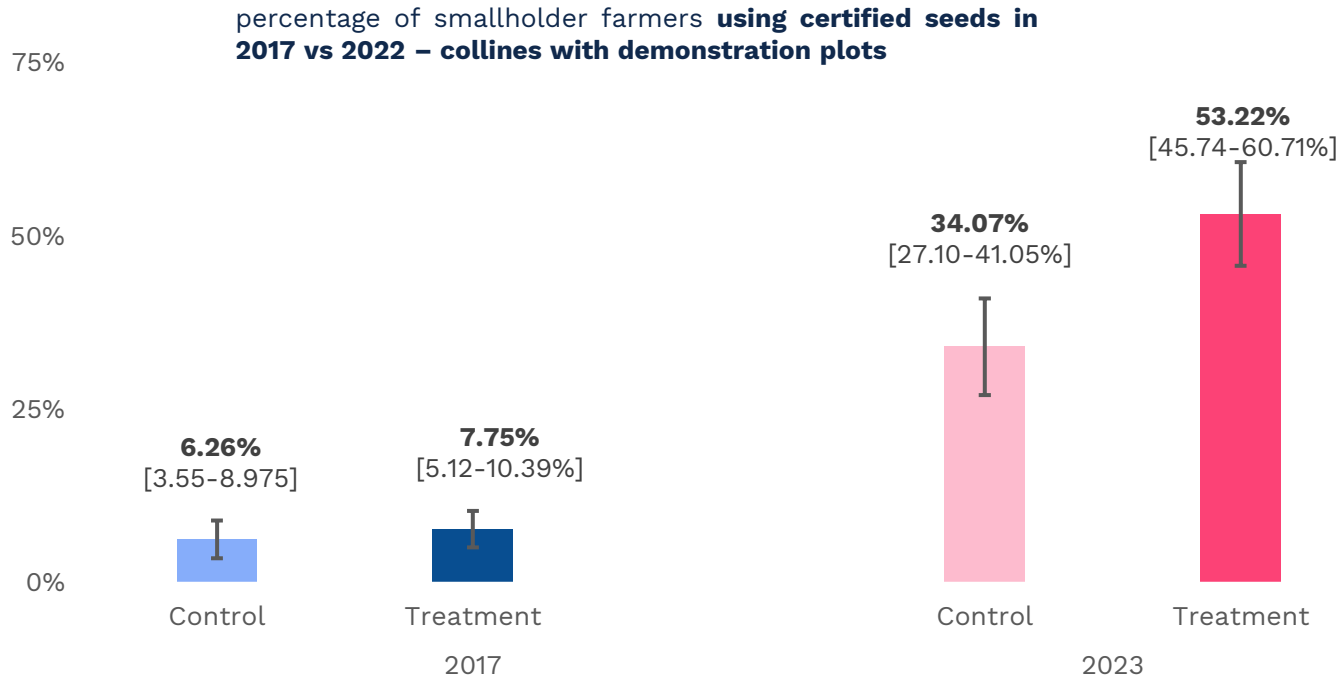
After visiting the **demonstration plot**, to what extent were you convinced of the advantages of certified seeds? (N=304)



Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

Results indicate that the presence of demonstration plots are the most effective PSSD intervention to promote the adoption of certified seeds among smallholder farmers. Evidence for the effectiveness of other PSSD interventions, such as mobile sales units, rural sales outlets, marketing campaigns, and seed fairs, is scant or absent.

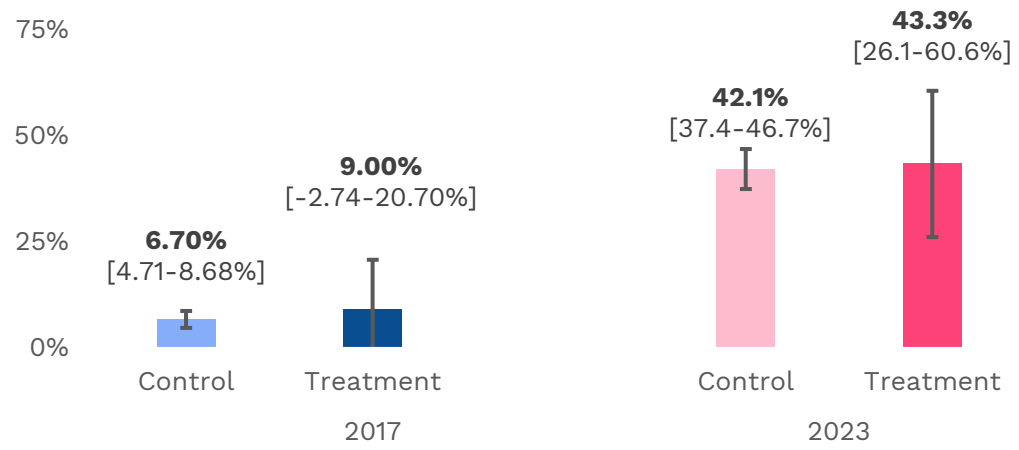
- Results show that the presence of a **demonstration plot (Figure below),** contributed the most to the adoption of certified seeds. Compared to control collines, 19.15%-points more farmers used certified seeds in treated collines when demonstration plots were present (53.22% vs. 34.07%) – corrected for the presence of other PSSD interventions.



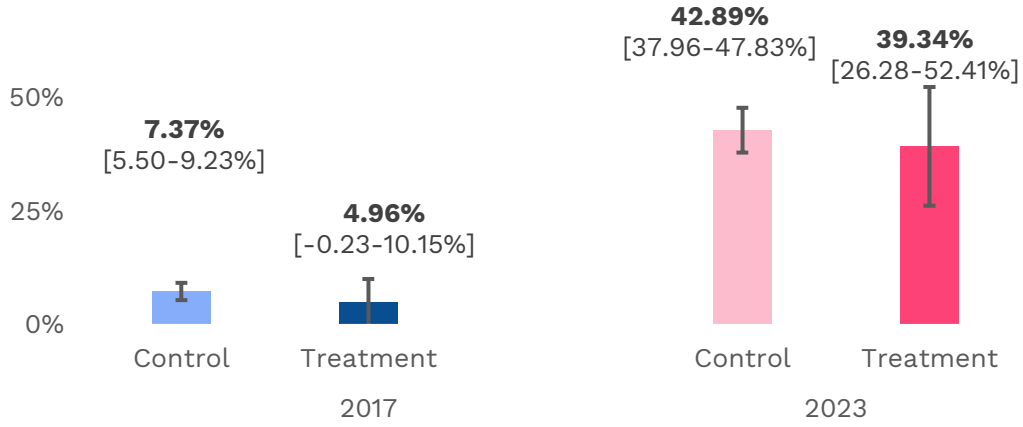
Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

The evidence regarding the effectiveness of mobile sales units and rural sales outlets suggests that they did not contribute to the adoption of certified seeds.

Percentage of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines with mobile sale units**



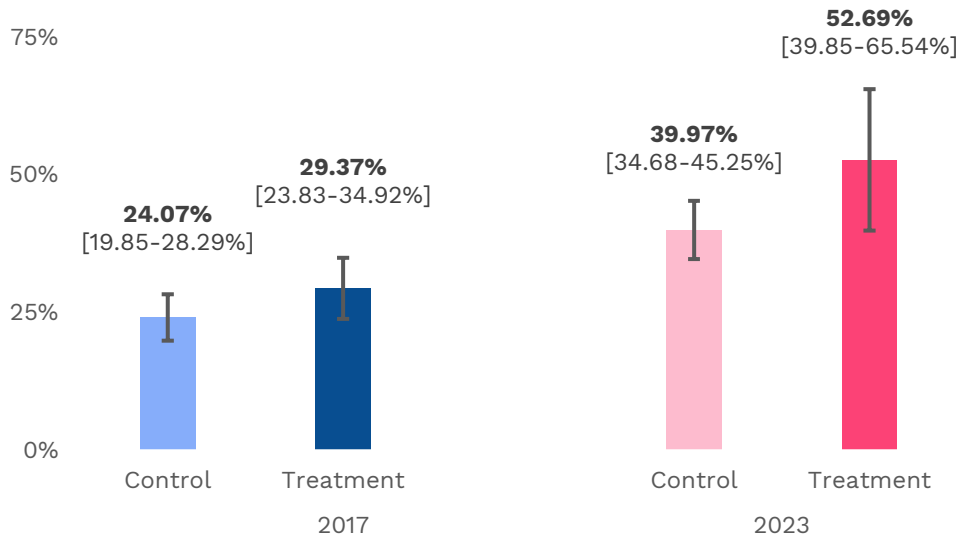
Percentage of smallholder farmers **using certified seeds in 2017 vs 2022 – collines with rural sale points**



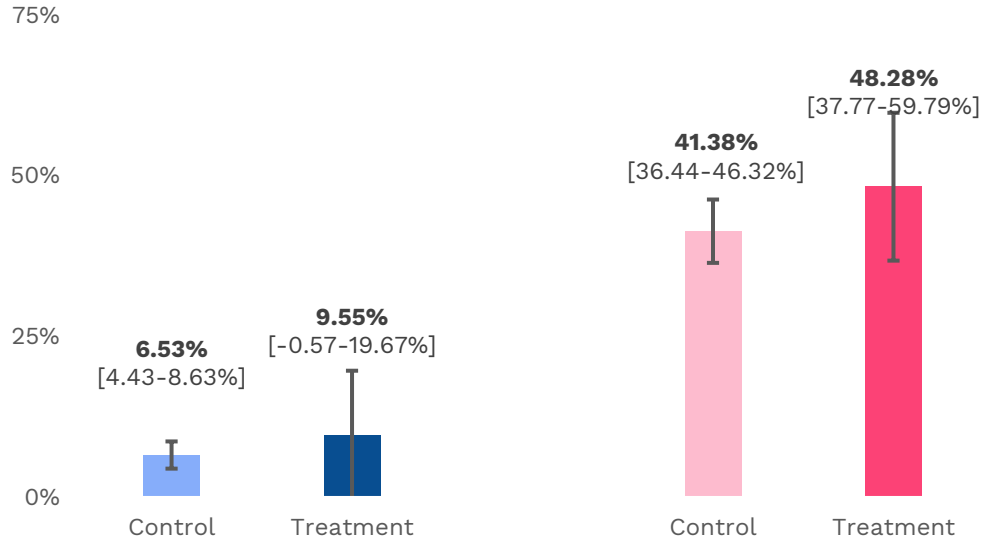
Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

Similarly, our analysis suggests that the impact of marketing campaigns and seed fairs as part of the PSSD programme in encouraging the adoption of certified seeds is marginal and statistically insignificant. When we account for other interventions within the PSSD programme, such as demonstration plots, the relative ineffectiveness of these marketing campaigns and seed fairs becomes evident.

% of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines exposed to PSSD marketing campaigns**



% of smallholder farmers **using certified seeds in 2017 vs 2022 – in collines with seed fairs**



Notes: Estimates presented herein are based on marginal effects (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the Colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 1,230 smallholder farmer households. Households that were purposely sampled are left out from this analysis. Important controls include the presence of other PSSD interventions (e.g., the effect of marketing campaigns correct for presence of demonstration plots).

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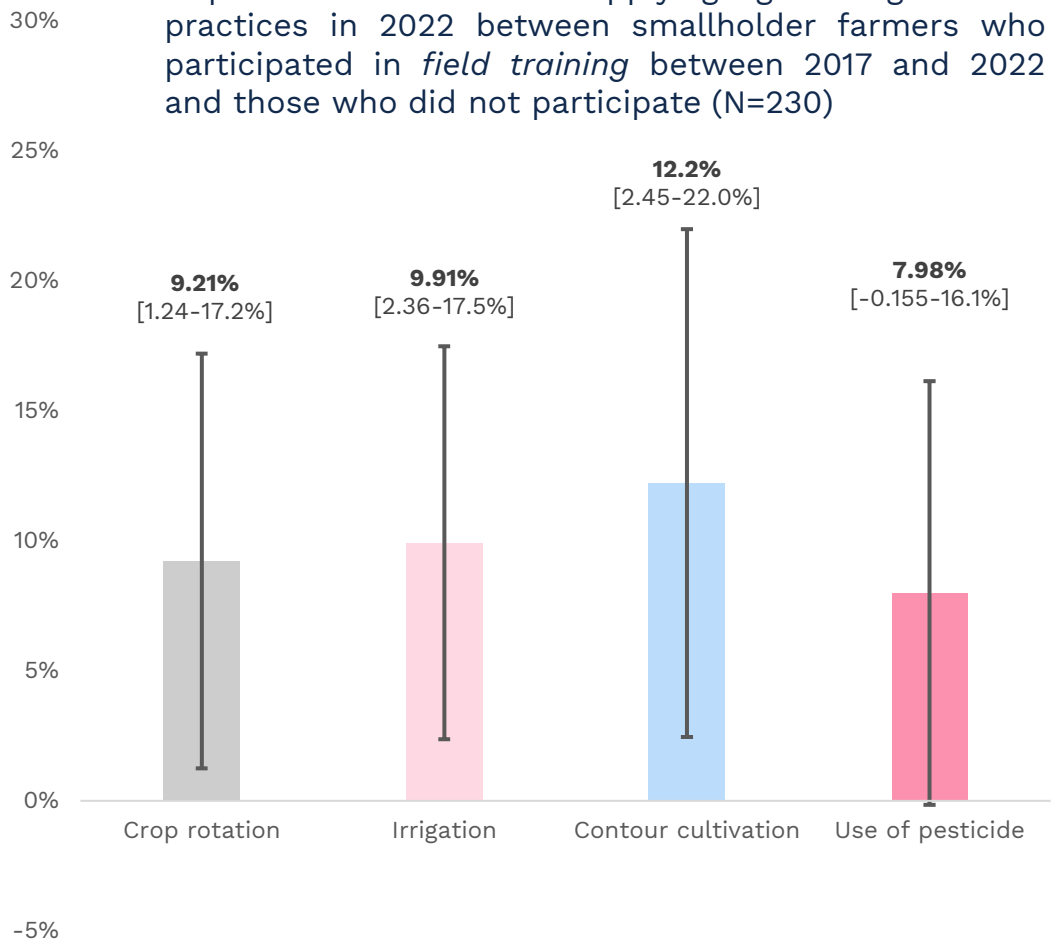
Smallholder Farmers Survey

3. Findings: Impact

Appendix B: 1.A Did the project effectively increase the adoption of certified seeds by farmers?

Extending our analysis to the adoption of good agricultural practices, we find that smallholder farmers in treatment collines are as likely to use good agricultural practices in 2022 as smallholder farmers in control collines – an absence of a treatment effect. However, we do find that farmers who participated in field training were more likely to adopt some good agricultural practices including crop rotation, irrigation, contour cultivation, and the use of pesticides. For instance, in 2022, smallholders who participated in field training were 9.21%-point more likely to apply crop rotation than those farmers who did not participate in field training. Other good agricultural practices that we considered – for which we did not find a significant difference - are: weeding, intercropping, early maturity of crops, and use of fertilizers.

%-point difference in applying good agricultural practices in 2022 between smallholder farmers who participated in *field training* between 2017 and 2022 and those who did not participate (N=230)



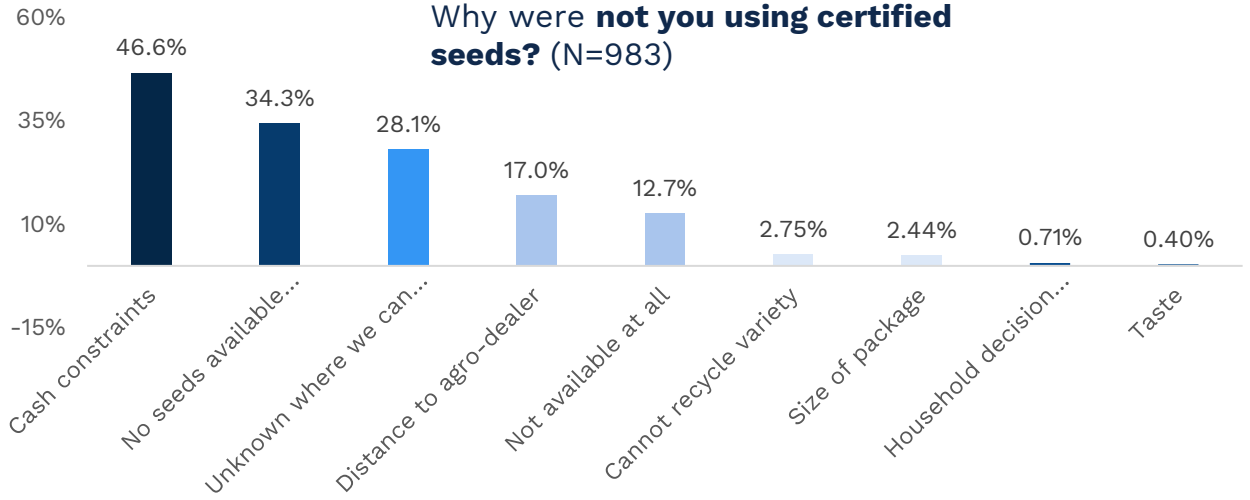
Notes: Estimates presented herein are based on marginal effects (at means) from a linear probability model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 230 smallholder farmer households.

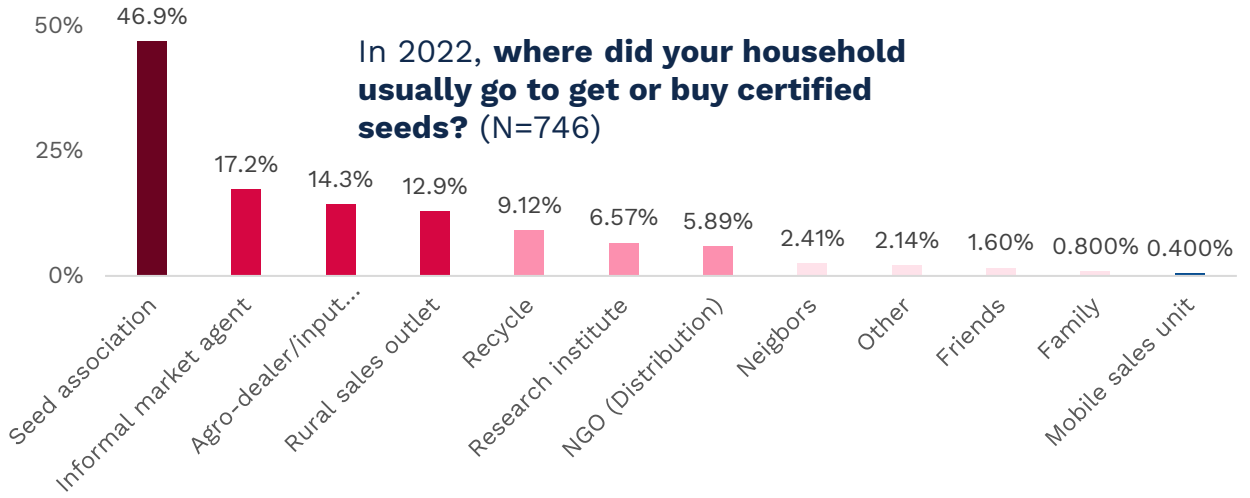
Appendix B: 1.B What were the main constraints for farmer households in adopting certified seeds?

The most important reason for smallholder farmer who are currently not buying certified seeds (N=983) is *cash constraints* - 46% of them reporting it as an important constraint for using certified seeds. Our results indicates that the expenditure of certified seed users is more than double per hectare compared to traditional seed users, with amounts of BAF 1962 for certified seeds versus BAF 877 for traditional seeds.

Another important reasons is the *lack of supply* during the relevant planting season (34.3%) or throughout the year (12.7%). Also significant is the lack of awareness of the *locations of seed suppliers* who sell certified seeds, accounting for 28.1%, as well as *the distance to seed suppliers*, which is a concern for 17.0%. However, our findings indicate that the PSSD program significantly decreased the average travel time for smallholder farmers to reach seed suppliers selling certified seeds by more than 15 minutes when compared to the control group collines.

If we consider those smallholder farmers that do buy certified seeds (N=746), we find that most of them buy them from seed associations (46.9%). Furthermore, smallholder farmers buy their certified seeds from informal market agents (17.2%), agro-dealers (14.3%), and rural sales outlet (12.9%). Not many farmers get their certified seeds from NGO's (6.57%). Also, mobile sales units are not an important supply source (<1%).



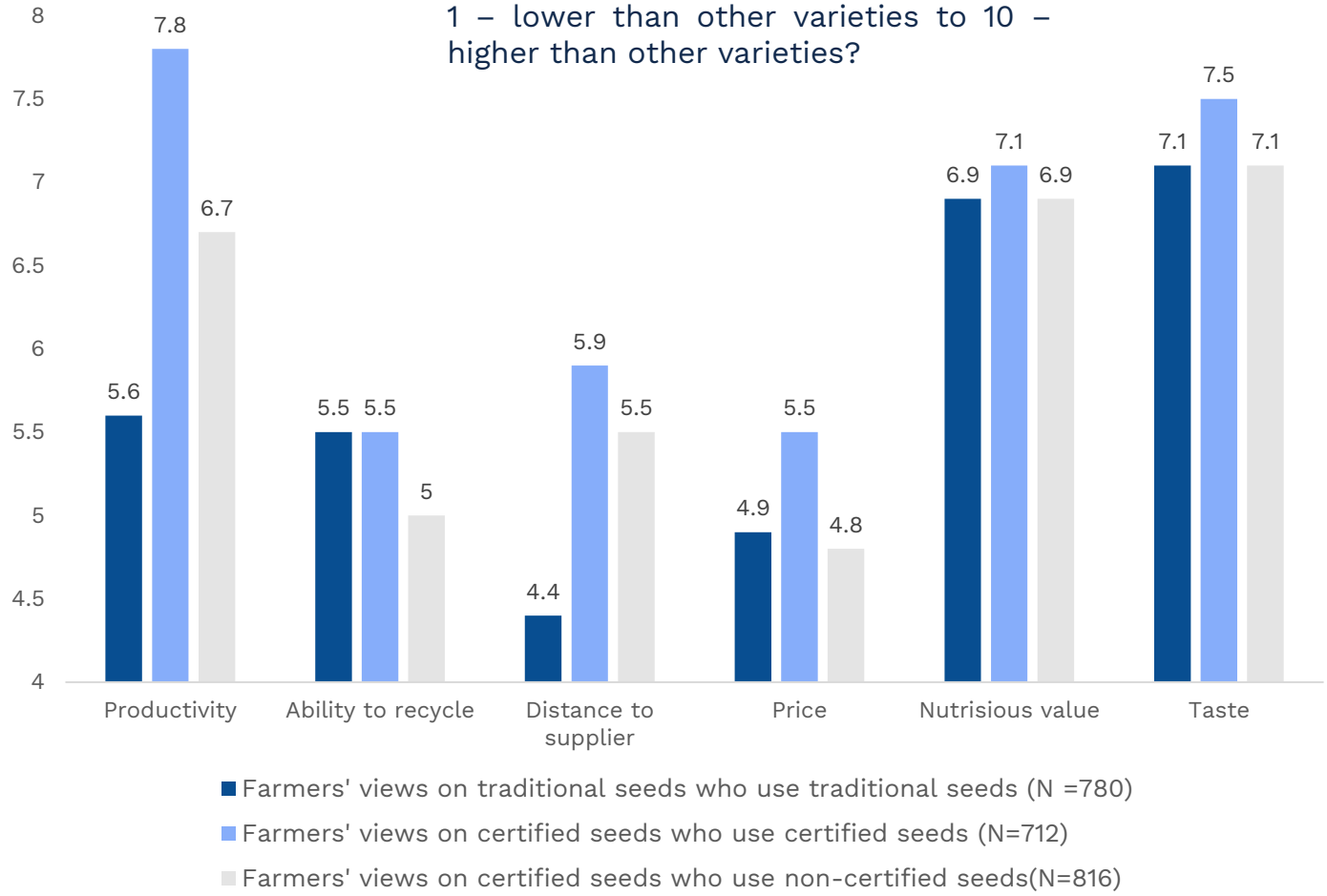


Appendix B: 1.B What were the main constraints for farmer households in adopting certified seeds?

Farmers, whether they adopted certified seeds or not, recognize that these seeds greatly enhance *agricultural productivity* relative to traditional seeds. We surveyed farmers who had adopted traditional and certified seeds, rating the performance of t on characteristics like productivity (positive characteristics) and price or distance to supplier (negative characteristic) from 1 to 10. Additionally, we asked the views of non-users on these characteristics for certified seeds. For instance, certified seeds are perceived as more productive, with users rating them at 7.8 and non-users at 6.7, compared to lower ratings from farmers using traditional seeds (5.6). At the same time, users of certified seeds also perceive the price of their seeds as relatively higher than users of traditional seeds (5.5 vs. 4.4)

Farmers acknowledge that acquiring certified seeds often involves longer travel to suppliers, and those who do not use them also view them as costlier compared to those who do. Simultaneously, both users and non-users acknowledge that certified seeds match or surpass traditional seeds in nutrition and flavor - .

How do you rate the **seed variety relative to other varieties ranging** from 1 – lower than other varieties to 10 – higher than other varieties?

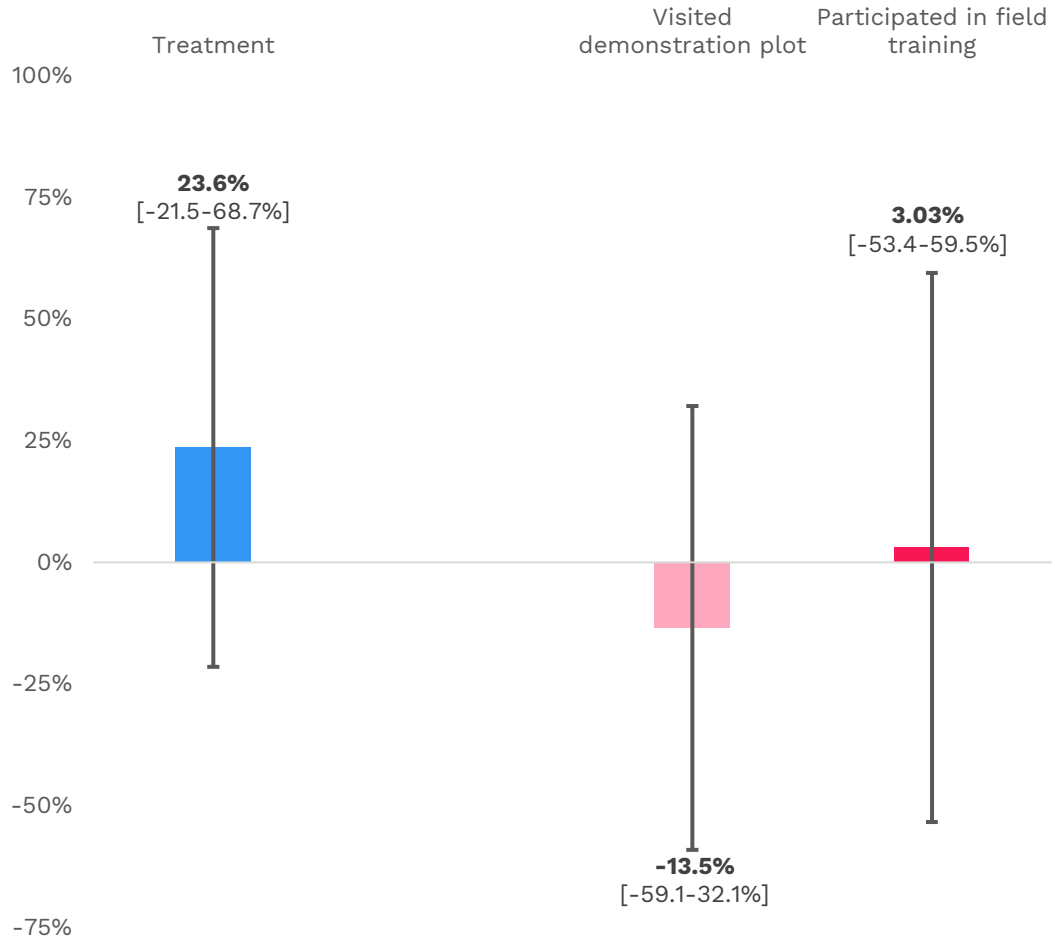


Appendix B: 1.B What were the main constraints for farmer households in adopting certified seeds?

The PSSD programme was not effective in reducing the cost of certified seeds per hectare of land. Our results indicates that the expenditure of certified seed users is more than double per hectare compared to traditional seed users, with amounts of BAF 1962 for certified seeds versus BAF 877 for traditional seeds. At the same time, smallholder farmers in treatment collines pay more for their certified seeds (per hectare of land) than farmers in control collines – although this difference is not significant. In addition, visiting a demonstration plot or participating in field training – as alternative measure for the exposure to the PSSD programme - does not lower the costs for buying certified seeds.

It is possible that farmers in treatment collines use more certified seeds per hectare of land as result of their improved understanding of using seeds. However, the total expenditures to certified seeds remain higher and shows the considerable investment that farmers need to make to use certified seeds.

%-difference in **expenditures on certified seeds per hectare of land** (cultivated with certified seeds) (N = 607)



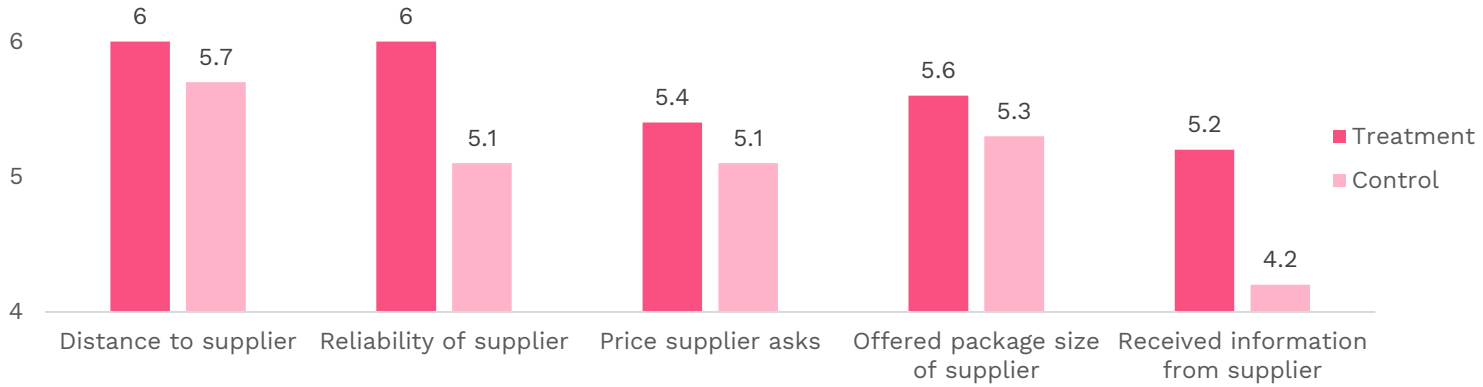
Notes: Estimates presented herein are based on marginal effects (at means) from a OLS model, adjusted for confounding factors at both household and provincial levels. The 95% confidence intervals are denoted in square brackets and are derived using standard errors that are clustered at the colline level, ensuring robustness of the intervals. These models have been estimated using data from a representative sample of 616 smallholder farmer households from which 9 observations (=1% of the sample) have been excluded due to abnormal land size or certified seed expenditures.

Appendix B: 1.B What were the main constraints for farmer households in adopting certified seeds?

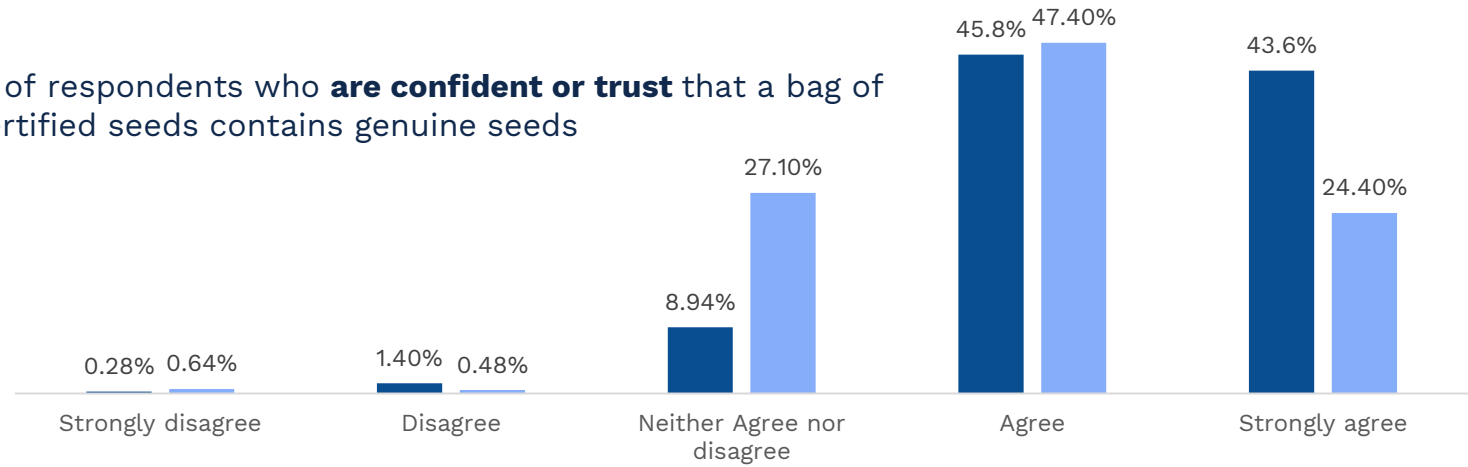
Users of certified seeds in the treatment collines report slightly higher satisfaction with their seed suppliers compared to those in control collines. This is attributed, in part, to the enhanced information treatment colline users receive about the proper usage of their seeds. Despite this, there remains a general sense of dissatisfaction among smallholder farmers with their seed suppliers.

Non-users of certified seeds exhibit slight trust issues with suppliers in comparison to users. They tend to be more skeptical about the authenticity of the certified seeds, fearing they might be adulterated with traditional seeds. This skepticism serves as an additional barrier to purchasing certified seeds for non-users. However, the observation that most certified seed users do not share these trust concerns suggests that the apprehensions of non-users may be unwarranted.

Satisfaction with seed supplier of smallholder farmers who adopted certified seeds on a scale from 1 dissatisfied to10 satisfied in treatment and control collines (N=743)



% of respondents who **are confident or trust** that a bag of certified seeds contains genuine seeds



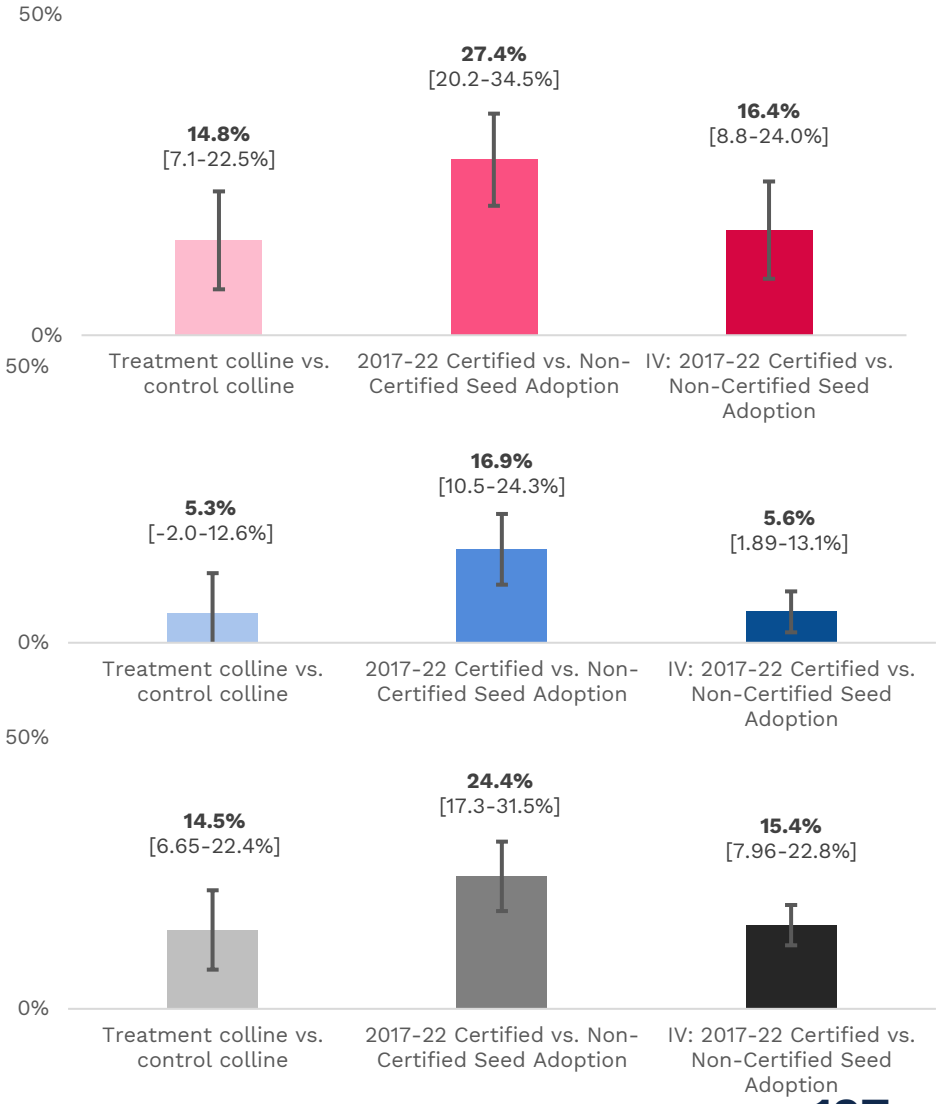
Appendix B: 1.B What were the main constraints for farmer households in adopting certified seeds?

Smallholder farmers who adopted certified seeds between 2017-22 are significantly more likely to self-assess that their agricultural productivity, revenues, and savings strongly increased over the last five years in comparison to farmers who still do not use certified seeds. For instance, farmers who adopted certified seeds are 14.8%-points more likely to say that their agricultural productivity has increased much between 2017-22 than farmers who did not. Although these difference remain significant, they become smaller if we correct for endogeneity - the possibility that more productive and richer farmers are more likely to adopt certified seeds – using instrumental variables (IV). Similarly, the effect size of PSSD remains small and significant if we consider all smallholder farmers living in treatment collines vs. those living in control collines regardless of whether they use certified seeds.

%-point difference between adopters (=1) and non-adopters (=0) that perceive their **agricultural productivity** has improved significantly in the period 2017-22

%-point difference between adopters (=1) and non-adopters (=0) that perceive their **agricultural revenues** (from potatoes, maize, beans) has improved significantly in the period 2017-22

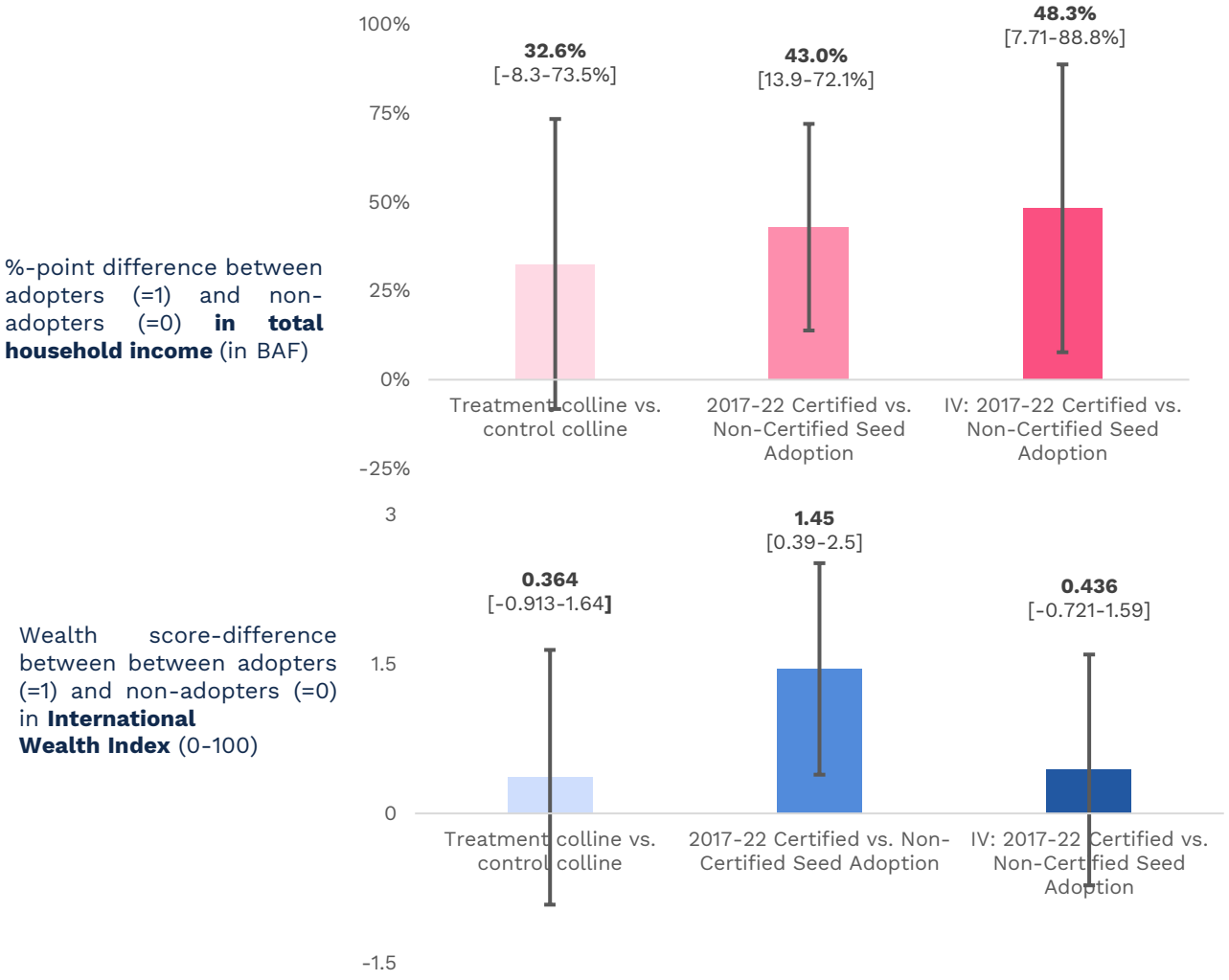
%-point difference between adopters (=1) and non-adopters (=0) that perceive their **household savings** has improved significantly in the period 2017-22



Appendix B: Has the increased adoption of certified seeds allowed farmers to increase their productivity/income?

Smallholder farmers who adopted certified seeds between 2017-2022 have a household income that is 43.0% higher in 2022 in comparison to those farmers who did not adopt certified seeds. These results hold even if we correct for endogeneity - smallholder farmers with higher incomes are more likely to adopt certified seeds – using instrumental variables.

Our analysis shows a modestly stronger resilience in certified seed users, as indicated by the International Wealth Index (IWI). The IWI measures household wealth on a scale from 0 to 100, with 100 reflecting ownership of key assets like a car and good housing, and 0 indicating no asset ownership. In our sample, the average IWI score was 34.5, with a high of 65.7. Certified seed adopters had an average IWI score 1.45 points higher than non-users, comparable to the ownership of a bicycle. However, these differences were not statistically significant after adjusting for endogeneity

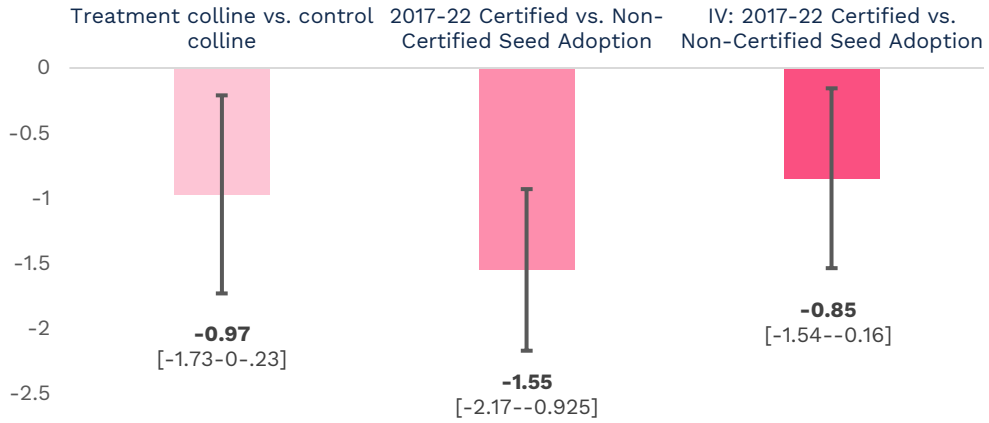


Notes: see earlier figures. For this analysis we included the purposely sampled smallholder farmers (and added controls accordingly)

Appendix B: 3.B What was the impact of the project on the income of smallholder households?

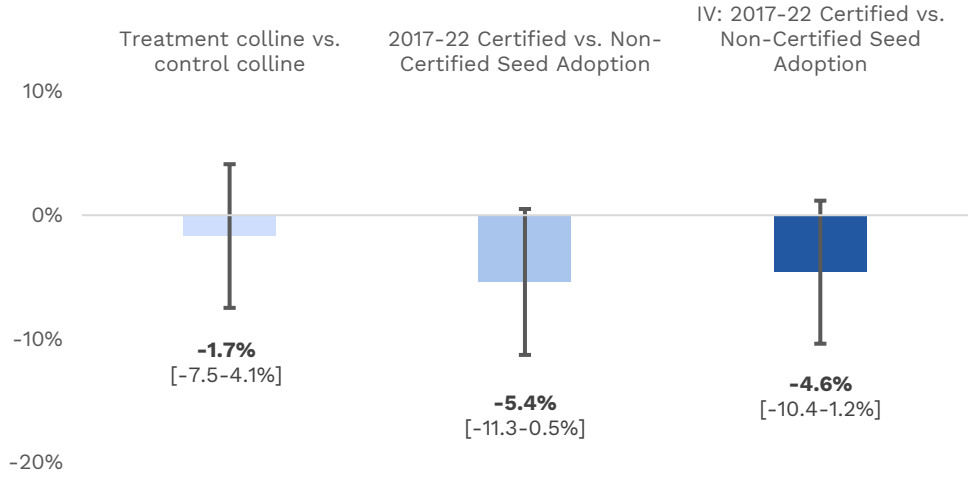
The survey results indicate that smallholder farmers using certified seeds from 2017 to 2022 reported significantly less extreme hunger compared to non-adopters. The hunger metric, spanning -15 to 15, reflects changes in extreme hunger incidence, with -15 denoting substantial reduction over the last five years. The mean change in hunger score in our dataset is -3, suggesting a general decrease in extreme hunger compared to five years ago. Farmers using certified seeds have an average score 1.55 points lower being approximately -4.55 signifying greater resilience to hunger. These findings remain consistent after addressing potential endogeneity with instrumental variable techniques.

Hunger score-difference between adopters (=1) and non-adopters (=0) **in experienced hunger scores** for period 2017-22



Similarly, adoption of certified seeds is correlated to reduced susceptibility **to income shocks from agricultural adversities** like diseases and pests, showcasing enhanced resilience in agriculture. However, these findings are slightly less precise and only significant at a 10%-confidence interval.

%-point difference in likelihood of **experiencing agricultural shock** (e.g., crops failure) for period 2017-2022 between adopters (=1) and non-adopters (=0)



Notes: see earlier figures. For this analysis we included the purposely sampled smallholder farmers (and added controls accordingly)

Caveats and limitations of survey analysis

Caveats:

- **Data and method triangulation:** The outcomes of the farmer's survey need to be triangulated with the survey among seed entrepreneurs and the Focus Group Discussions (see updated timeline). The preliminary results point towards supply-side constraints as the main bottleneck for certified seed adoption – for which the seed supplier survey and focus group is particularly relevant.
- **Update data & data on request:** Data on unreported variables or analyses is available upon request. While this may lead to minor adjustments in the reported outcomes, our conclusions remain solid across multiple sensitivity analyses.
- **Technical interpretation:** We have used the most rigorous empirical methods at hand to assess the PSSD programme's effectiveness. Consequently, interpreting some of the results may demand additional technical expertise. We are on hand to discuss the findings and clarify their primary interpretations.
- **Certified seeds for bean farmers:** For bean farmers, verification of certified seed usage was challenging because many lacked the original packaging, unlike maize and potato farmers whose seed use could be directly confirmed. Consequently, interpreting the lack of observable benefits among bean farmers requires careful consideration and further corroboration through focus group discussions.

Limitations:

- **Treatment spillovers** Intervention programs often benefit non-participants, such as control groups, which is advantageous for policy goals but complicates effectiveness assessments. Although we've chosen control collines carefully to mitigate this spillover effect, it's impossible to eliminate it entirely, which may lead to underestimating the program's impact. Despite this, our initial findings indicate that households in treated collines still experience significant benefits compared to those in control collines, even if spillovers may reduce the observed difference.
- **Endogeneity and instrumental variables:** There's a risk that our findings, especially for Research Question 3, may reflect endogeneity rather than direct causation. For instance, the observed positive relationship between certified seed adoption and income could be influenced by the fact that more productive farmers are likely to adopt certified seeds. We have applied advanced econometric techniques to mitigate this bias. While we meet all necessary conditions (such as instrumental validity and dummy-variable adjustment), it's important to note that using instrumental variables can lead to conservative estimates, being less precise.
- **Recall data:** In the absence of high-quality baseline data, we depend on recall data to approximate the PSSD program's impact and effectiveness, such as asking respondents to remember when they began using certified seeds. We have carefully crafted our survey questions to minimize recall bias, which can distort memories from the distant past. Typically, recall bias might lead to underestimating effectiveness, as respondents are inclined to be overly optimistic about their past.

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Annex C: Extensive methodology and results of seed entrepreneurs survey

Overview

Part 1: Methodology and Summary Statistics

Part 2: Results of Seed Entrepreneurs Survey – sorted by evaluation criterion

1. Effectiveness
2. Efficiency
3. Impact
4. Coherence
5. Sustainability

Part 3: Additional Information

- Type of seeds produced and preordering
- Equipment and products used
- Agricultural practices

Evaluation questions addressed by seed entrepreneurs survey

EQ1D: How effective was the integration of private sector partners in achieving the project objectives?

EQ1B: What were the main constraints for smallholder farmer households in adopting certified seeds?

RQ3: To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

EQ3A: To what extent has the project contributed to the development of the private seed sector in Burundi?

RQ5: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

RQ6: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

Main findings

1. Seed suppliers were effectively integrated in the PSSD program: all suppliers received at least one type of training or support from IFDC. Training on all activities was provided to at least ¾ of suppliers.
2. According to seed entrepreneurs, the main constraints to certified seed adoption by farmers was the low purchasing power of the latter. They also believed that many farmers had insufficient information on the use and benefits.
3. The most effective PSSD interventions to connect seed entrepreneurs and farmers were field days with demonstration plots, rural sale points and advertisement.
4. According to the entrepreneurs, the project strongly contributed to the development of the private seed sector in Burundi: 93.75% of suppliers attribute their financial success to the PSSD program. None of the interviewed seed entrepreneurs incurred in losses and 69% experienced a surge in profits.
5. 27% of seed entrepreneurs received support from other organization. The free distribution of seeds to the farmers by the government or other organizations did not have an impact on half of the suppliers, but it somehow affected 48% of suppliers.
6. Since revenues and profits significantly increased for all seed suppliers between 2017/2018 and 2022, they are likely to continue with their sale activities. The majority of suppliers believes that without IFCD they would continue the sale and marketing activities with the same frequency or even more often, while a minority would reduce their frequency.

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Seed Entrepreneurs Survey

Methodology

Annex C: Methodology

- We purposefully selected 48 seed entrepreneurs at different stages of the certified seeds chain who participated to the PSSD program (2017/2018-2022)
- Objectives:
  - Obtain retrospective information on the entrepreneurs to reconstruct the baseline in 2017 and compare it to 2022
  - Identify bottlenecks in the value chain
  - Evaluate the effectiveness of PSSD's training and marketing activities
  - Assess the sustainability of the projects from the entrepreneurs' perspective

Annex C: Seed entrepreneur survey

We purposefully selected 48 seeds entrepreneurs at different stages of the seed chain who actively participated in the PSSD program. The table on the right shows key characteristics of the sample.

In line with the overview table presented on slide 12, the evaluation questions addressed by the seed entrepreneur survey are the following:

- EQ1D: How effective was the integration of private sector partners in achieving the project objectives?
- EQ1B: What were the main constraints for smallholder farmer households in adopting certified seeds?
- EQ1G: To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?
- EQ3A: To what extent has the project contributed to the development of the private seed sector in Burundi?
- EQ4A: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?
- EQ5C: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

Like the smallholder farmer survey, this evaluation lacks baseline and midline data for seed entrepreneurs. Consequently, we depend largely on retrospective data and their perceptions of changes, such as income, since the PSSD programme began. The seed entrepreneur survey aims to be primarily qualitative, unlike the more quantitative smallholder farmer survey. The adjacent table provides descriptive statistics for the sampled seed entrepreneurs. It highlights that a majority, 81%, are male. These individuals were selected from the same provinces as those included in the farmer survey. Furthermore, they specialize in the production of seeds for various crops, predominantly maize.

More detailed information on the methodology and the complete results can be found in Annex C.

Variable	Mean [min-max]	Count
Respondents		48
Age	48.72 [25-70]	
Sex (1=male, 0=female)	81%	Females: 9 (19%) Males: 39 (81%)
Province		Bujumbura rural: 5 (10.42%) Bururi: 11 (22.92%) Cankuzo: 9 (18.75%) Makamba: 8 (16.67%) Ruyigi: 15 (31.25%)
Revenues 2022 (million BIF)	≅60	<10: 9 (18.75%) 10-30: 3 (6.25%) 30-60: 14 (29.17%) 60-100: 15 (31.25%) >100: 7 (14.58%)
Customers 2022	1098.1 [72-12,500]	
Customers 2018	316.9 [0,2,500]	
Crops		Maize: 42 (87.5%) Bean: 30 (62.5%) Potato: 17 (35.41%)
Type of seeds		Certified: 48 (100%) Hybrid: 10 (20.83%) Recycled: 3 (6.25%) Other: 1 (2.08%)
Yield 2022 (Kg)	35,339 [8-192,000]	

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Seed Entrepreneurs Survey

Findings

1. Effectiveness

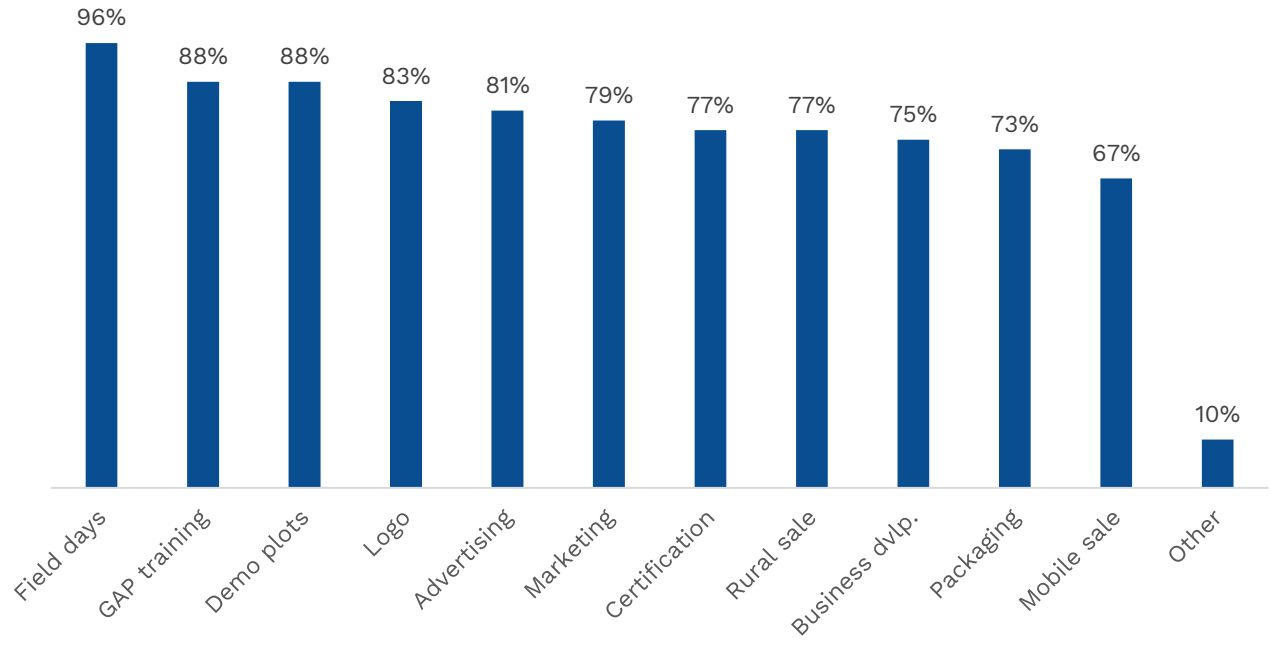
RQ1: How effective was the integration of private sector partners in achieving the project objectives?

- **Seed suppliers received both demand-side training** (advertising, marketing, rural sale points, mobile sale agents, labelling) **and supply-side training** (organisation of field days, demonstration plots, seed packaging, good agricultural practices) from IFDC

- **All suppliers received at least one type of training** or support from IFDC
- **Training on all activities was provided to at least ¾ of suppliers**
- The most provided trainings were:
  - Field days organization
  - Good agricultural practices
  - Demonstration plots

- 9 out of 48 suppliers felt extremely engaged and encouraged to participate to the decision-making process during the training activities, 39 did not answer.
- **The average number of customers increased from 316 to 1098 between 2017 and 2022**

Type of support received by seed entrepreneurs from IFDC/PSSD between 2017 and 2022



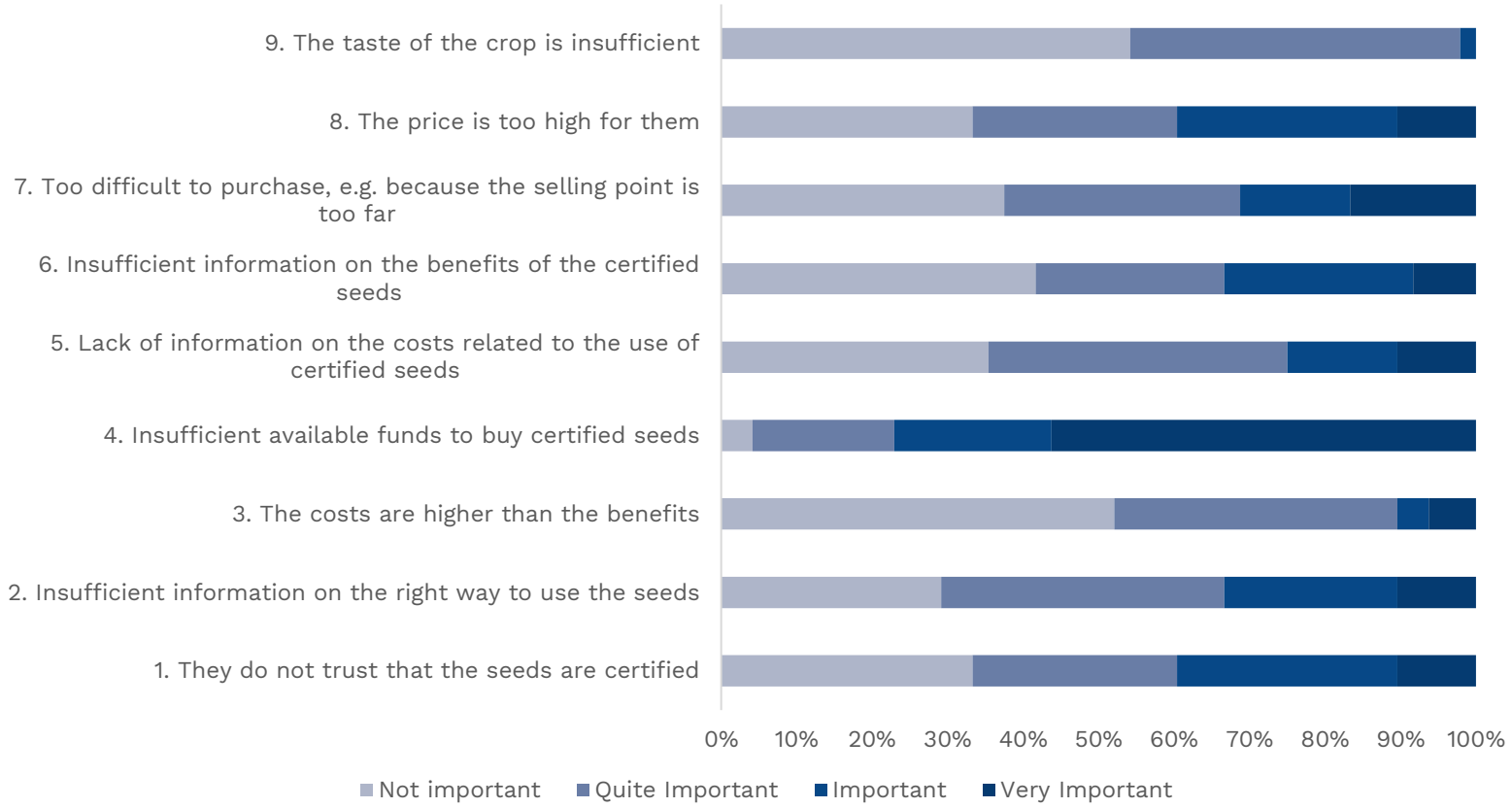
RQ2: What were the main constraints for smallholder farmer households in adopting certified seeds?

According to seed suppliers, the main reasons why farmers do not purchase certified seeds are:

- Insufficient funds
- Price too high
- Lack of trust

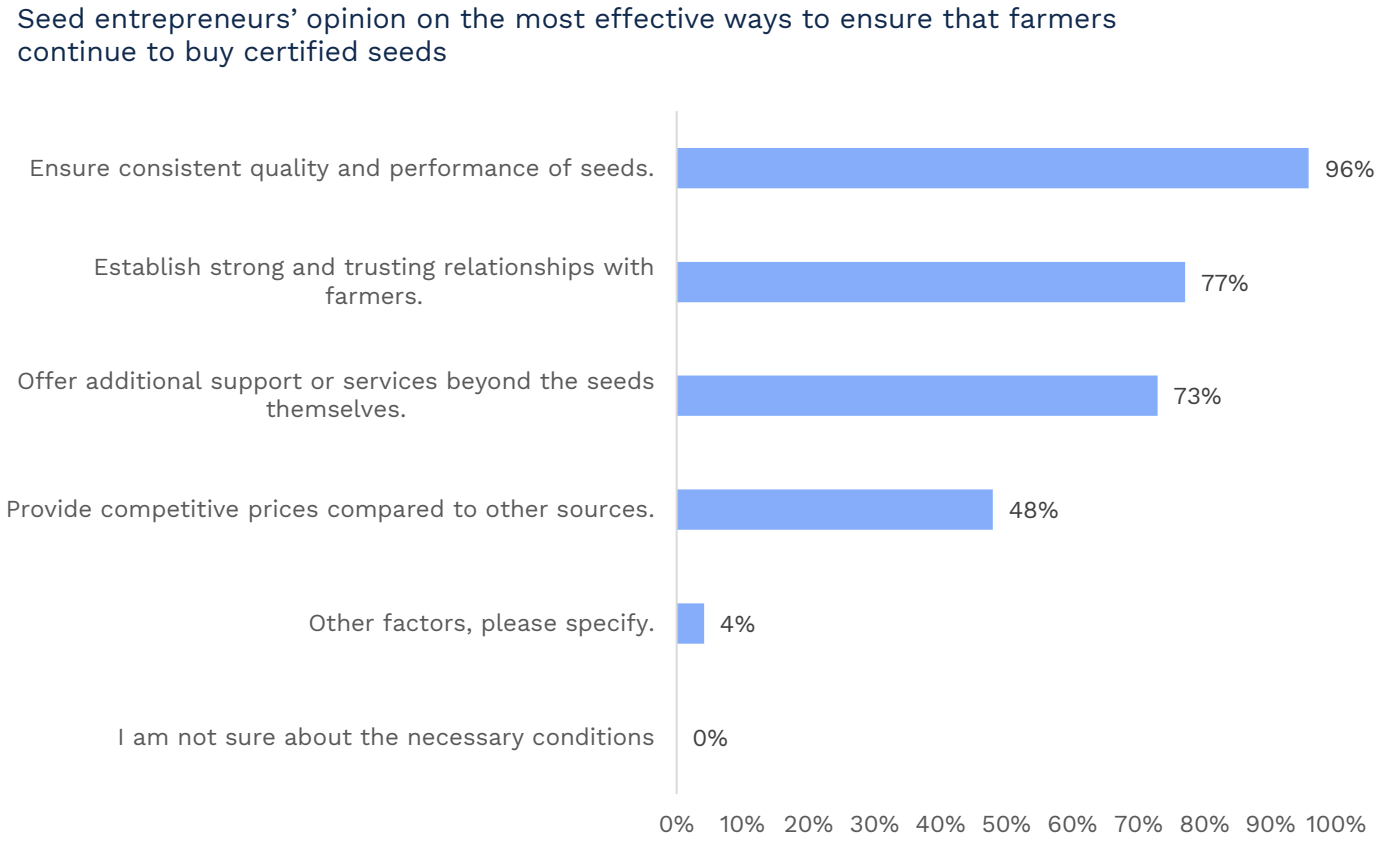
Suppliers believe that farmers would buy more certified seeds if they had more available funds. They also record some issues with information on the use and benefits of certified seeds.

Seed entrepreneurs' opinion on the reason why some farmers do not purchase certified seeds



RQ2: What were the main constraints for smallholder farmer households in adopting certified seeds?

Most suppliers declared that ensuring consistent quality and performance of seeds is key to ensure farmers continue using certified seeds, together with establishing trusting relationship with farmers and offering additional support.



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Seed Entrepreneurs Survey

Findings

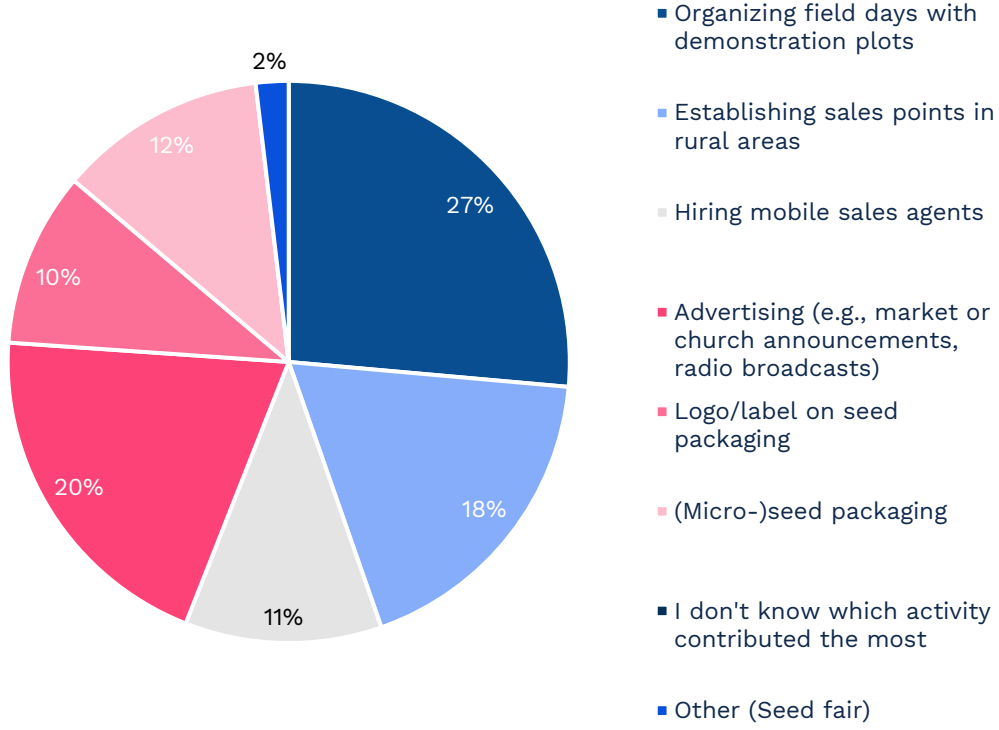
2. Efficiency

RQ3: To what extent and how did the project contribute to increasing access of seed entrepreneurs to farmers?

Seed entrepreneurs perceive field days on demonstration plots to have the highest value for money of all interventions promoted by PSSD

- The most efficient measure was the organization of field days with demonstration plots, which were the most effective in ensuring adoption, correct use and thus increased productivity for farmers; and increased revenues for both farmers and seed entrepreneurs.
- The training and marking activities which seed entrepreneurs carried out to farmers, thanks to the intervention of PSSD, significantly contributed to fostering trustful relationships between seed suppliers and smallholder farmers, to promoting good agricultural practices, to increasing awareness and access to certified seeds (1.A)
- Seed suppliers believe that the most successful sale and marketing activities to promote certified seeds were:
  - Field days with Demonstration plots
  - Rural sale points
  - Advertising

Which of your marketing and distribution activities do you think **have contributed most** to the purchase of certified seed by farmers?



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Seed Entrepreneurs Survey

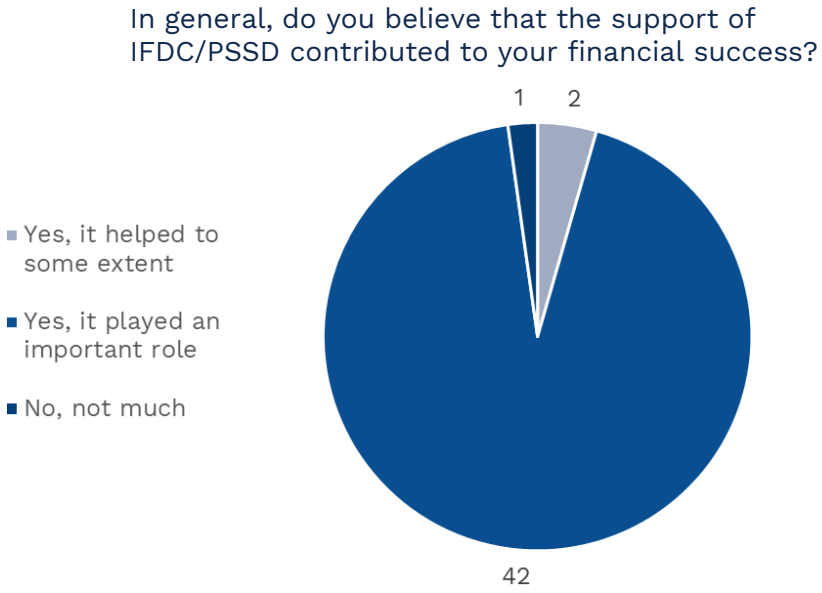
Findings

3. Impact

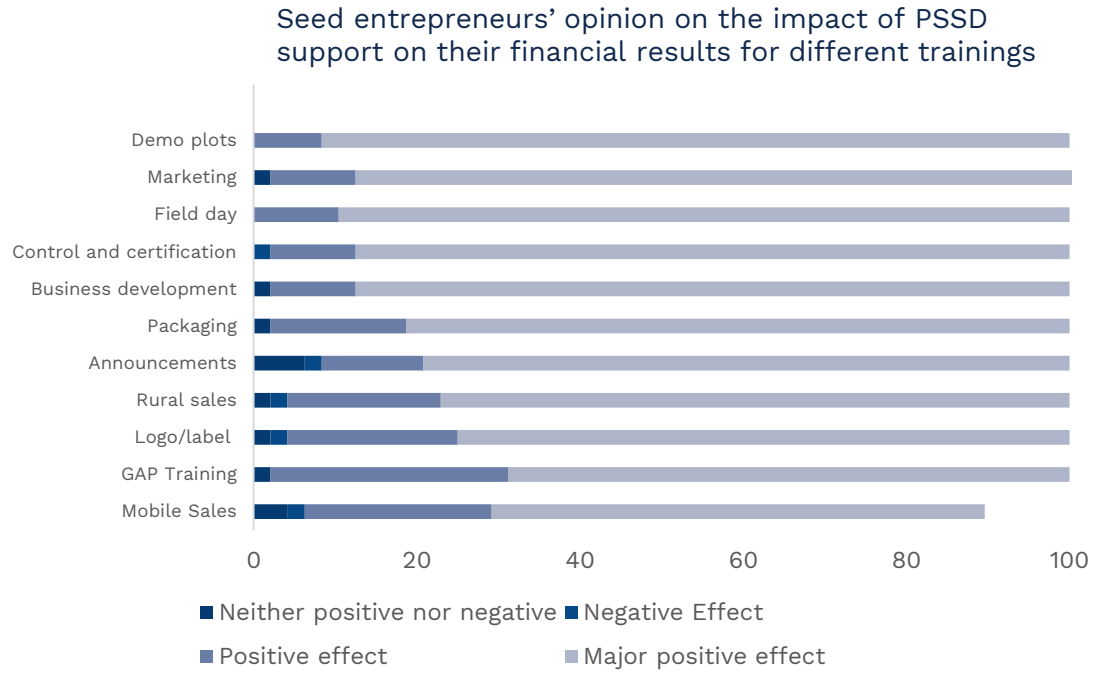
RQ4: To what extent has the project contributed to the development of the private seed sector in Burundi?

Evidence suggests that suppliers are satisfied with the IFDC intervention and mostly attribute their financial success to the PSSD program (93.75%). None of the interviewed seed entrepreneurs incurred in losses and 69% experienced a surge in profits.

93% of suppliers believed that PSSD played an important role in their business' success.



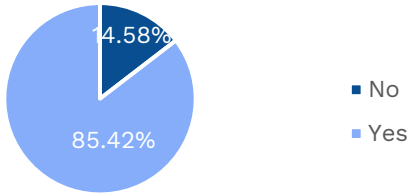
Suppliers reported that all activities had a major positive effect on their financial results, especially the training on demonstration plots and field day implementation trainings. Very few suppliers reported negative effects of an activity.



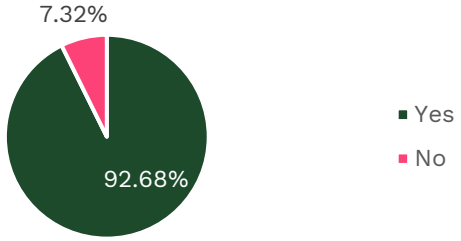
RQ4: To what extent has the project contributed to the development of the private seed sector in Burundi?

- 85% of suppliers pre-order their seeds, and out of them, 93% always pre-orders them.
- 73% of suppliers are satisfied or very satisfied with the pre-order
- The main causes of dissatisfaction (expressed by 10 suppliers) are related to the quality or quantity of certified seeds.

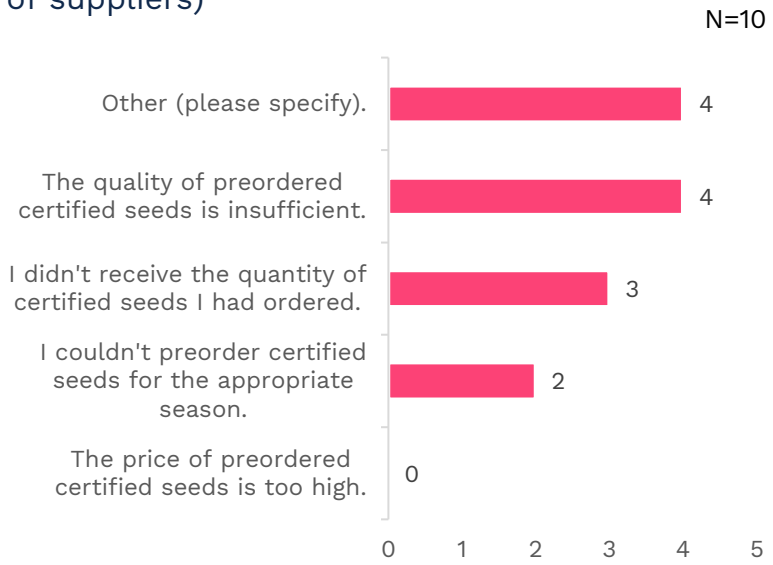
% of suppliers who have pre-ordered seeds in the past



% of suppliers who always pre-order certified seeds

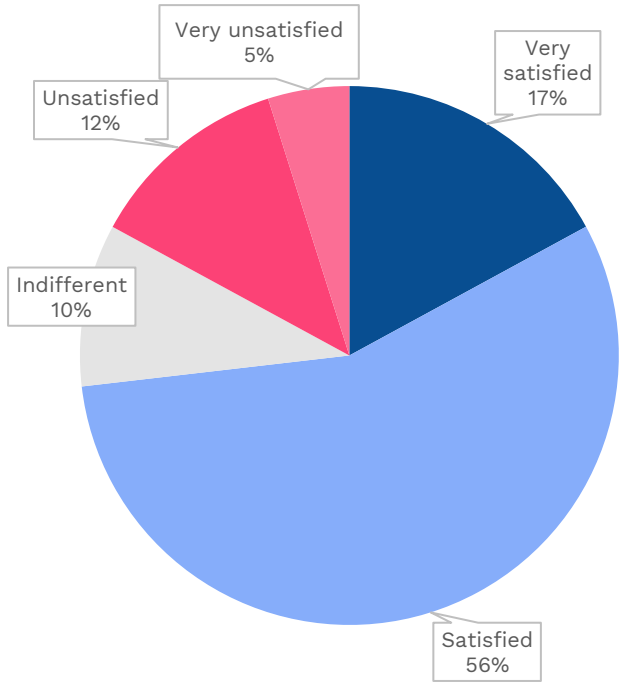


Reason for not pre-ordering (number of suppliers)



Other: I buy seeds from other multiplicators

Satisfaction with per-ordering system (% of suppliers)



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Seed Entrepreneurs Survey

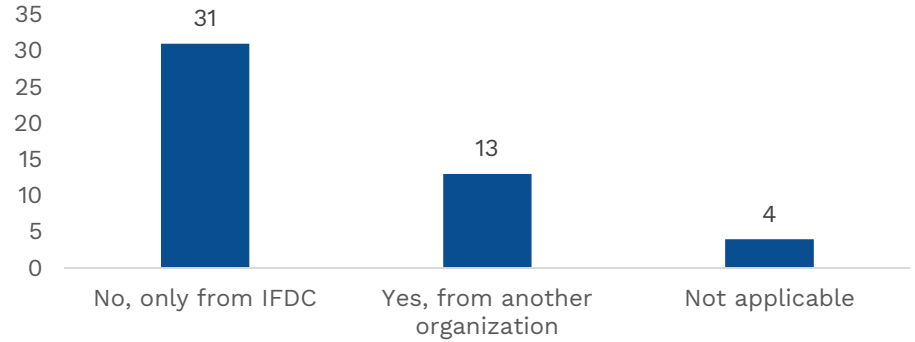
Findings

4. Coherence

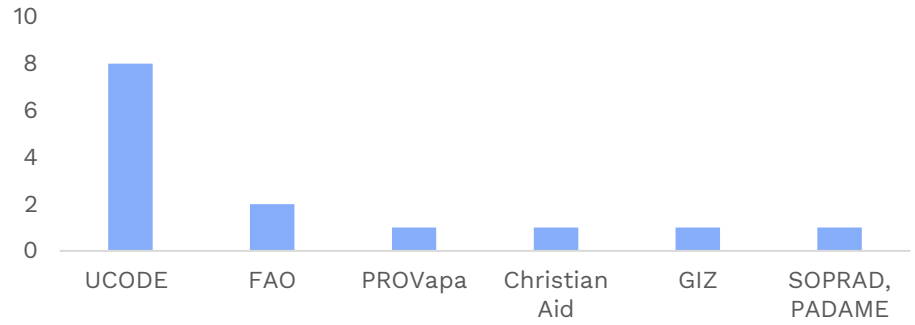
RQ5: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

- 13 suppliers received support other organizations than IFDC, the main one being UCODE
- The external training concerned good agricultural practiced for 25% of farmers

Number of suppliers who received help only from IFDC or from another organization



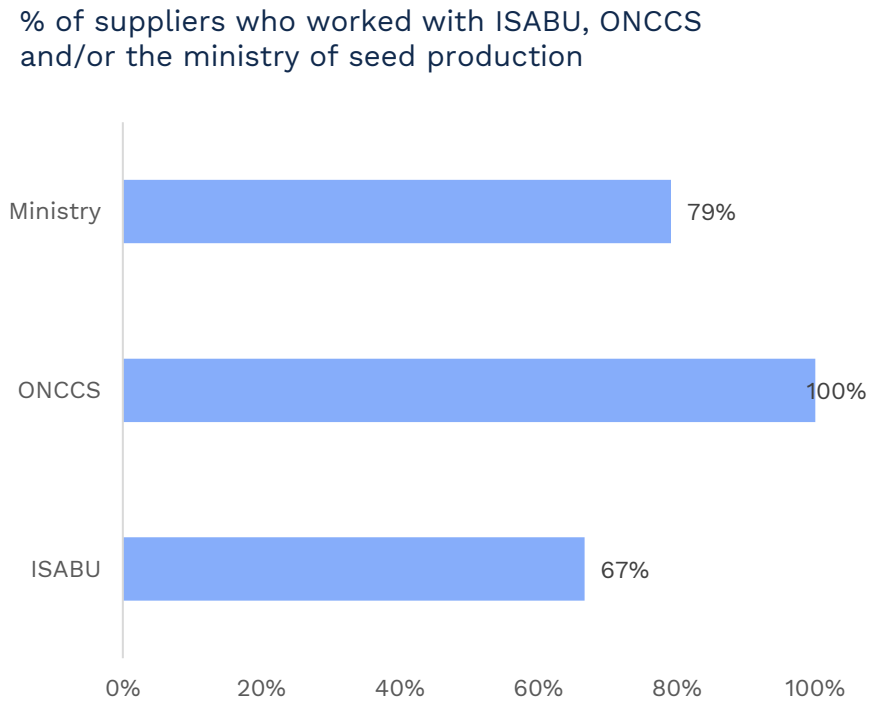
Number of suppliers who received support from another organization

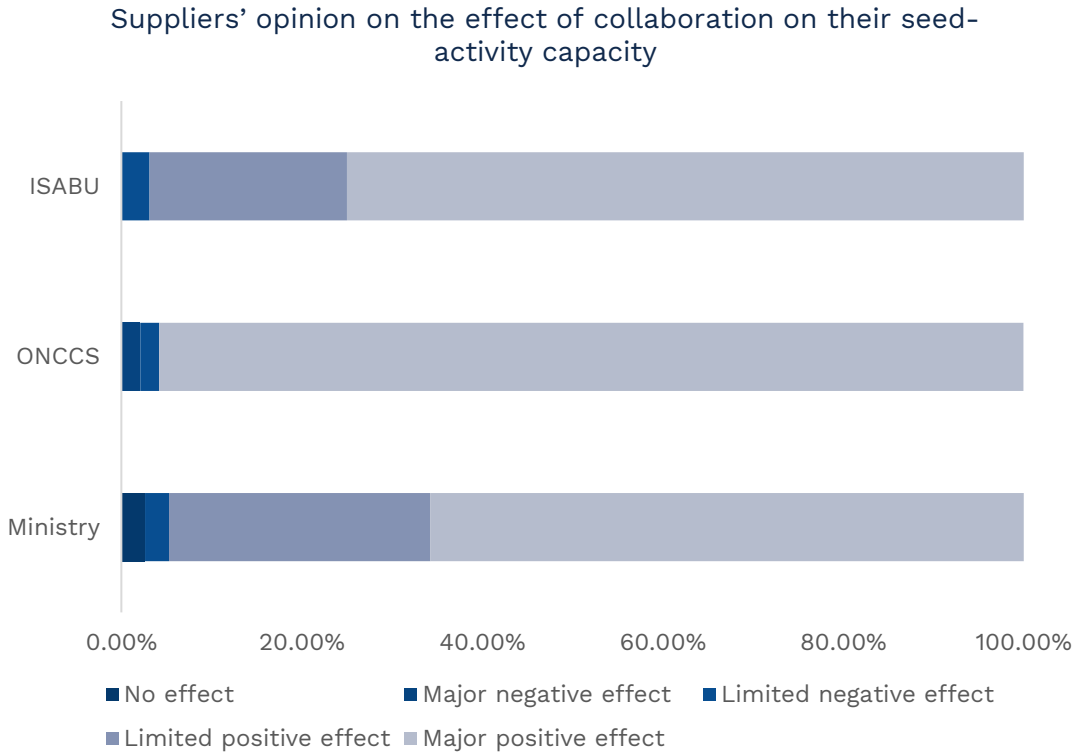


Type of assistance received from other organizations (% of suppliers)

RQ5: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

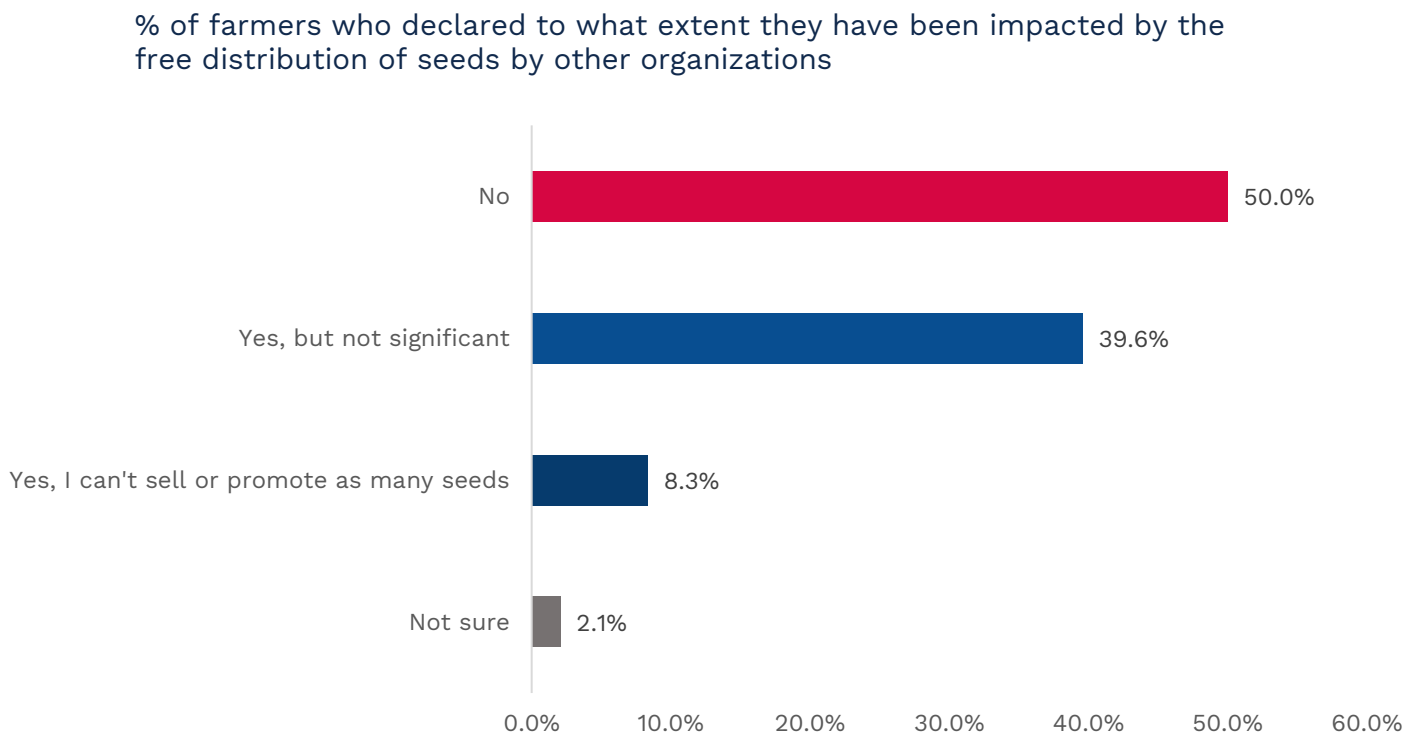
- All seed suppliers have worked with the ONCCS and most of them with the Ministry and/or ISABU.
- These collaborations had a **large positive effect** for most farmers, although this might not entirely reflect reality





RQ5: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

- The free distribution of seeds to the farmers by the government or other organizations did not have an impact on half of the suppliers, but it somehow affected 48% of suppliers



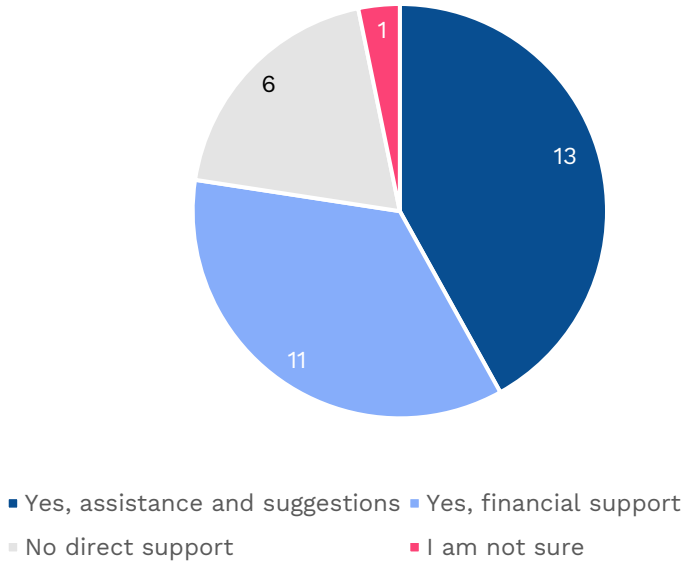
RQ5: To what extent was the PSSD project consistent with the policies and practices of the Burundian government and development agencies in the seed sector?

- If suppliers were negatively impacted by free seeds distribution, they mostly sold their seeds in other locations or increased their promotion activities
- 24 suppliers were assisted by IFDC in coping with the negative consequences

Strategies implemented to cope with negative consequences of free seed distribution

Other:
1. Reduced cultivated area
2. Borrowed money
3. Increased selling points

Number of suppliers who declared whether they received IFDC support



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Seed Entrepreneurs Survey

Findings

5. Sustainability

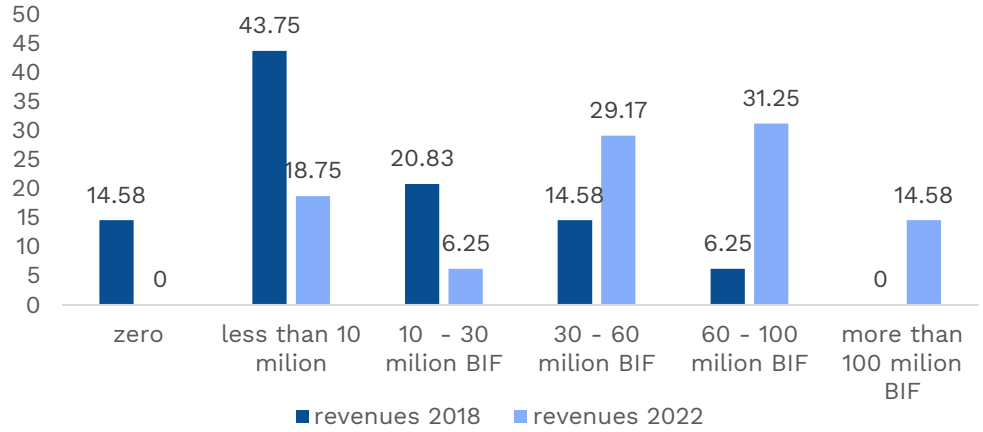
RQ6: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

- From the pre-intervention (2017) to the post-intervention (2022) periods, seed suppliers' revenues increased significantly
- The number of suppliers with a revenue inferior to 30 million BIF decreased by more than half, while the opposite trend was observed for suppliers with a revenue higher than 30 million BIF, which was recorded by 75% of suppliers in 2022 (20.83% in 2018)
- 2 suppliers (4%) experienced a profit reduction from 2018 to 2022, but without incurring into losses (from revenues largely to slightly over costs)
- 33 suppliers (68.75%) experienced an increase in profits
- For 13 suppliers (27%) the profits remained unchanged
- The number of suppliers recoding large profits increased more than 4 times; No suppliers recorded losses in 2022

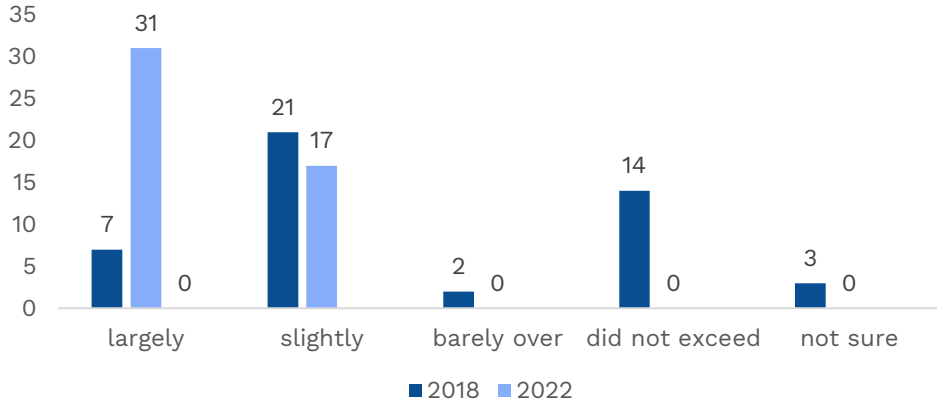
	2017	2022
revenues<costs	14	0
revenues=costs	2	0
revenues>costs	23	17
revenues>>costs	7	31

- Increase in average number of customers (3x) and employees between 2018 and 2022
- Conclusion: certified seeds production appears to be a viable business, seed entrepreneurs are likely to continue

% of suppliers in each revenue category, 2018 vs. 2022



Number of suppliers who declared whether their revenues exceeded their costs, 2018 vs. 2022

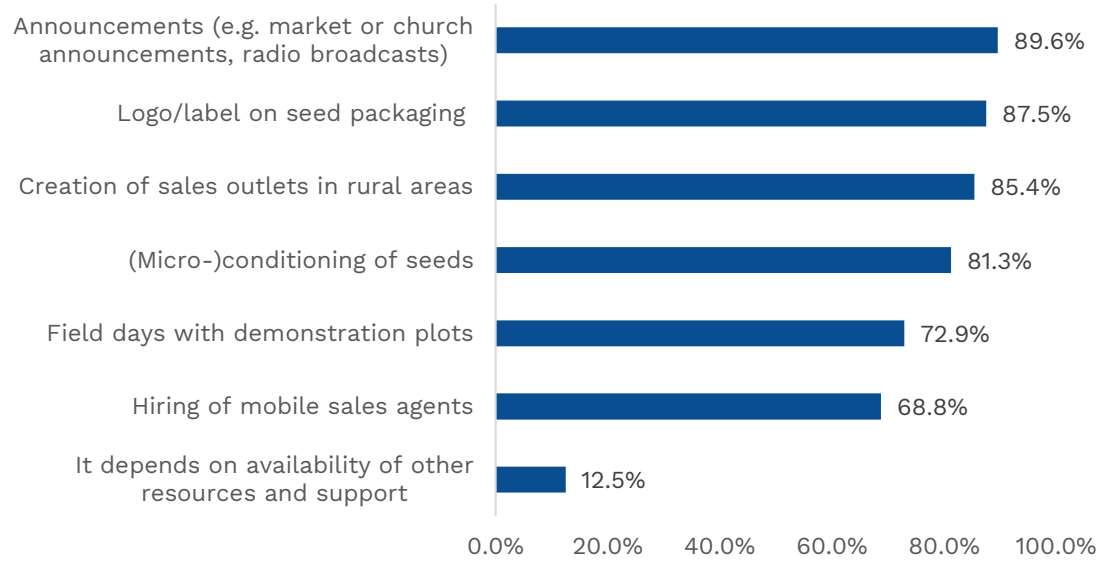


Sources: SEO & MDF seed entrepreneur survey

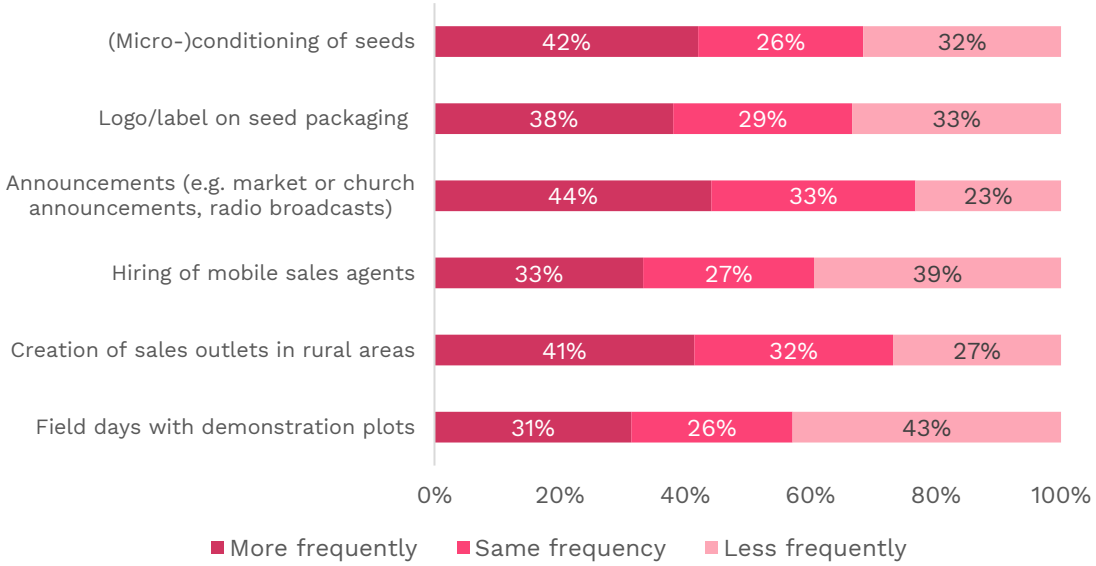
RQ6: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

- **ALL interviewed suppliers would continue doing at least one sale/marketing activity for certified seeds without the project** (except for one whose choice *only* depends on availability of other resources)
- Most suppliers believe they would continue their sale activities with the same frequency or even more often, while others would reduce their frequency.

% of suppliers who declared that they would continue doing each activity without PSSD support

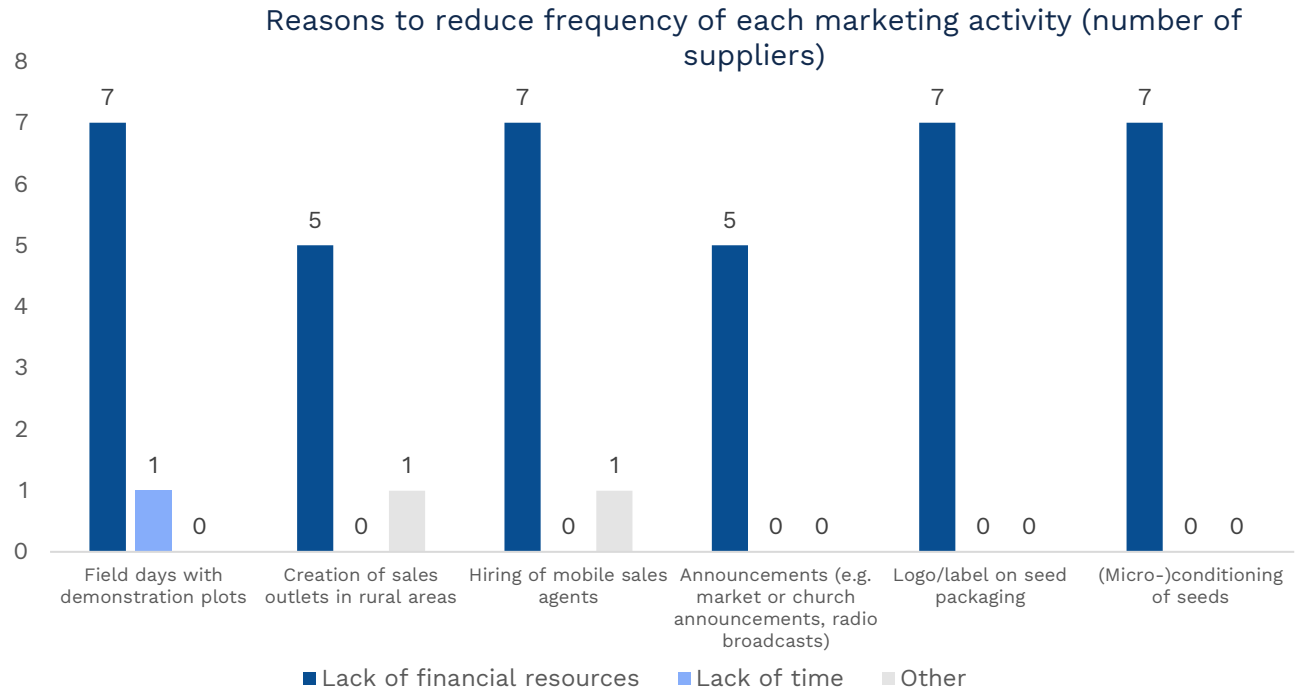


% of suppliers who would continue doing their marketing activities with less, same or more frequency



RQ6: To what extent are private seed entrepreneurs likely to continue seed production in Burundi on a commercial basis?

- 15 suppliers out of 48 would reduce the frequency of marketing activities
- The main reason to reduce frequency would be the lack of financial resources (38/41 answers for all activities)
- This is also likely the reason why demand exceeds supply at the moment



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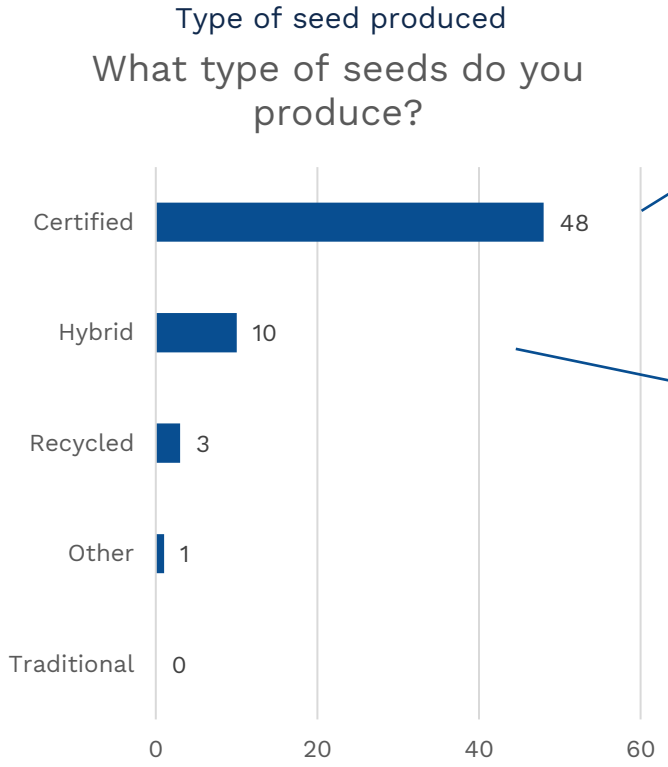
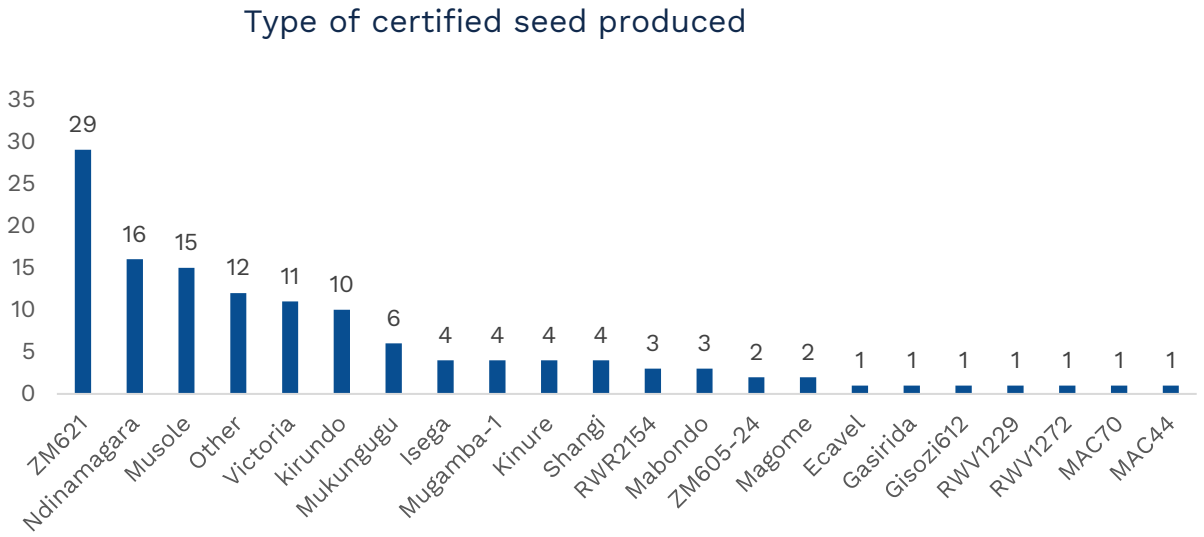
Seed Entrepreneurs Survey

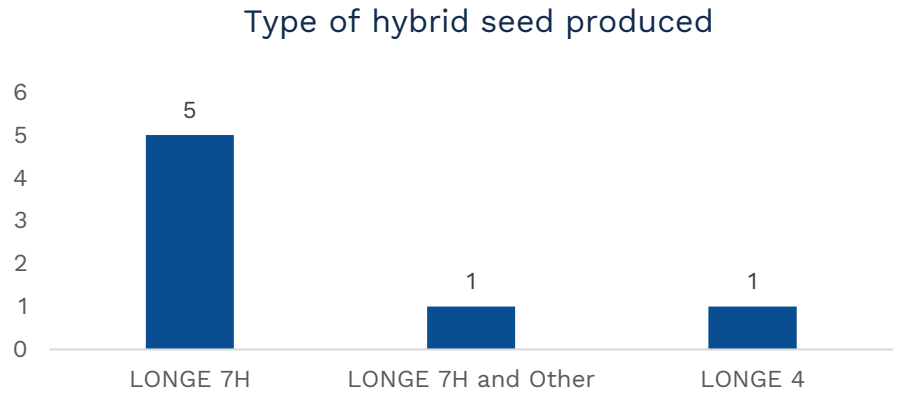
Additional information

Type of seeds produced

- All interviewed suppliers produce certified seeds (as per *ex-ante* selection)
- 10 of them also or exclusively produce hybrid seeds







Type of seeds produced

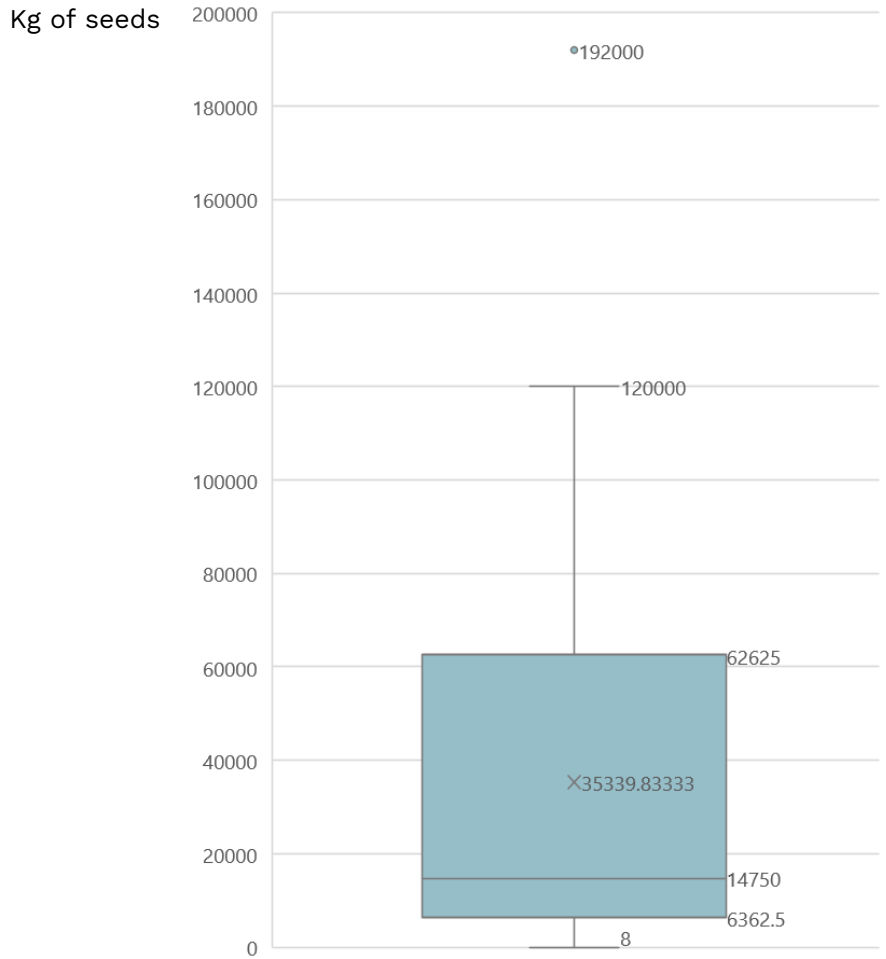
Approximately, how many **Kg of seeds** did you produce in 2022?

- Average: 35,339 Kg
- Median: 14,750 Kg

What approximate percentage of these seeds were **certified?**

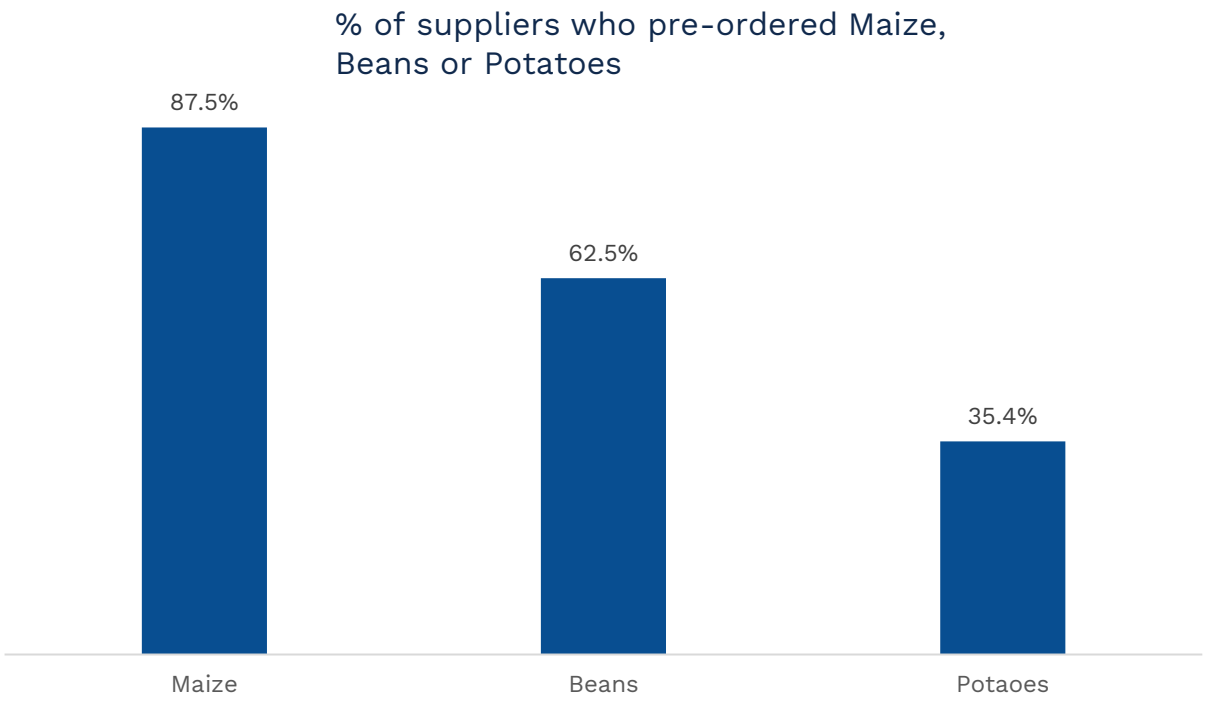
- Average: 8.6%
- Median: 9%

Kg of seeds produced by suppliers in 2022



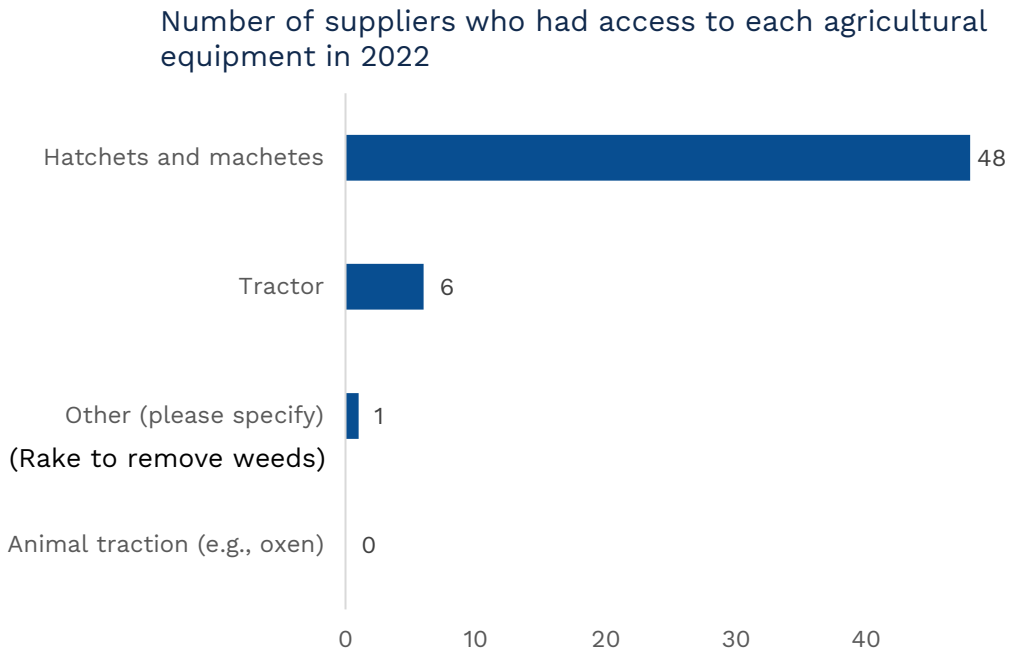
Pre-order

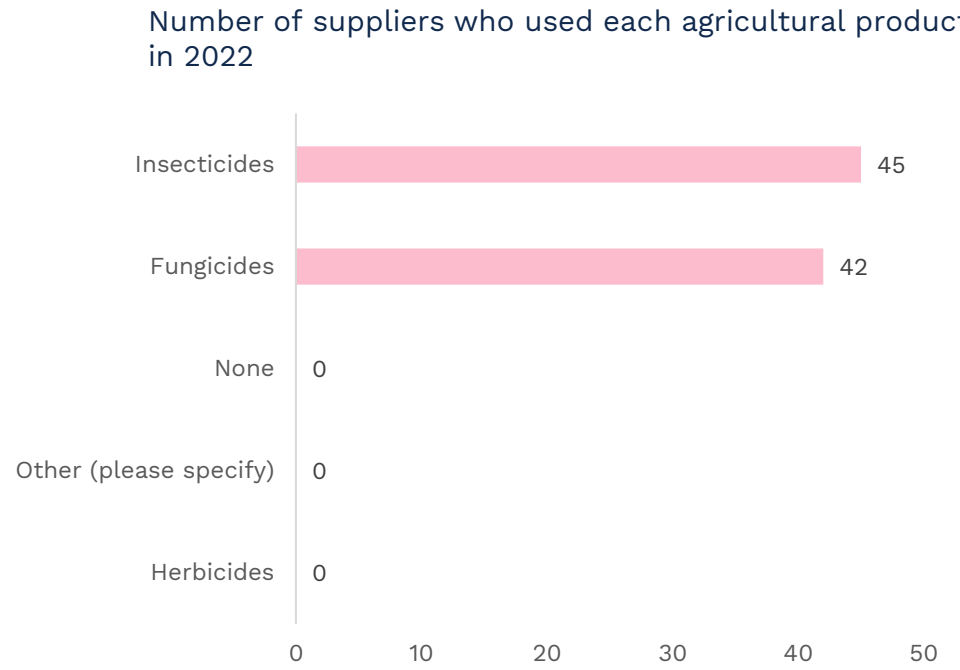
- Suppliers mostly pre-order Maize seeds (87.5%)



Equipment and products

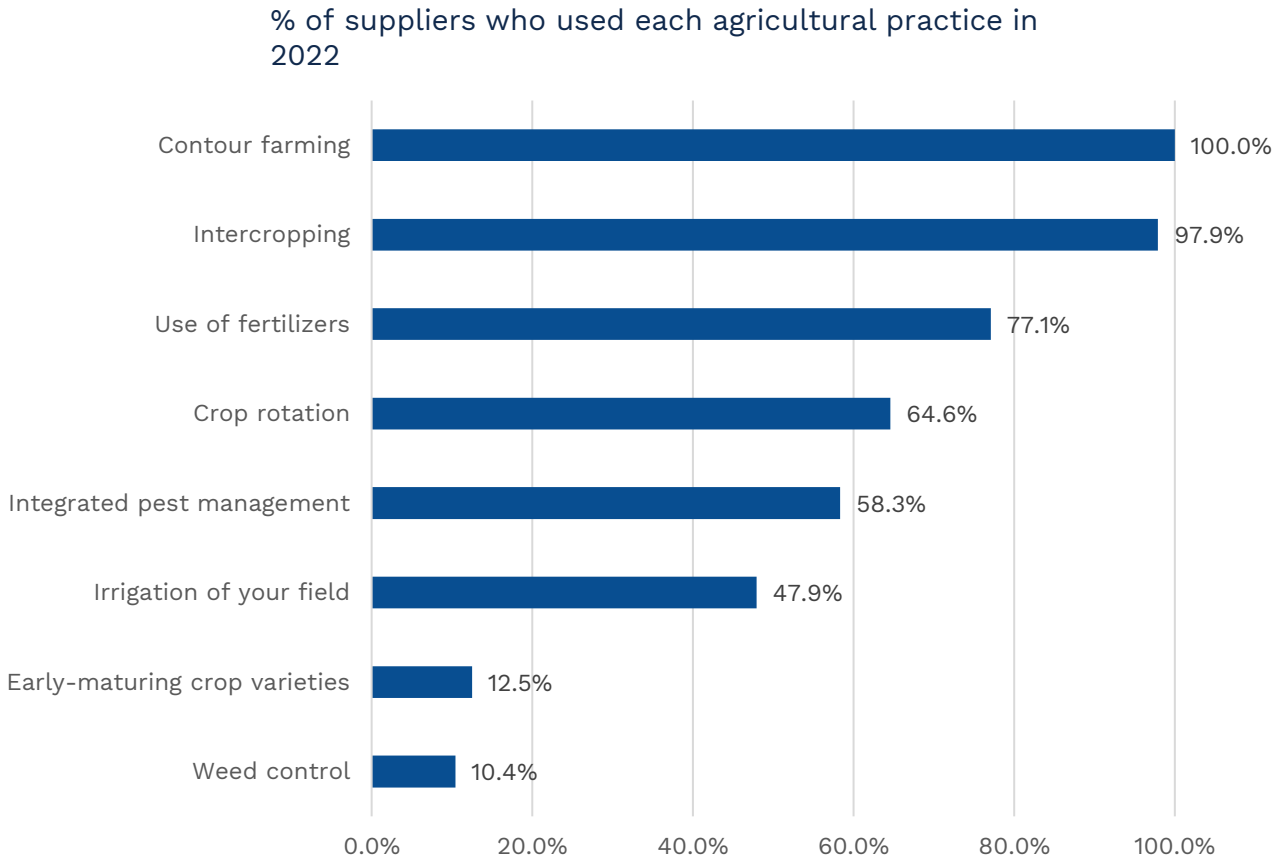
- All suppliers used traditional equipment such as hatchets and machetes, while only 6 of them had access to a tractor
- Almost all suppliers used insecticides and fungicides, none used herbicides





Agricultural practices

- All suppliers practiced contour farming, almost all of them used intercropping
- The use of fertilizers, crop rotation and integrated pest management was also widespread



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Annex D: KII and FGD guides

Annex D: KII and FGD guides

Microsoft Excel
Worksheet

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