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Local Techniques for Crop Conservation in Burkina Faso: Analysis of the Valorization Status and Perception of Tilgr-Baore Technology

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Abstract

Agriculture is the main source of income for the poorest people and the pillar of food security in Burkina Faso. However, the producers face the problem of food insecurity each year, due to the effects of climate change and the difficulty of conserving their produce, because of inadequate storage infrastructure. These situations result in the loss of large quantities of products after harvest. Technological advances can provide solutions to this problem of postharvest losses and help many small producers to reduce poverty. Unfortunately, new product conservation techniques implemented in Burkina Faso are less known and poorly adopted. The objective of this chapter is to identify constraints to the valorization of new post-harvest technologies of onion and potato and analyze factors influencing farmers' perception of these innovations. The results of the surveys conducted using the Tilgr-Baore technology show that many agricultural producers are analphabet and not yet aware of the existence of the new product conservation technology. The improvement of the level of education of farmers and the availability of information on innovations are needed to improve the perception of innovations and thus increase the probability of adoption of these innovations.

Keywords: agriculture, technological innovation, valorization, perception, Tilgr-Baore, Burkina Faso

1. Introduction

In Burkina Faso, agriculture is the main source of income for the poorest people and the pillar of the country's food security. It employs more than 80% of the active population and contributes to 30.3% of GDP [1]. Agriculture is dominated by small family farms, and production consists mainly of cereal crops, cash crops, legumes/tubers, and market garden crops. The market gardening crops concerns fruits and vegetables and is practiced especially in dry season. It accounts for 16.5% of agricultural production and generates about 400,000 jobs, 25% of which are held by

women [2]. Market garden crop production is practiced in all regions of the country over an area estimated at 27,661 ha, with nearly 21 crops produced. Most of the vegetable production is for sale, with an overall marketing rate of over 90% [3].

The bulbous onion is the main market gardening culture both in terms of the area planted and the quantity produced. The total production of bulbous onion accounts for 32.4% of total vegetable production, and 41.4% of market garden areas are grown on bulbous onions [3]. The northern region is the main production area for onions. In this area, the potato also occupies an important place. Potato production in the northern region accounts for more than half of the national production [2].

However, market gardening production like most agricultural products in Burkina Faso is affected by the effects of climate change. The effects of climate change are mainly manifested by a decrease in rainfall, a deregulation of the rainy season, a greater irregularity of rainfall, and a frequency of drought [4]. Extreme phenomena such as floods and droughts are increasingly recurrent and affect farms. In fact, flooding affected 6.2% of the plots in operation during the 2016–2017 campaign, and 23.9% of the plots were affected by drought at the national level [5]. This rainfall variability affects the availability of water that is required for agricultural production.

In addition to these production risks, market garden production faces conservation constraints. Crop conservation is affected by insect rodent and mold attacks [6]. Crop storage infrastructures are insufficient and remain inadequate. These conservation difficulties are a major constraint for market gardening. Indeed, most market garden products are perishable, and poor conservation deteriorates their quality [7]. The lack of adequate conservation technology does not allow producers to store products in anticipation of periods when prices are more remunerative. Thus, the products are sold at harvest, and this does not ensure a balance between supply and demand throughout the year.

In order to ensure a good management of the market gardening product supply and to assure a good income for the actors of the sector, technologies allowing a better conservation of the products have been developed. However, these technologies are less known and poorly adopted. The objective of this chapter is to identify constraints to the valorization of these technologies and analyze factors influencing farmers' perception of innovations. Knowledge of the constraints to the valorization of new technologies and understanding factors affecting farmers' perception of these technologies are key in informing policies that aimed at spreading these technologies. The literature on adoption of innovation reveals that farmers' perception of the modern technology has significant influence on adoption decisions ([8] and [9]). Adoption of technologies by farmers may reflect rational decision-making based on farmers' perceptions of the appropriateness of the characteristics and the value of technology. However, the literature on socioeconomic factors determining such perception of technology is scarce.

The rest of the chapter is divided into six sections. Section 2 presents the configuration of the onion and potato market in Burkina Faso. Section 3 reviews methods and technologies for preserving agricultural products. Section 4 examines the technology valorization process in Burkina Faso. Section 5 analyzes the perception of farmers toward Tilgr-Baore technology. Section 6 concludes the chapter.

2. The configuration of the bulbous onion and potato market

The onion contains two products depending on the stage of the harvest. When it is produced for the purpose of harvesting only the leaves, we speak of leaf onion; on the other hand, if we wait for the maturity to have bulbs, we speak of bulbous

	Onion		Potato	
	2005	2008	2004	2008
Production (tons)	54,959	242,258	1376	6954
Area (hectare)	3681	11,449	73	262
Yield (tons/hectare)	15	21	18.85	26.54

Source: [10, 11]

Table 1.
Evolution of onion bulb and potato production.

onion. Bulb onion is grown in all 13 regions of Burkina Faso. Its production is seasonal and has increased considerably in recent years. Burkina’s bulbous onion is marketed locally and in the subregion, especially in neighboring countries such as Cote d’Ivoire, Togo, Ghana, and Benin. In the rest of the chapter, we will use the term onion to describe the bulbous onion.

Like the onion, the potato production is realized mainly during the dry and cold seasons. The cultivation is necessarily irrigated, and the availability of a source of water is a sine qua non condition to its implantation. The production of potatoes is carried out by farmers grouped or not within producer organizations and is essentially intended to satisfy the national demand. **Table 1** shows the evolution of bulb onion and potato production in Burkina Faso.

The data in **Table 1** show that onion production increased by 341% between 2005 and 2008. This reflects the growing interest in the sector. It is an important source of income for rural people as more than 70% of production is devoted to marketing. The current situation of the local onion market is characterized by a single production cycle that runs from November to January with harvest periods that stop between March and April. This seasonality in onion production, combined with the weakness of onion conservation infrastructure, limits the availability of the product throughout the year. Fluctuations in the supply of onions during the year cause large price variations. **Figure 1** shows the evolution of the price of the kilogram of onion in CFA francs, during a year. Prices are highest from October to December declining thereafter and reaching their floor at the harvest period (in April). Thereafter they resume their cycle up until the end of the year.

Potato kilogram prices also fluctuate seasonally due to the low availability of the product throughout the year. Since the possibilities of conservation are very limited,

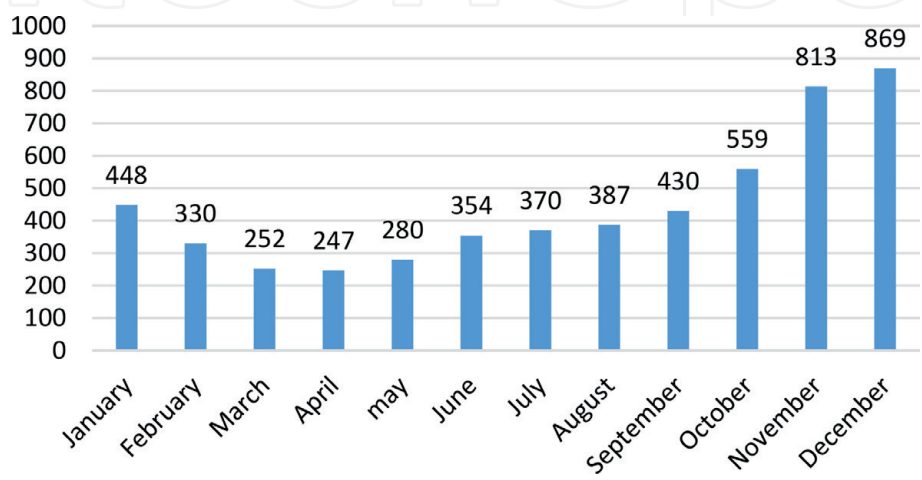


Figure 1.
Evolution of the price of the onion in CFA francs, during the year 2015. Source: [12].

the market is supplied irregularly, which has a significant impact on prices. The price of the kilogram of the potato drops sharply in times of plenty (150–200 FCFA/kg in February–March). A few months later, there is a rapid rise in price when the product becomes rare (between 500 and 700 FCFA/kg). At this point, it is the importation (from Mali and Europe) that intervenes to compensate for the insufficiency of local production [13].

The analysis of the onion and potato market pattern indicates that these two vegetable crops have identical production cycles. Almost all production is put on the market at harvest to avoid the losses that could result from poor conservation of products. Postharvest losses are highly dependent on the technologies used for storage and conservation. The example of the onion indicates that losses can reach up to 50% when production is not stored in any infrastructure [14]. The proportion of losses due to storage greatly reduces the profit margin of agricultural producers. The need to improve conservation techniques and the choice of appropriate structures is essential for the actors in the sector. However, what are the methods and technologies for the conservation of agricultural products in Burkina Faso?

3. Methods and technologies for the conservation of agricultural products

The Burkinabe government's efforts to promote agriculture that can stem food insecurity have earned the support of agricultural research to solve the problems that plague the sector. Thus, results of the research include not only the implementation of cultural methods but also crop conservation techniques to reduce postharvest losses and ensure availability of products. However, to cope with the problem of crop losses, the actors concerned use various techniques both traditional and modern to overcome the difficulties. Of a general nature, the drying of the harvests is a known practice but applies only according to the products. For cereals such as maize, millet, sorghum, and rice, farmers opt for exposure to the sun processing and the use of inert matter (ash and limestone) and repellent plants for their conservation [15].

Modern methods of conservation to reduce postharvest losses use products such as chemical insecticides (chlorpyrifos-methyl, pirimiphos-methyl, bioresmethrin, and deltamethrin) [16]. The transformation of certain products by drying from existing innovations such as solar drying equipment and storage warehouses makes it possible to preserve these products.

Among the conservation technologies, we find in the villages the granary that can store large quantities of crops. Designed from local materials such as animal dung straw, the attic is still used in rural areas to keep crops. For fruits and vegetables such as potato and onion, many producers use bags made from local materials such as straw. There is also the use of hangar and roofs and even houses to keep crops. Other technologies have been developed by local innovators. The innovators in Burkina Faso are mostly professionals (women and men) in the private sector working in workshops, small- and medium-sized industries, or small- and medium-sized enterprises, where they design, produce, and market new technologies. The main technological innovations for onion and potato conservation are the Klimax Z multipurpose fresh loft and the Tilgr-Baore storage box. The next section describes these two conservation innovations of agricultural products.

3.1 The Klimax Z multifunctional attic

The innovation Klimax Z still called the cool attic is a multipurpose solar cold room. **Figure 2** shows this innovation.



Figure 2.
The Klimax Z. Source: The promoter, 2018.

This storage infrastructure is designed and promoted by a young Burkinabe innovator. For its innovation, it benefits at the national level from the support of the Ministries of Scientific Research Energy, Youth Training and Professional Integration, and the Ministry of Agriculture.

The Klimax Z innovation has a capacity ranging from 6 to 60 m³. It comes in two forms: the positive cold room (2–15°C) for the conservation of fruits vegetables and milk and the negative cold room (up to –10°C) for preservation of fish and other commodities. With a lifespan of at least 15 years, its cost of realization varies between 6 and 12 million CFA francs according to the minimal and large formats.

The Klimax Z can be installed in the markets for sellers of fruit and vegetables, meats, and fish, or it can be installed in the production sites (farm plots). This innovation can be exploited both in rural and urban areas. The exploitation of Klimax Z can be individual or collective. Associations or groups of actors such as producers and sellers in the markets can exploit it by proceeding by renting Klimax Z storage lockers. The shelf life of the potato lasts up to 9 months. In 2016 the Klimax Z was patented by the African Industrial Property Organization (OAPI) by PV Patent No. 17824 PV No. 1201600096 of January 22, 2016.

3.2 The box of conservation of the onion and the potato: the Tilgr-Baore

The Tilgr-Baore innovation is more specific to onion and potato conservation unlike Klimax Z, which takes into account a wider range of products. The glimpse of this innovation is presented in **Figure 3**.

The Tilgr-Baore box is a technology designed by a producer in the northern region of Burkina Faso. The designer of this technology is the head of an association ATPOY (Association Tickwende Yatenga Onion Producers) with the financial support from the Office of Cooperation Switzerland (BUCO) and GEDES-Burkina (the General Services a private consulting and engineering company). This innovation makes it possible to dramatically reduce the losses associated with traditional storage. It is a significant opportunity to overcome the problems associated with the conservation of onion and potato. The Tilgr-Baore storage box has a storage capacity of 7–10 tonnes and preserves the product for about 1 year. This innovation is made with local building materials (mainly straw) compared to cement storage warehouses. This makes the Tilgr-Baore box more accessible to onion and potato



Figure 3.
Presentation of Tilgr-Baore. Source: The promoter, 2018.

producers in rural areas. It keeps up to 98% of production. The cost of making this innovation amounts to 1 million CFA francs. Given this cost, the exploitation in association or in a group of both producers and sellers is recommended [14].

4. The valorization of new technologies for agricultural product conservation in Burkina Faso

This section presents the concept of valorization and analyzes the national environment through existing valorization structures and actions.

4.1 The concept of valorization

The valorization of the results of the research is a polysemic and multidimensional concept whose content varies according to the implied actors, their expectations, and their interests. [17] distinguishes six different categories from the concept of valorization in Burkina Faso: academic or professional, scientific, technological, economic, social, and political valorizations. Of course, these different categories are not mutually exclusive. Academic valorization involves the incorporation of recent research results into the training modules for updating the

content of the courses offered to students or professionals engaged in the process of improving their professional knowledge and skills. Scientific valorization is mainly the activity of researchers. For these authors, the valorization of the results of research means the diffusion and the exchange of knowledge. The valorization is concerned in this case with the dissemination in the form of scientific publications in specialized journals, communications at conferences and seminars, posters, data sheets, photo, and video.

The social valorization of a research or an innovation aims to demonstrate the social utility of research or innovation in particular for the company to provide public funding. Economic valorization emphasizes the economic utility of innovation including its contribution to economic growth, increased productivity, and the creation of jobs and incomes for people. Regarding political valorization it aims to take into account innovations in the formulation execution, evaluation of public policies, and decision-making in general.

The national referential of the interventions of the government of Burkina Faso and its partners over the period 2016-2020, which is the National Economic and Social Development Plan (PNDES), gives importance to the valorization seeking to increase the number of research results and innovations valued in favor of the structural transformation of the economy. This is justified by the fact that most innovations are poorly known by potential users.

4.2 Analysis of the national environment

In Burkina Faso, scientific research and invention and innovation activities have generated many results that can contribute to the endogenous development of populations in many sectors of economic activity. Indeed the support provided to research and innovation since the 1990s by institutions such as the World Bank bilateral and multilateral cooperation agencies as well as international research institutions has enabled the country to have access to scientific and technological knowledge that can bring added value to the direct beneficiaries and to the State and thus reduce poverty in the country.

However, it is clear that many of these research and innovation results are less known to potential users, less used, and of little value. However, research activities are expensive, and the low value of research results is thus a poor allocation of resources as is the case in many developing countries [14]. In response to this, policy-makers are committed to enhancing the value of scientific research results, innovations, and inventions by institutionalizing the National Forum for Scientific Research and Technological Innovations (FRSIT) in 1995. The Ministry of Higher Education, Scientific Research, and Innovation (MESRSI) through the general direction of the National Agency for the Valorization of Research Results (DG ANVAR) organizes every 2 years the “FRSIT.” This forum allows all actors (decision-makers, researchers, inventors and innovators, promoters, development partners, users, and the public) to become familiar with the research, its results, and the inventions and technological innovations realized in Burkina Faso but also outside the country. It is in this national environment favorable to the valorization of the results of research and innovation that the technologies Tilgr-Baore and Klimax Z were created by local innovators. What is the importance of intellectual property rights in the valorization of innovations?

4.3 The intellectual property rights

Intellectual property rights are mechanisms for the recognition and protection of intellectual materialization through invention and innovation which entitle their authors to use the fruit resulting from the valorization of their creation. Protection

reassures innovators that products are not being pirated or spoofed. It puts innovators in trust with the use of their products with recognition because many innovators are reluctant to give information about the “processes” that are used in their innovation.

There are several systems of protection of an invention/innovation among which patents are the most known and most commonly used in Burkina Faso. The benefits of patent protection are multiple. In particular, the protection allows the work to be well scientifically documented, protects potential users, and provides substantial remuneration to the inventor or research institute concerned. Patents help to strengthen the country’s brand image because the more the number of patents increases, the more the level and credibility of the research or innovation that produces them are enhanced [18].

Burkina Faso is a member of the African Intellectual Property Organization and the World Intellectual Property Organization. These institutions are responsible for the management of patents and other intellectual property rights. There is also a National Intellectual Property Office (DNPI) in the country which is the public institution charged with protecting the intellectual property rights of innovators and raising awareness and giving advice on the need for property ownership. However, the partnership of innovators with intellectual property organizations is weak in the agricultural sectors of Burkina Faso.

4.4 Valorization statements and constraint of valorization of Tilgr-Baore technology

The Tilgr-Baore technology was presented at the National Forum for Scientific Research and Technological Innovation (FRSIT) in 2016, where it was selected among the best innovations and awards. FRSIT has also included it on the national list of innovations. The steps for the patenting of Tilgr-Baore are in progress. The innovator with the support of FRSIT and DG ANVAR filed his patent application with the African Intellectual Property Organization. He holds from this organization for the moment just the acts which prove that he has introduced to OAPI his patent application for Tilgr-Baore.

Because of its importance for the conservation of agricultural products, the Tilgr-Baore is increasingly popularized by programs that work in the rural world. These projects include the Support Program for the Modernization of Agro-Pastoral Family Farms (PAMEFA program) whose objective is to promote modern family farming, the Agricultural Sector Support Project (PROFIL program) that involves installing 500 boxes of Tilgr-Baore types in four regions of the Burkina Faso, and an action research program of INSS, whose objective is to facilitate the access of Tilgr-Baore innovation to producers organized into associations and unions of associations.

Despite these promotional actions of Tilgr-Baore, there are constraints to the diffusion of innovation. The promoter of the innovation expresses itself in these terms: “There is the PROFIL program which has installed 500 boxes in 4 regions of Burkina Faso, but has not been completed. There was no follow-up or training for the operators of the box so that these beneficiaries could use the technology” (Ouedraogo Lassane, Ouagadougou, November 2018).

Considering the example of the PROFIL project, the developer estimates at 35% the completion rate of the construction of the 500 Tilgr-Baore box. Lack of training of beneficiaries remains the main obstacle to exploiting innovation. These remarks raise the difficulty of training beneficiaries on the various facets of technology. From the maintenance of the environment where Tilgr-Baore is installed, to the box itself and then to the stored products, a whole procedure of maintenance must be taught to the beneficiaries of the box for its judicious exploitation.

The Tilgr-Baore technology benefits from the support of various ministerial departments including the Department of Scientific Research and the Department of the Environment, Agriculture, Trade, and Crafts. This is an asset for promoting innovation, but it is difficult to bring together these different actors around a table to coordinate interventions. In this regard, the initiator of Tilgr-Baore said: “The fact that our technology brings together several ministerial departments, lead to difficulties to bring them together to work. This is a problem for us because we do not know how to bring all these authorities together to coordinate the actions of valorization of the technology” (Ouedraogo Lassane, Ouagadougou, November 2018). So, there is a need for a revitalization of the partnership between the ministerial departments, concerned with the promotion of innovation, and innovators.

Based on survey data from rural producers, the following section analyzes the perception of Tilgr-Baoré technology by rural people.

5. Perception of farmers toward Tilgr-Baore technology

Perception of innovation is very important in the adoption process. It indicates the user’s view of a technology. Individual innovation decisions are based on the individual’s perceptions of the innovation. According to [19], rejection, discontinuance, and re-invention frequently occur during the diffusion of an innovation, and such behavior may be rational and appropriate from the individual’s point of view, if only the diffusion scholar could adequately understand the individual’s perceptions of the innovation and of his or her own situation, problems, and needs. We are therefore analyzing the farmers’ perception of Tilgr-Baore, in order to guide policies aimed at better dissemination of this innovation.

This section presents the model used to analyze the perception of Tilgr-Baore, the source of the data, the descriptive statistics of the sample, and the econometric results of the estimation.

5.1 Model specification and definition of model variables

The perception of Tilgr-Baore is analyzed using a probit model. The dependent variable is a binary variable. In most practical cases, one can choose indifferently between the models probit and logit, to analyze the perception of the innovation or adoption of innovation. We choose a probit model to analyze the perception of Tilgr-Baore technology.

5.1.1 Probit model

Consider Y^* the latent variable that is unobservable, whose value depends on a series of explanatory variables X_i . We have the following equation:

$$Y_i^* = \beta' X_i + \varepsilon_i \quad (1)$$

The dichotomous variable Y , observed, is linked to the latent variable Y^* by the following relation:

$$Y_i = 1 \quad \text{if } Y^* > 0 \text{ that is to say } \beta' X_i + \varepsilon_i > 0 \quad (2)$$

$= 0$ if not.

where the dependent variable Y_i is the farmers’ perceptions of Tilgr-Baoré technology and X_i the sociodemographic and institutional characteristics that can

influence the perception of innovation. β being the coefficients, ε_i is the error term. We assume the error term is distributed normally with mean zero and variance one. $i = 1, 2, \dots, n$. n is the number of observations.

If $\beta' X_i + \varepsilon_i > 0$, the farmer has a very good perception of the Tilgr-Baore, which could give him enough incentives to adopt the technology, and the dichotomous variable takes the value 1. The error term is due to the effects not considered.

5.1.2 Definition of model variables

The perception of the producer depends on several factors. The most conventionally analyzed are the socioeconomic and sociodemographic characteristics of the producer, as well as the institutional factors. The choice of the analysis variables of the model is based on empirical literature [20–22] as well as on the availability of data.

The dependent variable of the probit model is defined as binary variable, equal to 1 if the farmer has a very good perception of the Tilgr-Baore and 0 if not. The definitions and the measurements of the variables used in the estimation of perception were summarized in **Table 2**.

5.2 Source of data

The survey data were collected as part of the research program “Adoption and popularization of onion and potato conservation technology for food and nutrition

Variables		Expected sign
Dependent variable		
Farmers' perceptions	Level of appreciation of the technology. Equal to 1 if the producer has a very good appreciation of the technology and 0 if not	
Independent variables		
Age	Age is defined in terms of the number of years of birth. There are five age groups identified: Under 18 years, 18–34 years, 35–54 years, 55–70 years, and over 71 years	+/-
Sex	Sex is a binary variable equal to 0 if the producer is female and 1 if he is male	+/-
Level of education	The level of education is a binary variable that is equal to 0 if the producer has no level (cannot read or write) and 1 if the producer has acquired a level of education (by school or training adults)	+
Household size	Household size refers to the number of people living in the household. There are four household categories according to size. Small-sized households consist of less than 5 people. Then we have the household of 5–10 people, followed by household of 10–15 people, and finally the large household, with more than 15 people	+
Experience in farming	Experience refers to the number of years spent in agricultural activity. The different levels of experience are less than 5 years in agriculture, 5–10 years of experience, 10–15 years of experience, 15–20 years of experience, and more than 20 years of experience	+
Farm size	Area sown with onion and potatoes, in hectare	+
Information on the existence of new conservation techniques	Binary variable, equal to 1 if the farmer knows the existence of new technologies and 0 if not	+

Source: Authors, survey data, July 2018

Table 2.
Definitions of the variables used in the empirical model and the expected signs.

security in Burkina Faso: case of Tilgr-Baore.” This program is part of an action research carried out by a multidisciplinary team composed of anthropologists, economists, sociologists, building specialists, and innovator of the Institute of Science of Societies (INSS) and the Research Institute of Applied Sciences and Technologies (IRSAT) of Burkina Faso.

This composition of the team has helped to collect quantitative and qualitative data required to cover the different lines of research. For the field phase, a sample of 300 producers was surveyed including 200 potato producers and 100 onion producers, using a questionnaire in the northern and north-central regions of the country. Data were collected in July 2018 at four sites: Yako, Tougou, Titao, and Zintenga. These sites are characterized by strong market garden productions. The specialization of the region in potato and onion production and the existence of selling opportunities in the country’s capital and some neighboring countries have justified the choice of these areas. The producers’ sample allowed us to carry out descriptive statistics and econometric estimates.

5.3 Descriptive statistics of the sample

The characteristics of the producers, the characteristics of the production, and the state of knowledge of Tilgr-Baore technology are presented in this section.

5.3.1 Characteristics of onion and potato growers

The sex and the level of education are the two mean characteristics of producers, presented here. **Figure 4** shows the distribution of the sample by sex.

The sample of producers is 57% female and 43% male. This means that women are more involved in market garden production. In the northern and north-central regions, market gardening is an income-generating activity for many women in rural areas, as the rural population is predominantly female. According to the continuous multi-sectorial survey [23], the rural population is 51.52% women versus 48.47% men. According to the level of education, **Figure 5** shows the percentage of producers according to the level of education obtained.

The analysis of the sample shows that the majority of onion and potato growers have no level of education. These producers represent a proportion of 53%. Of the producers, 25% are literate in French or in national languages in the non-formal education system and 18% have a primary level. Only 4% of producers reach a secondary level in their study. The lack of training of many producers can limit the use of technology.

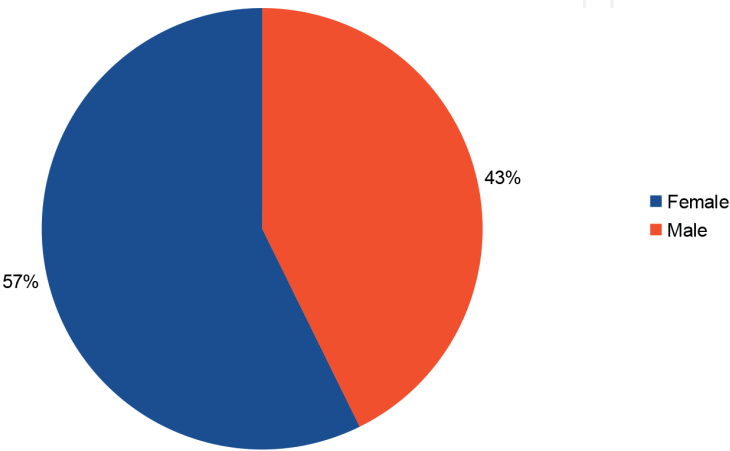


Figure 4.
Representation of producers by sex. Source: Authors, survey data, July 2018.

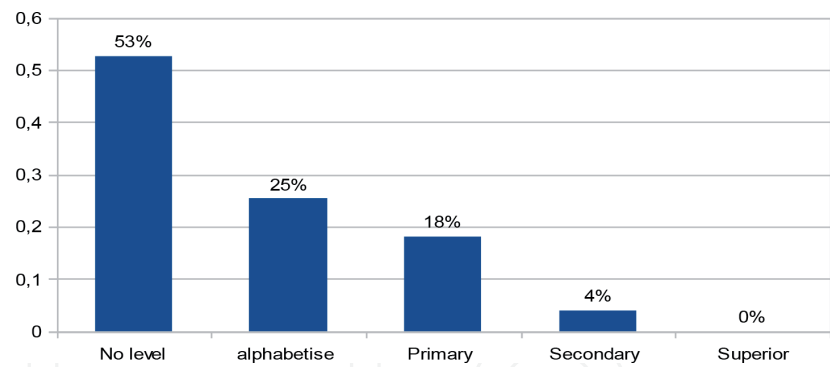


Figure 5.
The level of education of producers. Source: Authors, survey data, July 2018.

5.3.2. *The characteristics of the production*

This section highlights the perception of postharvest losses by farmers. **Figure 6** shows the percentage of producers facing production losses related to the conservation of the potato.

Potato producers record losses due to their conservation methods and technologies. Indeed 86% of producers experience losses of 21 kg or more related to the conservation of their potato production. The analyses show that the producers clearly perceive the losses related to their conservation technique. The extract from the interview with a producer from the study area proves that. This producer from the north-central region said: “There is no infrastructure to keep our production, we sell at harvest because it is difficult to keep. There is also the fact that those who produce the first, have an interest in selling it quickly. For the production from February to April, the market is very very weak, it is at this moment that we will gain to keep because it is at this period that we produce more. PAFASP¹ has tried to help some people build small sheds to keep, but it is very little compared to large production. So that we sell the production in the field because we can not preserve” (speech of Naaba Tingre producer of onions and potatoes at Zimtenga, July 2018).

5.3.3. *State of knowledge of Tilgr-Baore technology*

We present in this part the state of knowledge of the innovation, the source of the information about the technology, and the perception of the attributes of this innovation. **Figure 7** shows the state of knowledge of the Tilgr-Baore box in the sample.

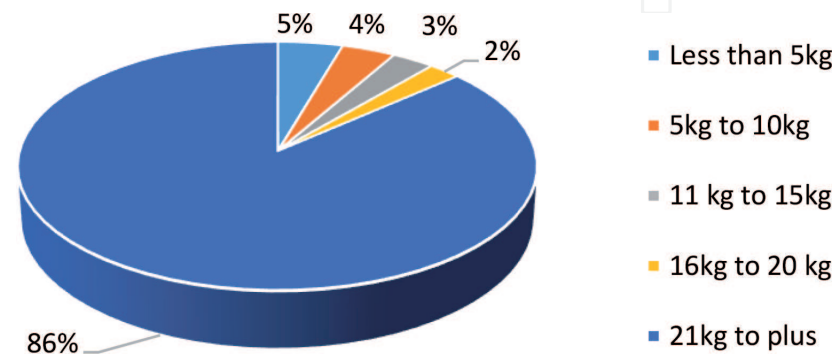


Figure 6.
The losses of the producers related to the conservation of the potato. Source: Authors, survey data, July 2018.

¹ PAFASP: Agro Sylvo Pastoral Support Program

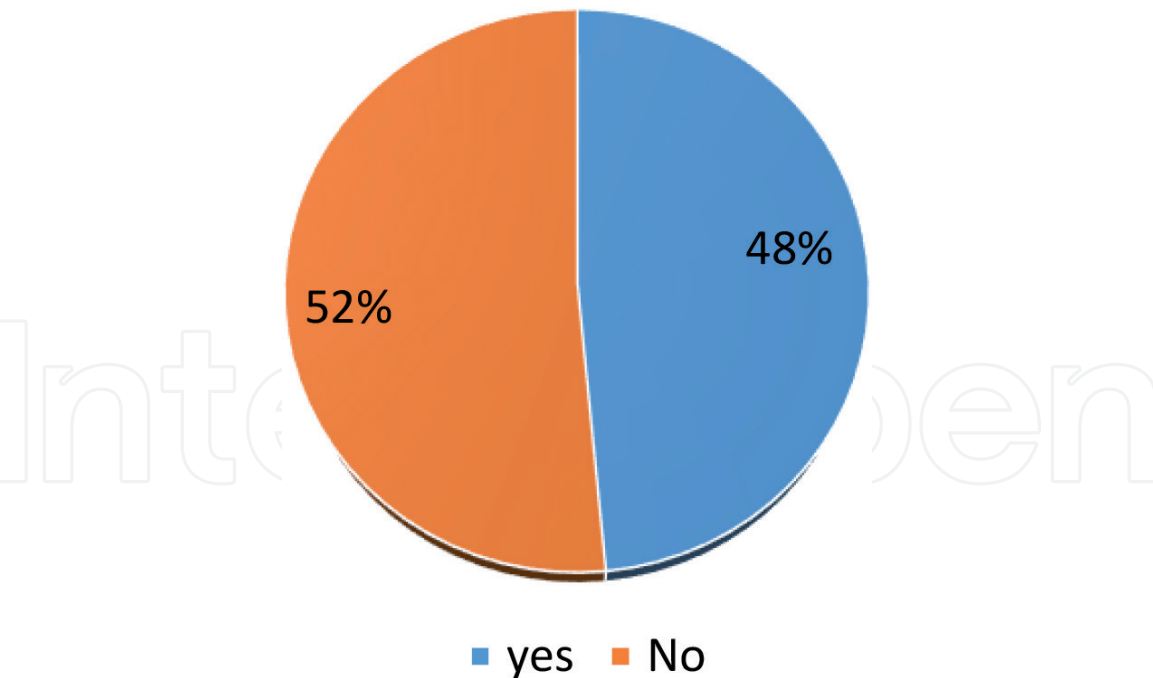


Figure 7.
Knowledge of the Tilgr-Baore box by the producers. Source: Authors, survey data, July 2018.

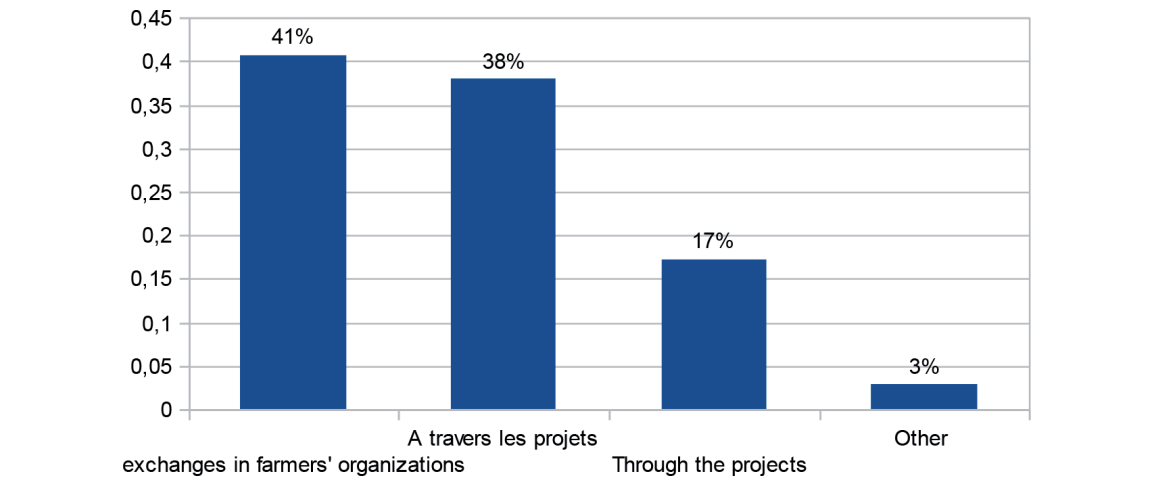


Figure 8.
Producer information channels on the existence of the Tilgr-Baore box. Source: Authors, survey data, July 2018.

More than half of the producers interviewed (51.5%) do not yet know the Tilgr-Baore conservation box. This ignorance of innovation does not allow producers to benefit from the advantages offered by this technology. What are the reasons that can explain this situation? Would it be a weak use of communication channels?

By focusing on the communication channels through which producers have learned about the box, **Figure 8** shows that the media played a weak role in disseminating information to producers. This could be explained by the high costs of disseminating information in the media or the low level of education of producers who are mostly illiterate.

Chat within farmer organizations is the most used communication channel for disseminating information on innovations. This mode of communication has allowed 41% of producers to be informed about the existence of the innovation. Only 17% of producers received information through the media channel (mainly radio). This result means that farmers' organizations play an important role in the dissemination of information because these exchange frameworks constitute elements of the social capital of producers. For a better promotion of the innovation,

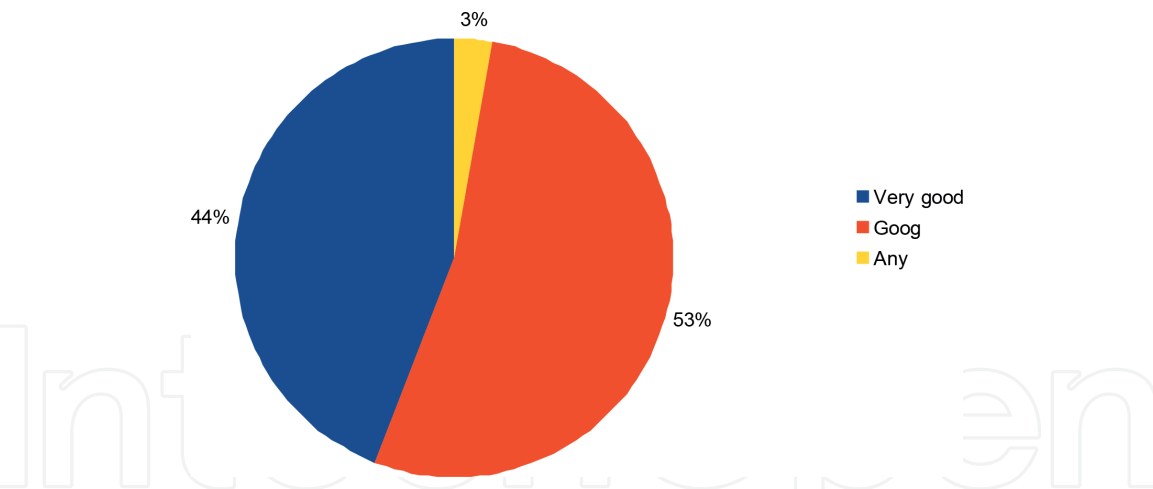


Figure 9.
The level of appreciation of Tilgr-Baore by the producers. Source: Authors, survey data, July 2018.

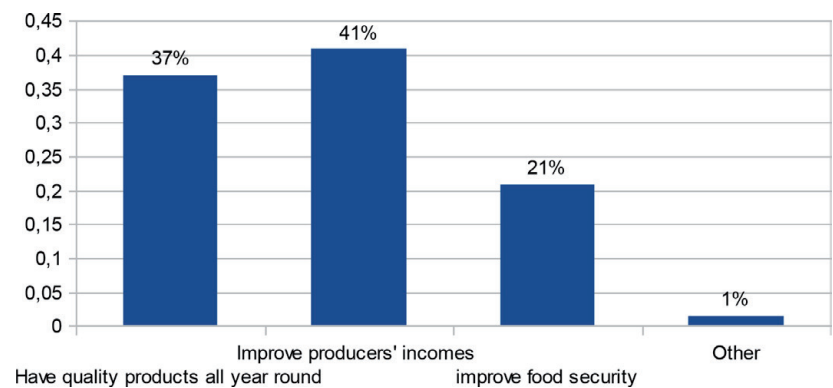


Figure 10.
The advantages of Tilgr-Baore according to the producers. Source: Authors, survey data, July 2018.

it is important that the diffusion projects are in relation with farmers’ organizations and in contact with the producers. These actions would improve the level of appreciation of Tilgr-Baore by the producers. **Figure 9** gives an overview of the assessment of innovation by agricultural producers.

Among producers who are aware of the existence of the innovation, we note that 44% have a very good appreciation of the conservation box. The majority of producers surveyed (about 53%) gives a good appreciation of the box. However, to allow Tilgr-Baore technology to play an important role in the conservation and marketing of products, 55.9% of producers believe that its management should be done in groups or in association. In addition, a significant proportion of producers (41.4%) want the technology to be managed at the family level.

Producers evaluate the benefits of Tilgr-Baore in relation to increased income, improved product quality, and food security. **Figure 10** represents the perception of producers on the benefits of the innovation.

The result of producer’s perception analysis on the benefits of the innovation show that 41% of producers find that the use of the conservation box improves incomes compared to 37% who believe that the technology maintain quality of products over a long period of time. Only 21% think that Tilgr-Baore improves food safety. This result implies that producers give more importance to the income-enhancing effect of the new conservation technologies.

The analysis of state of knowledge of Tilgr-Baore technology reveals that the technology is well appreciated and the benefits associated with its use are known. However, the proportion of producers who have this knowledge of technology is still low. This leads us to analyze the actions of valorization of the technology.

5.4 Econometric results of perception of Tilgr-Baore technology estimation

Table 3 presents the results of the probit model estimation of farmers’ perception of Tilgr-Baore technology. The probit model parameters were estimated by the maximum likelihood method.

The likelihood ratio test (LR test) indicates that the estimated model is globally significant at the 1% threshold. Individual significance tests indicate that educational level, farm size, and information availability significantly influence the perception of Tilgr-Baore technology.

Educated farmers have a higher probability of perceiving the utility of Tilgr-Baore. When the producer is educated, the probability of having a very good perception of Tilgr-Baore increases by 12.71%. The level of education of the individual is an element of human capital. Instruction is described as an essential element in any development process. When a producer is educated, he can better appreciate the usefulness of new technologies, and he will be open to new ideas. The coefficient for size of cultivating land has a negative sign and shows that farmers with larger farm size were less likely to appreciate Tilgr-Baore technology. When the size of the farm increases by 1 hectare, the probability of having a very good perception of Tilgr-Baore decreases by 4.02%. This can be explained by the fact that small farms are the ones that face the most constraint of crop storage. The availability of information about the existence of new technologies has induced farmer more probability to perceive Tilgr-Baore technology. Access to information on the existence of new product storage technologies increases the probability of having a very good perception of Tilgr-Baore of 28.07%.

The positive sign associated with age, household size, and agricultural experience shows that these variables are positively related to Tilgr-Baore perception, but the effect is not statistically significant. These variables cannot explain the difference in perception of technology. Similarly, the sex variable has no significant effects on the perception of technology.

Perception of Tilgr-Baore	Marginal effects	Standard error
Age	0.0347137	0.0463629
Sex	−0.0344878	0.0636664
Level of education	0.1271664**	0.0589712
Household size	0.0429695	0.0315065
Agricultural experience	0.0359173	0.0300884
Farm size	−0.0402437**	0.019039
Information	0.2807886***	0.0664915
Number of observations	=	300
Likelihood ratio (LR) chi-square test: LR chi2(7) ¹	=	31.18
Prob > chi2 ²	=	0.0001

¹The likelihood chi-square test is a statistic test used for comparing the goodness of fit of two statistical models. The number in the parenthesis indicates the number of degrees of freedom. In this model, there are seven predictors, so there are seven degrees of freedom.
²Prob > chi² is the probability of obtaining the chi-square statistic, which is compared to a critical value 0.01, 0.05, or 0.1 to determine if the overall model is statistically significant. In this study, the model is statistically significant at the 1% threshold because Prob>chi² is less than 0.000.
*Mean the parameter is significant at 10%, ** the parameter is significant at 5%, and *** the parameter is significant at 1%.
Source: Authors, survey data, July 2018

Table 3.
Probit regression of farmers’ perception of Tilgr-Baoré technology.

6. Conclusion

Onions and potatoes are market garden produce that are produced mainly during the dry season. The production of these two crops has increased sharply in recent years as it represents a major source of income for rural populations in Burkina Faso who are mostly poor. The current situation of the local market for these products characterized by a single production cycle makes it difficult to offer products throughout the year. A large part of the production is put on the market of the harvest to avoid the losses postharvest due to the lack of adapted storage infrastructures. To improve farmers' profit margins and maintain product quality throughout the year, local innovators have created new conservation technologies. These new technologies need to be valorized because they are not sufficiently known by the users who are the producers and the sellers. The valorization of technological innovations must aim for a structural transformation of the economy. The analysis of the national environment shows in a general way an environment favorable to the valorization of the innovations. The results of the surveys show that many agricultural producers are not yet aware of the technological innovations of onion and potato conservation. These producers are weakly alphabetized. The lack of training of many producers and the high cost of innovations can limit the use of innovative technologies. Econometric estimation of the determinants of the farmers' perception of Tilgr-Baore technology indicates that educational level and information availability have a positive and significant influence on the perception of Tilgr-Baore, while farm size negatively influences the probability of a very good perception of technology.

For a better dissemination of new technologies for onion and potato conservation, public policies must revitalize the partnership between ministerial departments involved in the promotion of innovations and innovators. In addition, public policies should encourage the promotion of innovation protection and speed up the process of obtaining patents to ensure the transfer of technological innovations. The adoption of innovations requires an improved perception of innovation. To do this, it is necessary to improve the level of education of farmers and make available information on innovations. Farmers' organizations are the main channel for transmitting information on the existence of innovations. It is an element of the social capital of the farmer that needs to be strengthened. Our results also imply that policies to promote new technologies adoption (mainly the Tilgr-Baore) should target small farms as a priority.

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