International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 10, Issue 3, pp: 87-100, 2025
https://doi.org/10.55126/ijzab.2025.v10.i03.012 **http://www.ijzab.com**

Research Article

FARMERS PERCEPTIONS OF LEPIDOPTERA STEM BORERS AND CONTROL METHODS IN IRRIGATED RICE IN BURKINA FASO: THE CASE OF THE BAMA AND KARFIGUELA SCHEMES

[1]Kossi Latevi, [2]Etienne Zakané, [3]Delphine Ouattara, [1]Olivier Gnankine and [2*]Souleymane Nacro

[1]Université Joseph KI-ZERBO, Ecole doctorale Sciences et Technologie, Laboratoire d'Entomologie Fondamentale et Appliquée, UFR/SVT, Burkina Faso.
[2]Centre Régional de Recherches Environnementales, Agricoles et de Formation de Kamboinsé 01 BP 476 Ouagadougou 01, Burkina Faso.
[3]Centre Régional de Recherches Environnementales et Agricoles de l'Ouest, Station de Farakô-Ba, 01 BP 910 Bobo-Dioulasso 01.

Article History: Received 11th March 2025; Accepted 29th April 2025; Published 31st May 2025

ABSTRACT

In Burkina Faso, damage caused by Lepidoptera stem borers is a threat to rice production. This study aims at assessing farmers' perceptions of these insect pests to improve our understanding of their management. Thus, a semi-structured survey was submitted from September to November 2022 to 436 rice farmers in the irrigated schemes of Bama and Karfiguéla in western Burkina Faso. Results showed that 59.25% of rice farmers had a good knowledge of rice Lepidoptera stem borers, their associated damage and the vulnerable phenological stages of the rice plant to these insect pests. Farmers reported considerable yield losses (average of 33.33%) to these insect pests. In both Bama (64.96%) and Karfiguéla (59.25%), chemical control using mainly deltamethrin was the most important method of managing these pests. Respondents revealed the existence of a diversity of natural enemies associated with rice insect pests. These beneficials were dominated by arachnids. In view of these results, training rice farmers in biological and cultural control methods would be a major asset in the implementation of a sustainable integrated insect management strategy.

Keywords: Rice, Lepidoptera stem borers, perceptions, damage, Burkina Faso.

INTRODUCTION

Burkina Faso is an agro-pastoral Sahelian country whose agriculture is dominated by cereal crops. These cover 88% of the area sown annually (Koutou *et al.*, 2021). Among the cereals grown, rice ranks 4th in terms of area and production, after sorghum, millet and maize (Konaté *et al.*, 2022). Rice production is estimated at 438,982.38 tons in 2022 (FAOSTAT, 2022). Rice is a commodity of strategic importance, given its role in the country's food and nutritional security and economy. The area sown to rice has increased from 136,864 ha in 2012 to 221,052 ha in 2021 (MARAH, 2022). According to FAOSTAT, average annual national rice production rose from 319,390 tons in 2012 to 438,982.38 tons in 2022, with a peak in 2020 (451,421 tons). Annual national rice consumption is about 450,000 tons, with a growth rate of around 5.6% per year (MAAH, 2019), and is increasing by 11% per year, while production is growing by 5.3% per year (SNDR II, 2021). Increasing rice production in Burkina Faso is therefore becoming a necessity. For this reason, measures were implemented by the government, with the support of its partners, to make the most of national rice production. These measures include intensifying rice cultivation, building new hydro-agricultural infrastructures, subsidizing inputs and agricultural equipment, introducing improved varieties and improving cultivation techniques and practices through training. Despite these efforts, domestic rice production only covers 47% of the population's needs (Barro, 2021). This production deficit forces the country to import large quantities of rice every year. From 2018 to 2022, the

*Corresponding Author: Souleymane Nacro, Centre Régional de Recherches Environnementales, Agricoles et de Formation de Kamboinsé 01 BP 476 Ouagadougou 01, Burkina Faso Email: snacro2006@yahoo.fr.

quantity of rice imported rose from 615,460.9 tons to 714,063.8 tons, with values ranging from $ 148, 363, 636 to 1, 630, 727, 272 (INSD, 2022).

The poor national production is associated with socio-economic, abiotic and biotic constraints (Sanou *et al.*, 2017). Among the biological constraints are insect pests whose damage to the rice plant can lead to yield losses of between 2% and 38% depending on the cropping season (Ba *et al.,* 2008; Togola *et al.,* 2010). Halilou *et al*. (2018) reported that stem borers are a major biotic constraint to cereal production in sub-Saharan Africa. The Lepidoptera rice stem borers include : *Chilo zacconius* Bleszynski, *C. diffusilineus* Joannis; *Sesamia calamistis* Hampson; *Maliarpha separatella* Ragonot. They constitute one of the main groups of rice insect pests. Their damage is caused by larvae feeding in the light of the rice stem. During the vegetative phase of the plant, the attack of these borers causes the death of the central part of the stem. This damage is known as “dead heart”. During panicle initiation, infestation leads to the formation of empty or sparsely filled white heads known as “white heads” (Ogah and Nwilene, 2017). Damage by these insects can cause losses of up to 30% on upland rice and 100% on lowland rice in a year of heavy infestations (Umeh *et al.*,1993). In Burkina Faso, research has shown that stem borers are responsible for yield losses of 30% to 40% (Ouattara *et al*., 2018). Nwilene *et al.* (2006) estimated losses associated with this group of insects at up to 80% in West Africa. Muralidharan and Pasalu (2006) reported that 1% dead hearts or white heads correlated with 4% and 6% yield loss respectively.

Given the economic importance of damage, capitalizing on endogenous techniques for managing rice Lepidoptera stem borers is essential. This is highly advantageous, as it not only involves grassroots players in identifying solutions, but also ensures that they are sustainable, economical and environmentally friendly. Therefore, it is important to understand how rice farmers currently perceive these insect pests, their damage and their impact on yield.

MATERIALS AND METHODS

Study areas

The 1260 ha rice-growing scheme of Bama is located 25 km northwest of Bobo-Dioulasso (Hauts-Bassins region), on the Bobo-Faramana-Mali border between parallels 10° 20' north latitude, 4° 20' west longitude (Figure 1). Karfiguéla is a village located in the Cascades region, some ten kilometers northwest of Banfora (Figure 1). The geographical coordinates of this village are: latitude North 10° 42' and longitude 4° 49' West, with a developed surface area of 300 ha. The climate in this part of the country is South Sudanian (Thiombiano and Kampmann, 2010), with two alternating seasons per year. The rainy season runs from May to October, and the dry season from November to April. Rice is produced in Bama in both growing seasons, but in Karfiguéla, dry season production depends on the availability of water shared with SN SOSUCO, a sugar company. The rice-growing shemes of Bama and Karfiguéla are farmed by 1,300 and 400 farmers respectively (Ouattara, 2019). The choice of these two sites is justified by the fact that the main agricultural production on these schemes is rice. In addition to that, the prevelence of insect pests associated with rice was reported several times.

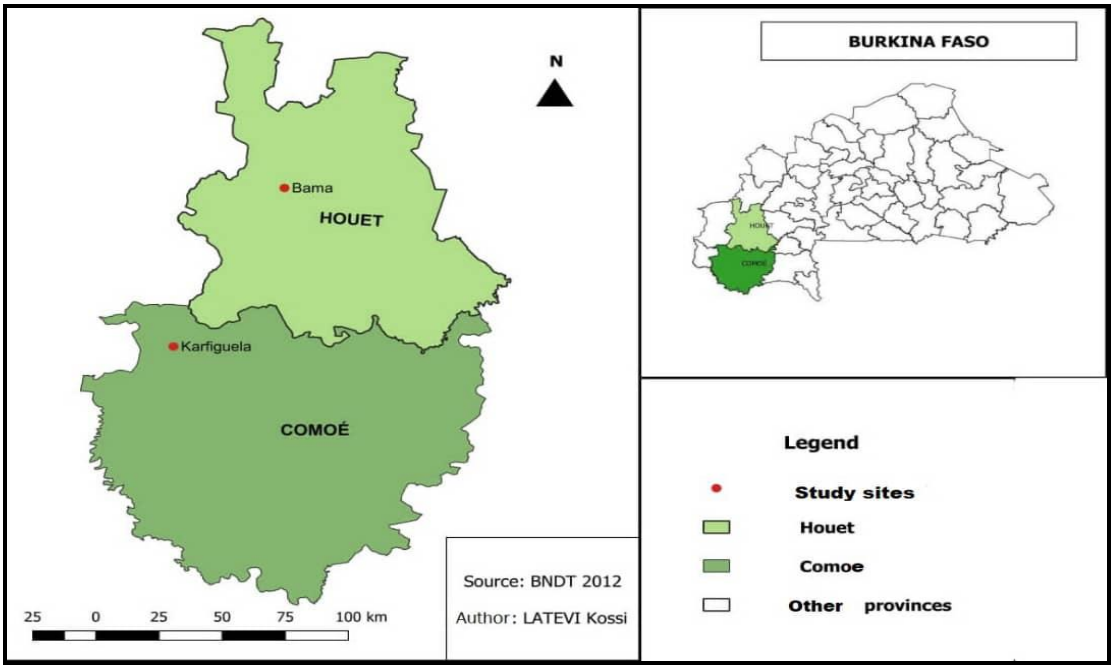

Figure 1. Map of study areas.

Data collection tools

A semi-structured questionnaire was drawn up and submitted to farmers in the 2-study sites.

Sample size

The sample size was determined by considering the number of rice farmers in each irrigated scheme. Thus, estimating the number of farmers set at 1300 for the Bama scheme and 400 for the Karfiguéla scheme, and adopting a margin of error of 5% and a confidence interval of 95%, the sample size is determined according to the following formula proposed by Gret (2012):

$$n = \frac{t_{p2} \times P(1 - P) \times N}{t_{p2} \times P(1 - P) + (N-1) \times y^2}$$

- n: sample size.

- N: size of target population (number of households, farmers, etc.), actual or estimated.

- P: expected proportion of a population response, or actual proportion set at 0.3.

- tp: sampling confidence interval. This value corresponds to 1.96 for a confidence level of 95%.

- y: 0.05 represents the margin of error considered in this survey.

Based on this formula, the size of the sample to be surveyed was 436 rice farmers, including 258 farmers in Bama and 178 farmers in Karfiguéla.

Data collection

The study involved a semi-structured questionnaire of 436 rice farmers and was carried out from September to November 2022. Respondents were selected at random from lists made available by the supervisory staff of each scheme. In order to avoid bias in the answers given by the respondents, the questionnaire was administered individually to each respondent. Questions related to socio-demographic characteristics, techniques for recognizing and managing rice Lepidopteran stem borers insects and their impact on production, recognition of natural enemies and inappropriate practices favoring the development of these insect pests.

Assessed parameters

The parameters covered by this study included:

- ✓ Socio-demographic characteristics of rice farmers in the two rice-growing areas;
- ✓ Knowledge of irrigated rice-growing practices;
- ✓ Recognition of the main lepidopteran rice stem borers;
- ✓ Consequences of insect pest attacks on rice productivity;
- ✓ Different methods of controlling insect pests of rice;
- ✓ Recognition of natural enemies associated with insect pests of rice;
- ✓ Knowledge of insecticides used by farmers.

Data analysis

The data collected were first reorganized in the form of quantitative variables after coding. They were then entered and grouped in Excel 2021. The data were then subjected to statistical analysis using R software version 4.2.1. Descriptive statistics were used in this study. It was used to highlight the average percentages of farmers' responses for each target variable, as well as trends, observations and other social aspects linked to the management of rice Lepidoptera stem borers. Results were presented in the form of tables or graphs (histograms and pie charts).

RESULTS AND DISCUSSION

Men and women were surveyed at both sites (Figure 2). The proportion of men was 95.17% on the Bama scheme, compared with 93.11% on the Karfiguéla one. Women accounted for 4.83% of respondents at Bama versus 6.85% at Karfiguéla.

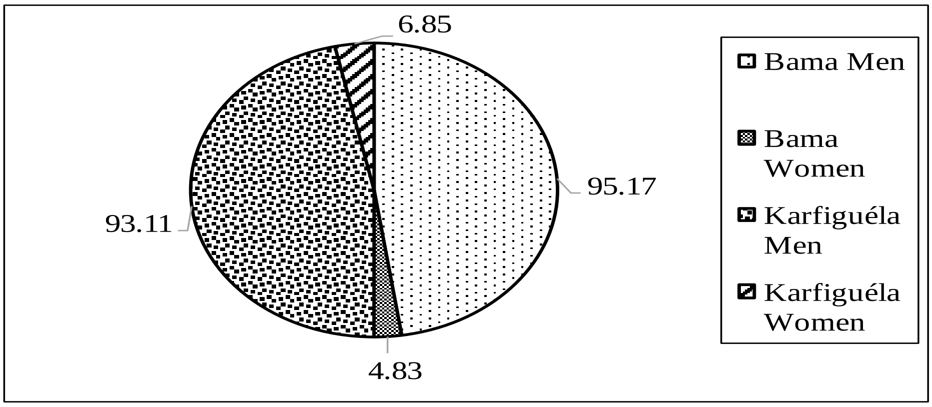

Figure 2. Distribution of surveyed rice farmers by gender and rice-growing sheme.

The survey population was divided into three age groups. The [40-60[age group accounted for the largest number of rice farmers, with 59.31% in Bama and 55.48% in Karfiguéla (Figure 3). Farmers aged between 20 and 40 made up the 2nd largest group, regardless of the rice-growing scheme considered. Finally, the last age group (60 and 80 years) accounted for 14.38% of respondents in Karfiguéla and 6.21% in Bama.

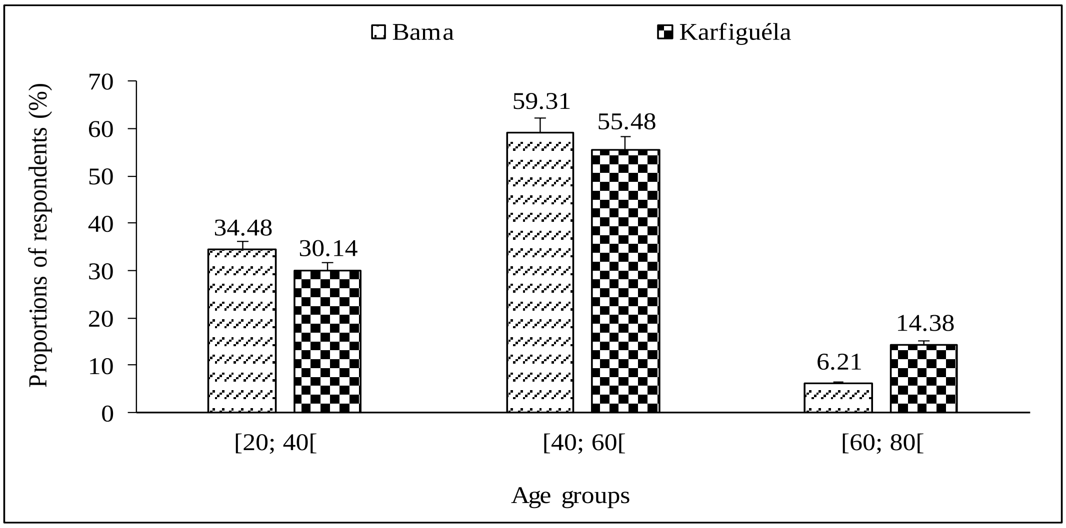

Figure 3. Distribution of survey population by age group and rice schemes.

The large majority of rice farmers surveyed were illiterate, with 59.73% of respondents recorded in Karfiguéla versus 57.09% in Bama (Figure 4). The proportion of educated rice farmers was 28.18% in Karfiguéla and 15.43% in Bama. Literate rice farmers accounted for 12.08% of respondents in Karfiguéla versus 27.52% in Bama.

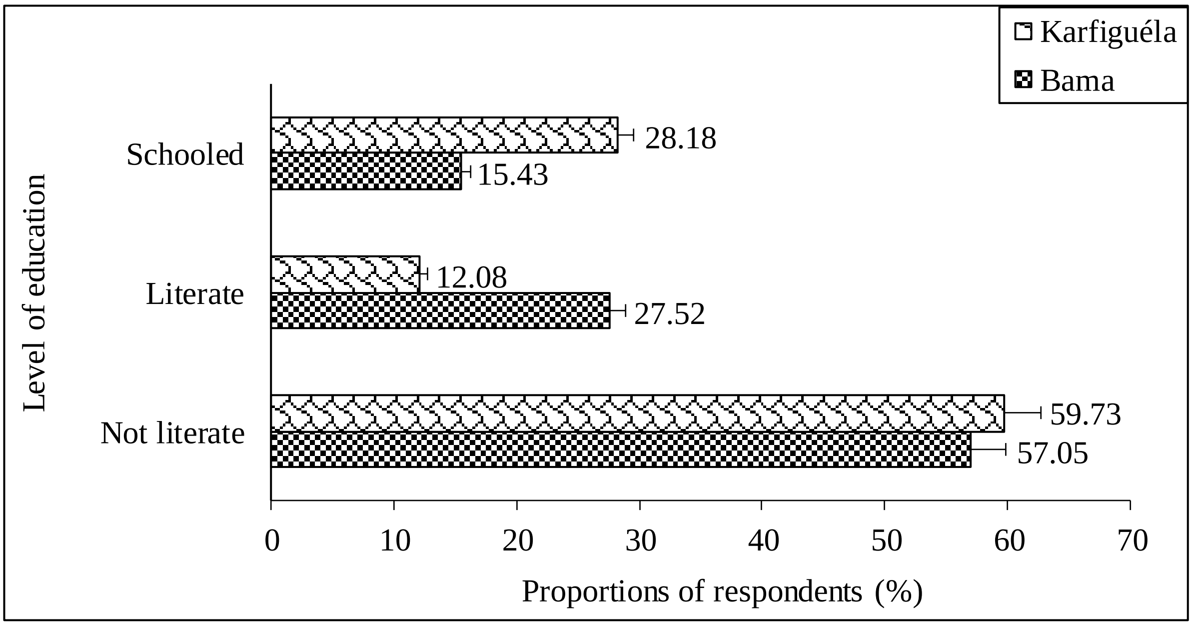

Figure 4. Level of instruction of rice farmers surveyed in Bama and Karfiguéla.

Rice is not only a source of income for rice farmers, but also contributes to their food and nutritional security. Over ¾ of respondents in Karfiguéla (81%) and half in Bama (55%) claimed to have around 24 years' experience in rice growing (Figure 5). In Karfiguéla, 57% of farmers had an average of 12 years' experience in rice farming. The same number of years of experience was noted for 46% of rice farmers surveyed in Bama. Levels of 20% and 13% of respondents in Bama and Karfiguéla respectively had 36 years' experience in rice farming. Only the Bama site recorded 27% of surveyed rice farmers with a total of around 48 years of rice cultivation.

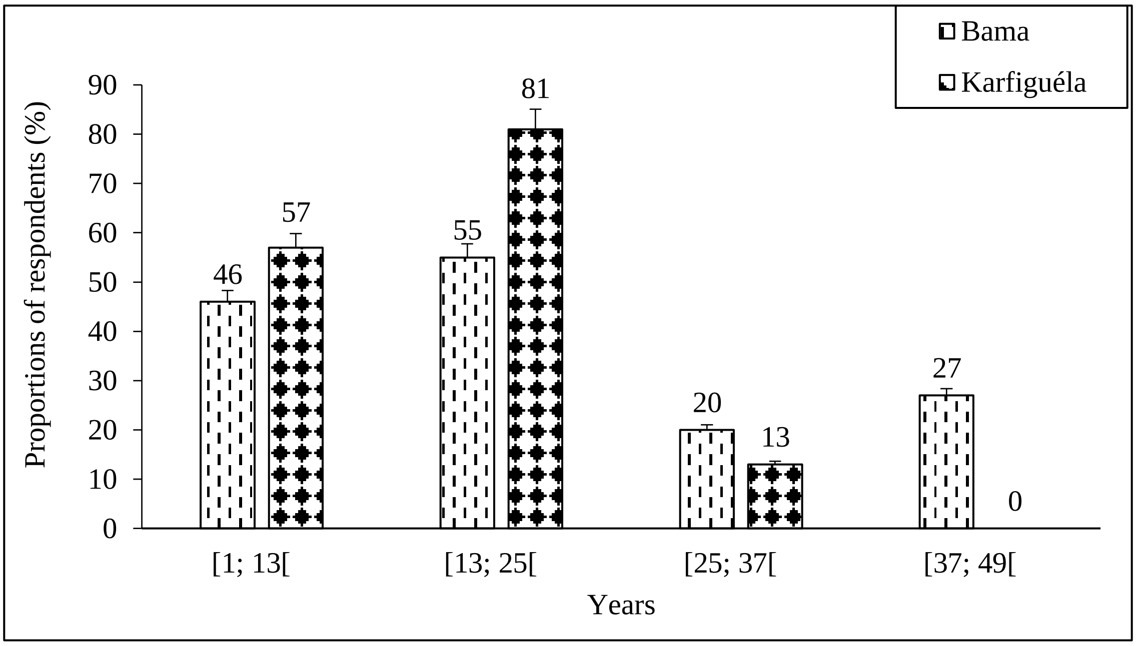

Figure 5. Proportions of rice farmers according to number of years' experience in rice farming in Bama and Karfiguéla.

Table 1 shows the results of responses from surveyed rice farmers who had received training in rice farming. The most frequent training received by rice farmers in Bama (24.26%) was on good agricultural practices, while in Karfiguéla just over half of respondents (50.75%) were trained on the intensive rice-growing system. In Bama, 20% of respondents and 16.41% in Karfiguéla claimed to have received no training at all. Less than 2% of farmers surveyed had received training in pest management, followed by integrated production and pest management (Table 1).

Table 1. Training received by rice farmers surveyed in Bama and Karfiguéla.

	Proportions of respondents (%)	
Topics of training received	**Bama**	**Karfiguéla**
Good Agricultural Practices	24.26	13.2
Fertilization and Soil Maintenance	17.6	10.4
Intensive Rice Cultivation System	18.6	55.75
Pest Management	1.54	1.06
Harvest and Post-harvest	16.8	2.19
Integrated Production and Pest Management	1.2	0.99
No training	20	16.41

The large majority of rice farmers surveyed in Bama (96.22%) and Karfiguéla (92.6%) claimed to have heard of rice Lepidoptera stem borers (Figure 6).

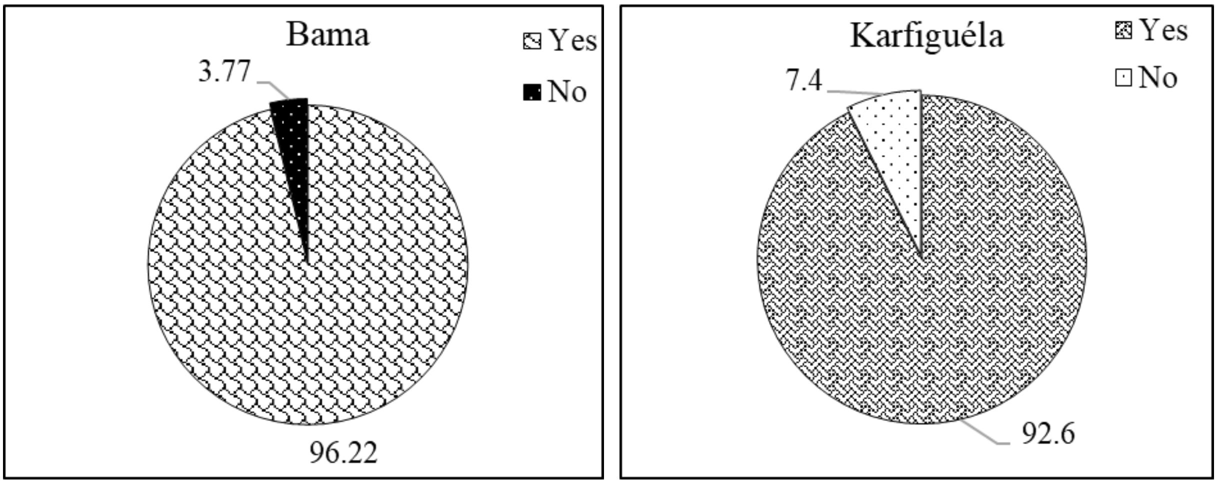

Figure 6. Proportions of rice farmers with knowledge of rice Lepidoptera stem borers in Bama and Karfiguéla.

Nearly ¾ (72.8%) of the rice farmers surveyed in Bama and 2/3 (65.76%) of those in Karfiguéla claimed to be able to identify rice Lepidoptera stem borers (Figure 7). The remainder (27.2% in Bama and 34.24% in Karfiguéla) said they could not identify them.

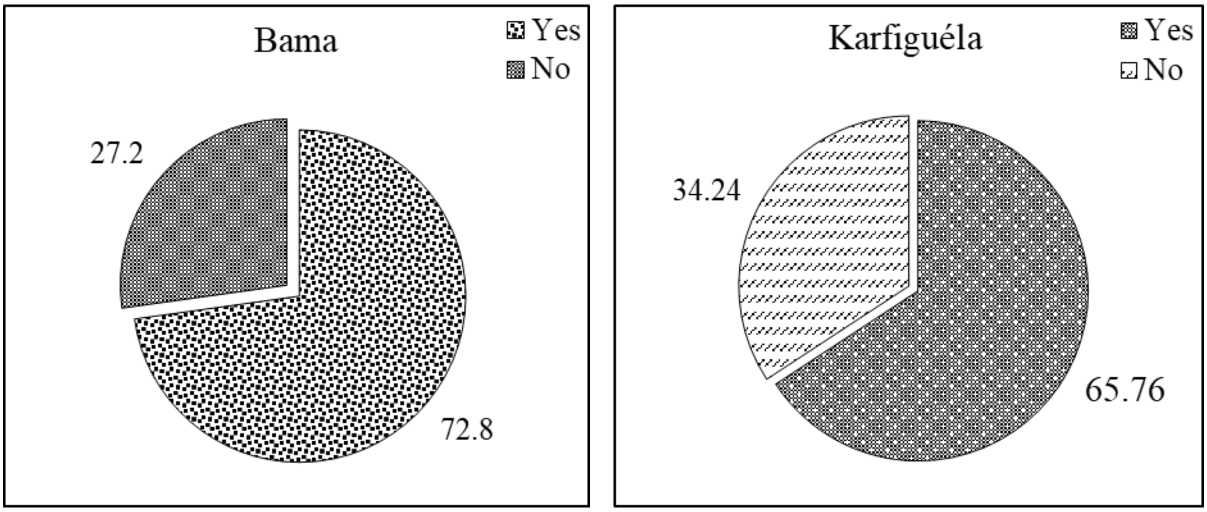

Figure 7. Proportions of rice farmers able to identify rice Lepidoptera stem borers in Bama and Karfiguéla.

Several criteria are used by rice farmers to identify rice Lepidoptera stem borers. These include the color of the larvae, drying of the main tillers, white heads and stem perforation. Thus, 52.6% of respondents in Bama and 69.92% in Karfiguéla said they could identify these insect pests by the color of their larvae. Then, 27.66% and 16.75% of respondents in Bama and Karfiguéla respectively relied on the presence of the white head symptom to identify these insects. Some farmers surveyed (17.5% of respondents in Bama versus 11.95% in Karfiguéla) mentioned the desiccation of the central leaf (the dead heart symptom) of rice plants in their fields as a criterion for the presence of the rice Lepidoptera stem borers (Figure 8). Finally, a small minority of the population surveyed in Bama (2.24%) and Karfiguéla (1.38%) cited rice stem perforation as a criterion for the presence of this group of insect pests.

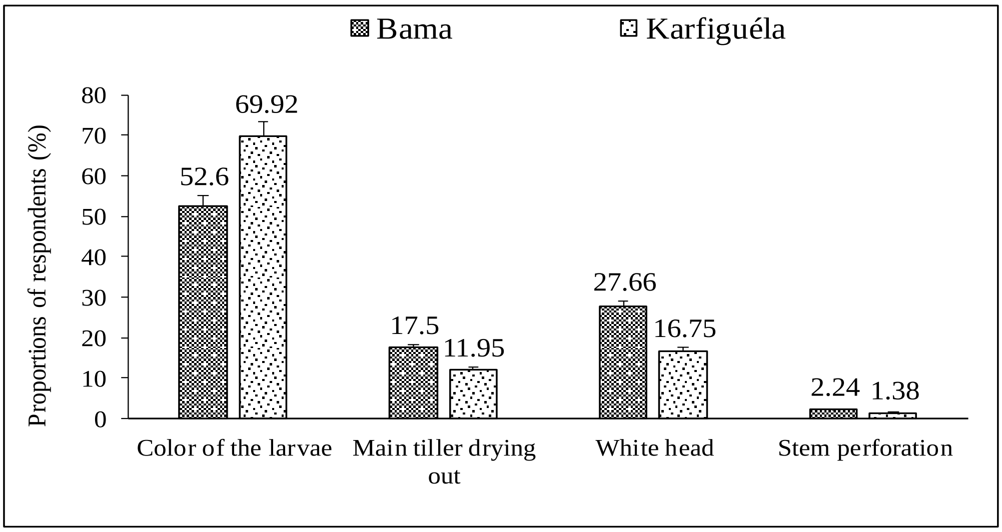

Figure 8. Criteria and proportions of rice farmers using them to identify rice Lepidoptera stem borers.

Table 2 shows farmers' knowledge of the damage and phenological stages of rice plants vulnerable to attack by rice Lepidoptera stem borers. The symptoms of this damage are white heads and dead hearts. White heads were mentioned by 62% of rice farmers in Bama and 58% in Karfiguéla as symptoms of stem borers damage. Dead heart' symptoms were mentioned by 38% and 42% of rice farmers surveyed in Bama and Karfiguéla respectively. In Bama and Karfiguéla respectively, 52.5% and 51% of farmers felt that the heading stage was the most susceptible to attack by stem borers (Table 2). Other farmers surveyed (36.92% in Bama and 30.5% in Karfiguéla) cited the tillering stage as the most sensitive. Finally, the seedling stage was mentioned by few farmers in Bama (10.58%) and Karfiguéla (18.5%) as being the most susceptible to rice stem borers (table 2). The assessment of crop losses is an important indicator in the justification and development of control methods. Half of the rice farmers surveyed in Bama (50%) and 55% of those in Karfiguéla thought that losses caused by rice Lepidoptera stem borers were low (< 10% of production) (Table 3). Then 35% and 32% of respondents in Bama and Karfiguéla respectively felt that they were between 10-20% of production. Finally, these losses were considered high (> 20% of harvests) by 15% of respondents in Bama versus 13% in Karfiguéla.

Table 2. Farmers' knowledge of damage and phenological stages of rice considered susceptible to rice Lepidoptera stem borers.

	Proportions of farmers (%)	
Variables	**Bama**	**Karfiguéla**
1. Type of damage		
Dead hearts	38	42
White heads	62	58
Total (%)	**100**	**100**
2. Growing stages		
Seedling	10.58	18.5
Tiller	36.92	30.5
Heading	52.5	51
Total (%)	**100**	**100**

The majority of respondents (61.25% in Bama and 51% in Karfiguéla) stated that damage caused by rice stem borers was higher in the dry growing season than in the wet season, regardless of the rice-growing scheme considered (Figure 9).

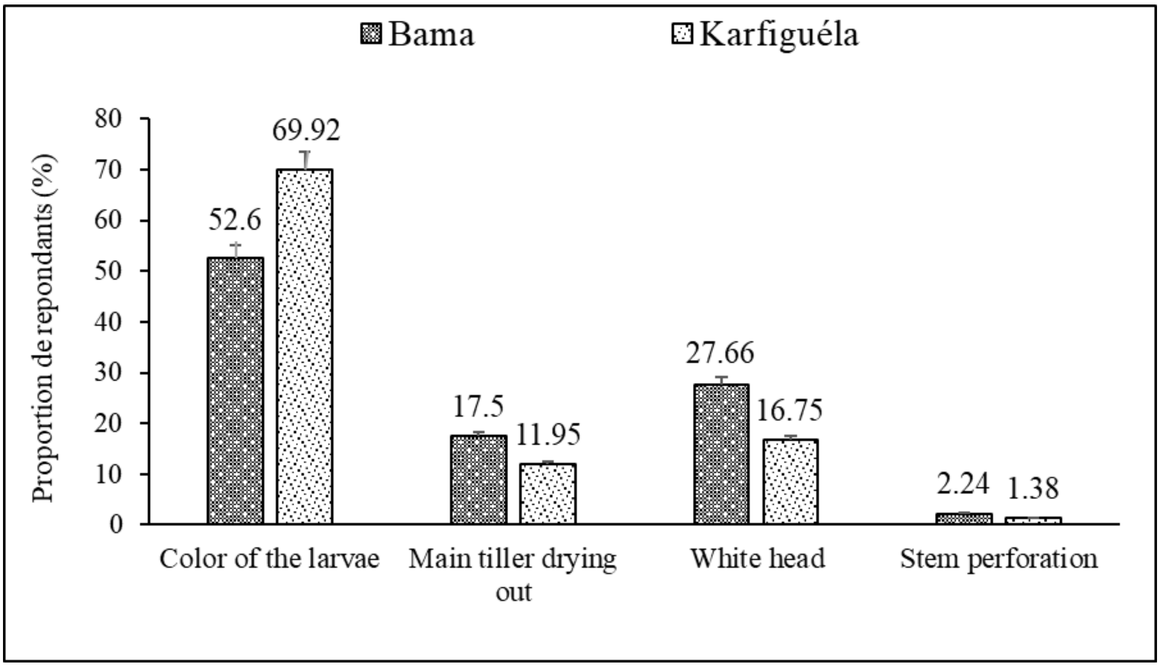

Figure 9. Rice farmers' perception of the variation in damage caused by rice Lepidoptera stem borers according to cropping season.

Table 3. Rice farmers' perception of the level of losses caused by rice epidoptera stem borers in Bama and Karfiguéla.

	Proportions of farmers (%)	
Level of damage	**Bama**	**Karfiguéla**
Low losses (< 10%)	50	55
Intermediate losses (10 to 20%)	35	32
High losses (> 20%)	15	13
Total	**100**	**100**

Figure 9 shows the main pesticides used by rice farmers to manage rice Lepidoptera stem borers. These consisted solely of chemical insecticides. Deltamethrin was mentioned by the large majority of farmers as the product most frequently used at Bama (64.96%) and Karfiguéla (59.25%). Some rice farmers at the two sites also claimed to have used Lambda-cyhalothrin (15 g/l) + Acetamiprid (10 g/l) and Chlorpyriphos-ethyl (50 g/kg), while Acetamiprid (15 g/l) was used by only 4.45% of respondents at Bama. Of these insecticides, only Carbofuran (3%) was not authorized, as it was not on the list of pesticides authorized by the Sahelian Pesticides Committee. However, a minority of rice farmers claimed to have used it. Proportions of 12.1% (Bama) and 3.11% (Karfiguéla) of rice farmers said they did not know the name of the insecticides they used.

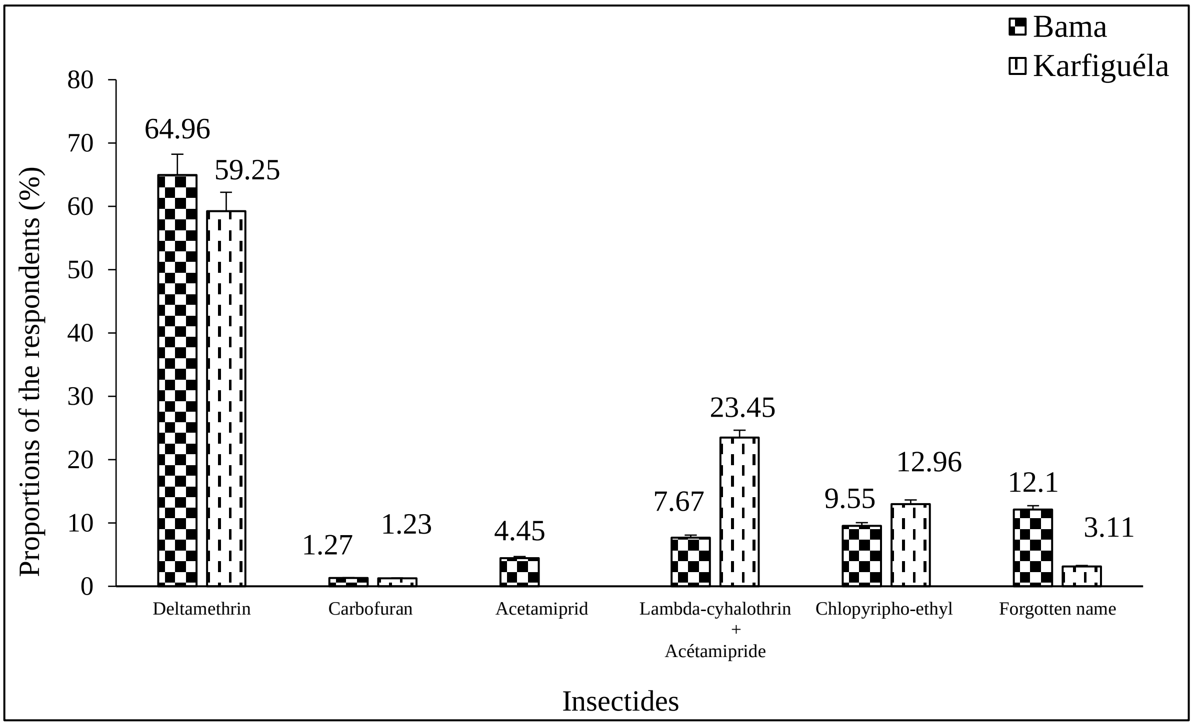

Figure 9. Main insecticides used by rice farmers to control rice stem borers Lepidoptera.

Three levels of insecticide applications were revealed by rice farmers from the tillering stage onwards. The highest proportion of rice farmers (77.5% in Bama and 65.22% in Karfiguéla) claimed to have applied insecticides in their fields 3 times throughout the rice growing season. Some farmers reported 7 applications (frequency of 2 weeks), while others reported 8 applications, corresponding to a frequency of around 7 days (Figure 10).

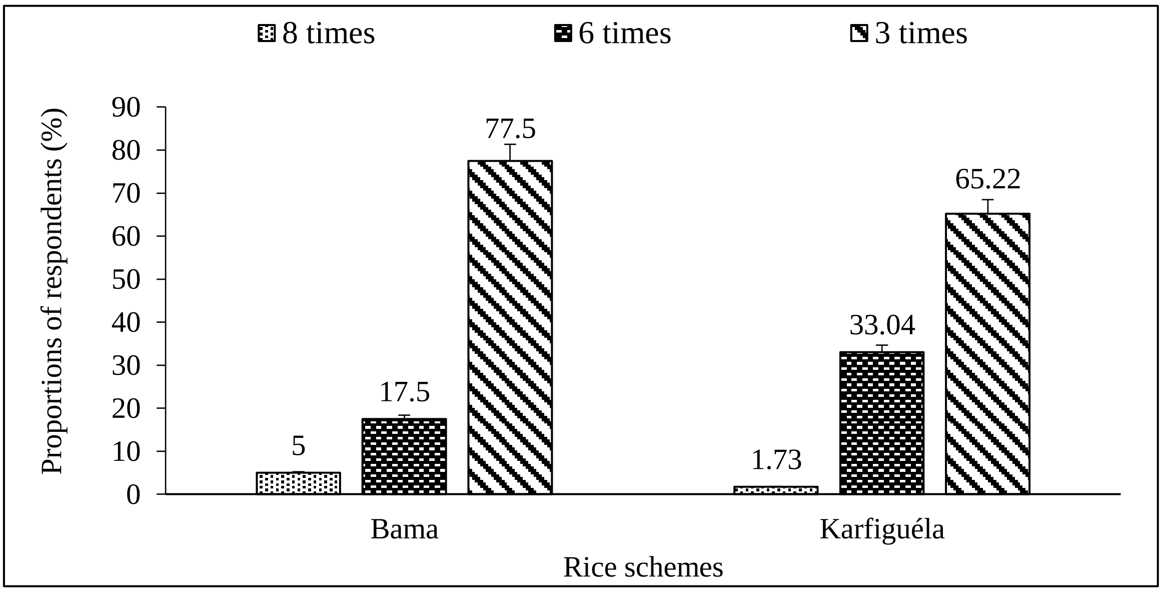

Figure 10. Number of insecticide applications done by rice farmers against rice Lepidoptera stem borers during the rice growing season.

Table 4 provides information on how rice farmers use crop residues. Rice straw is generally used to feed livestock, regardless of the study site. For this last variable, the proportion of respondents was 56.1% in Bama and 44.6% in Karfiguéla. Some of this straw is composted by 10.1% of rice farmers in Bama, compared with 23.2% in Karfiguéla. To prevent the rice straw from serving as a temporary host for stem borers, 26.4% and 13.9% of rice farmers interviewed in Bama and Karfiguéla respectively burn it on site. Finally, some farmers bury the straw in the soil (7.4% in Bama and 18.3% in Karfiguéla) to improve soil fertility.

Table 4. Management of harvest residues by rice farmers in Bama and Karfiguéla.

	Proportions of respondents (%)	
Post-harvest practices	**Bama**	**Karfiguéla**
Livestock feed	56.1	44.6
Composting	10.1	23.2
Burned after harvest	26.4	13.9
Buried in the ground	7.4	18.3
Total	**100**	**100**

The majority of respondents (32.2% in Bama and 42.7% in Karfiguéla) felt that monotonous and ungrouped insecticide applications were the main factor in the development of insect pests (Table 5). Instead, 21.6% of respondents in Bama and 16% in Karfiguéla felt that growing several crops on the same site was the cause of insect pest outbreaks. Farmers in Bama (16.8%) and Karfiguéla (10.9%) felt that poor management of the rice field environment was responsible for the outbreak of insect pests. Excess irrigation water was cited by 11.5% of farmers surveyed in Karfiguéla and 1.6% in Bama as responsible for the presence of insect pests. Failure to observe the cropping calendar (7.1% in Bama and 4.5% in Karfiguéla), abandoning rice straw in rice fields (6.2% in Bama and 4.6% in Karfiguéla) and poorly decomposed manure (2.9% in Bama and 1.3% in Karfiguéla) were cited by less than 10% of farmers surveyed as causes of insect pest development. Finally, 9% of rice farmers in Bama and 8.7% in Karfiguéla gave no answer to this question.

Table 5. Responses from respondents on agricultural practices that may favor the presence of insects on the scheme.

	Proportions of respondents (%)	
Cultural pratices	**Bama**	**Karfiguéla**
Several crops on planted on the same rice scheme	21.2	16
Excess of water	1.6	11.5
Poorly decomposed manure	2.9	1.3
Leave the straw in the fields	6.2	4.6
Poor management of surrounding plants	16.8	10.9
Failure to comply with the crop calendar	7.1	4.5
Monotonous and non-grouped insecticide applications	35.2	42.5
No response	9	8,7

Rice farmers' perception of natural enemies

Most rice farmers reported the existence of organisms that feed on insects. For example, 56% and 50% of farmers in Bama and Karfiguéla, respectively, recognized spiders as natural enemies (Figure 11). Then, 18% and 26% of respondents from the same schemes reported encountering ants that prey on rice pests. More specifically, dragonflies and praying mantises were cited by farmers in varying proportions. Finally, among the rice farmers surveyed, 6.8% (Bama) and 8% (Karfiguéla) reported being unaware of the existence of natural enemies associated with rice insect pests.

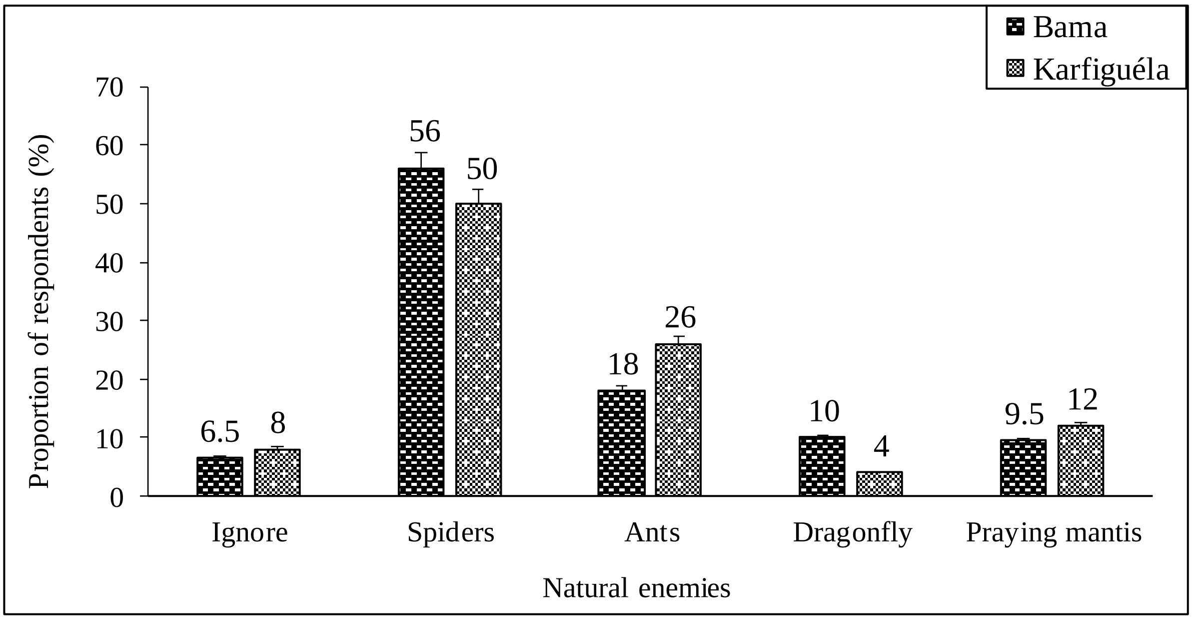

Figure 11. Perception of natural enemies by rice farmers in Bama and Karfiguéla.

Surveys conducted with 436 rice farmers in western Burkina Faso generated information on the social characteristics of rice growers, their perceptions of rice stem borers, and the management practices used. This survey revealed that the large majority of rice farmers were illiterate, with 59.73% in Karfiguéla and 57.05% in Bama. Indeed, individuals with low levels of education have difficulty finding employment in the formal sector, which exschemes their high number in the agricultural sector where activities do not require specific skills. Thus, Dri (2022) reported that in sub-Saharan countries, particularly in Côte d'Ivoire, farmers in the village of Kayeta and the sub-prefecture of Kononfla are no exception to this reality and are predominantly illiterate. The same observation was made by Kambou (2022) who recorded an illiteracy rate of 83% during his study on the entomofauna of non-timber forest products in Burkina Faso. More than 90% of the farmers surveyed were men. This very high proportion of men at the expense of women poses the problem of access to land for the latter. Lewu and Assefa (2009) and Urge et al. (2020) have shown that agricultural practice is highly gender-dependent in Africa. Moreover, Thiombiano (2015) states that women generally contribute as laborers to agricultural activities but not as managers. This further confirms the withdrawal of women from the management and accountability of agricultural work. Moreover, this high proportion of men can be explained by the fact that rice farming, like all field work in general, requires a great deal of physical effort that men are more skilled at.

The predominant age group in the study areas was between 40 and 60 years old, with a proportion of 59.31% in Bama and 55.48% in Karfiguéla. This age group consists of adult heads of households. The majority of respondents had an average of 24 years of experience in rice farming. They had received training on good agricultural practices and the System of Rice Intensification (SRI). These results highlight the training efforts deployed by the national extension system in the field. Despite the low level of education, almost all of the farmers surveyed were aware of the damage caused by rice Lepidoptera stem borers. More than 90% of respondents were familiar with rice pests, with some even believing they could identify them. These results are comparable to those reported by Togola et al. (2010) who showed that in Benin, rice farmers had a good knowledge of the main stem borers such as *S. calamistis*, *C. zacconius* and *M. separatella*. These pests cause significant damage to rice crops, with the tillering and heading stages being the most vulnerable to their attacks. This situation is explained by the biology of these insect pests on the rice plant. Dembélé (1995) reports that the critical period most affecting yields is between full tillering and the beginning of heading.

Seasonal variation also influences the severity of attacks by Lepidoptera stem borers: 61.25% of respondents in Bama and 51% in Karfiguéla reported that the most significant damage was observed during the dry growing season. This statement is believed to be linked to the very different climatic conditions between these two seasons. Indeed, a rise in temperature shortens the life cycle of these moths, which give them time to attack the existing crop again. Rice farmers estimated significant losses based on the damage recorded. These losses vary from less than 10% to more than 20%. These results are in the same order of magnitude as those reported by Dakouo *et al.* (1992) whose losses caused by stem borers were estimated between 2 and 38%. Our results also corroborate the estimates made by Ouattara *et al.* (2018) which were between 30 and 40%. More than half of the rice farmers in Bama (64.96%) and Karfiguéla (59.25%) use deltamethrin-based chemicals against rice stem borers. This trend is explained on the one hand by the accessibility of these products and their acquisition costs and on the other hand by their effectiveness as a broad-spectrum contact insecticide. These results are consistent with those of Zerrouki *et al.* (2021) who showed that deltamethrin has neurotoxic effects on the nervous system of insects. Some rice farmers at both sites preferred carbofuran even though this insecticide is no longer on the list of approved pesticides because of its high toxicity. Such results explain the limitation of contact insecticides in such a fight. Polaszek and Delvare (2000) report that Lepidoptera stem borers live inside the stem during the larval phase, a period during which they cause damage but are also protected from insecticide treatments.

The majority of rice farmers in the two schemes report applying insecticides in their fields three times during tillering, heading, and grain maturation. Indeed, an insecticide application should take into account the pest threshold, which corresponds to the lowest level of the pest population capable of causing economic damage. Failure to take this into account could compromise the farmer's desired objectives, as their sole objective is to maximize the profitability of their agricultural production. In addition, regular monitoring of farms is essential to identify pests early. All this information combined would allow rice farmers to assess the appropriate method. Rice straw is used in many activities carried out by rice farmers after the harvest. Among these, livestock feed was the most cited by rice farmers in Bama (56.1%) and Karfiguéla (44.6%). Other activities mentioned included composting, burning the straw, and burying it through plowing. These results show that these rice farmers are also livestock farmers, and this is precisely what further justifies the use of rice straw produced at the end of the season for livestock farming. Composting serves to improve the physicochemical properties, hence the health of the soil. This action strengthens the clay-humic complex and therefore helps retain cations in the soil and prevents soil leaching by rain. Rice straw burned or buried in the soil limits the conservation of crop pests. After examining the responses provided by rice farmers, certain practices were identified that promote the presence and proliferation of insect pests. These include rice straw left on the plot, poorly decomposed manure, untimely use of pesticides, poor management of surrounding plants, failure to follow the crop calendar, excessive watering, and multiple crops on the same field. These results corroborate those of Akinsola and Agyen-Sampong (1984), who argued that Lepidoptera can enter diapause in the straw for 251 days, constituting a reservoir or source of infestation. Excessive, monotonous, and ungrouped use of insecticides is thought to be the cause of an outbreak of insect pests. Our results are consistent with those of Dakouo et al. (1992), who for the irrigated scheme of Bama, noted a systematic and almost anarchic use of chemicals. In addition to being harmful to the environment, chemicals are dangerous because they may cause the selection of resistant insect breeds. In addition to that, the persistent presence of these insect pests on the study sites would be linked to the monoculture of rice. Thus Koné *et al.* (2018) reported that there is a high abundance of insect pests in monocultures, unlike polycultures with special thought given to the chosen crops and which would not be relay hosts.

Finally, the survey highlighted the presence of natural enemies associated with insect pests. From the above, it appears that these rice farmers have a good perception of the role of predation. Indeed, the recognized roles are only those of predators such as spiders, damselflies wrongly called dragonflies, praying mantises and ants. Of these beneficial insects, more than half of the rice farmers reported encountering more spiders in their fields. Rahaman *et al.* (2014) state that the orders of natural enemies contain a large number of beneficial species including spiders. In addition, the role of ant predation on stem borers, observed by rice farmers, confirms the work of Delobel (1977).

CONCLUSION

Lepidoptera stem borers are one of the main groups of insect pests of rice in Burkina Faso, and are responsible for significant yield losses. This study assessed rice growers' perceptions of these pests and the means they use to manage them on the rice-growing schemes of Bama and Karfiguéla. The study showed that the majority of farmers on these schemes are men. The study also revealed that farmers were able to recognize rice Lepidoptera stem borers. Also, the tillering and heading stages of the rice plant are the most vulnerable to this group of insect pests. Rice growers exclusively use chemical insecticides to control Lepidoptera stem borers. These products were applied with varying frequency. Certain practices adopted by rice growers are likely to encourage the proliferation of insect pests. Finally, this study showed that rice growers were aware of certain natural enemies associated with rice Lepidoptera stem borers. The results of this work can be used by the Ministry of Agriculture's extension service to further strengthen the technical capabilities of rice growers in the two rice-growing areas.

ACKNOWLEDGMENTS

Our sincere thanks go to the people from the following organizations and institutes who kindly supported and assisted us in carrying out this survey, and whose assistance was invaluable: the extension officers in charge of the Bama and Karfiguéla schemes, who facilitated our exchanges with farmers from the various cooperatives; the rice INERA research program brought administrative and logistic assistance.

CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

REFERENCES

Akinsola E. A. et Agyen-Sampong M., (1984). Ecologie, bionomie et lutte contre les foreurs de tige du riz en afriquede l'Ouest. Insectologie et ses applications, 5, 69-77.

Ba N. M., Dakouo D., Nacro S. et Karamage F., (2008). Seasonal abundance of lepidopteran stemborers and diopsid flies in irrigated fields of cultivated (*Oryza sativa*) et wild rice (*Oryza longistaminata*) in western Burkina Faso. *International Journal of Tropical Insect Science* 28 (1), 30-36.

Barro M., (2021). Epidémiologie des maladies majeures et structuration des microbiomes racinaires : étude comparative entre rizicultures irriguée et de bas fond au Burkina Faso. Thèse de Doctorat Université Montpellier, 190 p.

Baudron F., Zaman-Allah M. A., Chaipa I., Chari N. et Chinwada P., (2019). Understanding the factors influencing fall armyworm (*Spodoptera frugiperda* J.E. Smith) damage in African smallholder maize fields and quantifying its impact on yield: A case study in Eastern Zimbabwe. *Crop Protection* 120: 141-150.

Dakouo D., Nacro S., Post R. et Traoré Y., (1992). Un système de lutte rationnelle contre les insectes ravageurs sur les périmètres rizicoles au Burkina Faso: La surveillance phytosanitaire et l'intervention sur seuils. Nuisibles-Pests-Pragas N° 001-12/92. Bobo-Dioulasso, Burkina Faso.

Dembélé F., (1995). Contribution à l'étude de la dynamique des populations adultes de *Maliarpha separatella* et *Chilo zacconius* (Lépidoptère : Pyralidae) à l'office du Niger (zone de Niono). Rapport de fin de cycle présenté pour l'obtention du diplôme de Technicien Supérieur de I'I.P. R de Katibougou, Option Agriculture. Institut Polytechnique Rural de Katibougou, Mali 40 p.

Delobel A., (1977). Mise au point sur la lutte contre les foreurs du riz en Asie tropicale. *Cah. ORSTOM, Sér. Biol.*, vol. XII, n° 1, 1977: 55-63.

Dri L. C., (2022). Alphabétisation des agriculteurs de Kayéta, gage du développement de la sous- Préfecture de Kononfla. n° 8, Vol. 2. Pp. 241-252.

Gret T., (2012). Fiches techniques et méthodologiques. Commune de Rosso, Mauritanie. Schéma communal d'eau et d'assainissement. 122p.

Halilou H., Kadri A., Karimou I. et Zakaria M. O., (2018). Gestion intégrée des foreurs de tiges du mil à Maradi, Niger. *Journal of Applied Biosciences*, 126: 12665-12674.

Heinrichs. E. A., Barrion A. T., (2004). Rice-feeding Insects and Selected Natural Enemies in West Africa: Biology, Ecology and Identification. *International Rice Research Institute*, Los Baños, Philippines and WARDA-The Africa Rice Centre, Abidjan, Côte d'Ivoire. 247 pp.

INSD, (2022). Annuaire du commerce extérieur, Ouagadougou, Burkina Faso 2022, pp.120-167.

FAOSTAT, (2022). Données statistiques sur le riz https://wwwfao.org/faostat/fr/#data/QCL Consulté le 19/06/2024 à 9h 30 mn.

Kambou S. F., (2022). Diversité des insectes inféodés aux produits forestiers non ligneux d'origine végétale importance économique: cas de Vitellaria paradoxa (C.F. Gaertn) dans la province du Ziro au Burkina Faso. Thèse de doctorat unique, Université Joseph KI ZERBO, Oaugadougou, Burkina Faso. 113p.

Konaté K. A., Zougrana S., Koné S. et Wonni I., (2022). Evaluation des performances agronomiques des variétés de riz aromatiques au Burkina Faso, *Int. J. Biol. Chem. Sci.* 16 (1), 42-53.

Kone M., Tuo Y., Yapo M. L., Soro Y. A., Dosso N. et Kambou B., 2018. Pratiques culturales et diversité des insectes en cultures vivrières à Korhogo (Nord, Côte d'Ivoire). *Int. J. Biol. Chem. Sci*. 12(6): 2644-2652.

Koutou M., D'Alessandro C., Tondel F., Cortese M. P. et Knaepen H., (2021). Projet AgrInvest-Systèmes alimentaires - Évolutions récentes du secteur rizicole au Burkina Faso : Contraintes de développement et opportunités d'investissement privé. Rome, FAO, 59p.

Lewu F. B. et Assefa Y., (2009). Farmers' knowledge in the cropping systems of Northern KwaZulu-Natal, South Africa: current challenges and solution for sustainable future food production. *African Journal of Agricultural Research*, 4(11), 1148- 1153.

MAAH. (2019). Stratégie nationale de développement du warrantage version finale. Burkina Faso. 36 p.

MARAH, (2022). Annuaire des statistiques agrosylvopastorales 2021. Ouagadougou, Burkina Faso. 540 p.

Muralidharan K. et Pasalu I. C., (2006). Assessments of crop losses in rice ecosystems due stem borer damage (Lepidoptera: Pyralidae). *Crop Protection*, 25, 409-417.

Ogah E. O. et Nwilene F. E., (2017). Incidence of insect pests on rice in Nigeria. *Journal of Entomology.* 14, 58-72.

Ouattara D., Nacro S., Dabiré R., Bama H. et Dakouo D., (2018). Effect of Transplanting Zones et Dates on Pre-imaginal Populations, Parasitism et Attacks of Major Insect Pests of Rice on the Rice-Growing Area of la

Vallée du Kou (Bobo-Dioulasso). *Environ. Ecolology. Ressources*. 6 (4), 284-396.

Ouattara D., (2019). Ecologie et biologie du développement de *Platygaster diplosisae* et de *Aprostocetus procerae* deux parasitoïdes associés à la cécidomyie africaine du riz, *Orseolia oryzivora* H & G au Burkina Faso. Thèse en Entomologie, Option : Systèmes de Production Végétale, Université Nazi BONI, Bobo-Dioulasso Burkina Faso, 139 p.

Polaszek A., Delvare G., (2000). Les foreurs des tiges de céréales en Afrique : importance économique, systématique, ennemis naturels et méthodes de lutte. CTA et CIRAD, Editions Quae. Amazon, France. 534p.

Rahaman M. M., Islam K.S., Jahan M. et Mamun M. A. A., (2014). Relative abundance of stem borer species et natural enemies in rice ecosystem at Madhupur, Tangail, Bangladesh. *Journal Bangladesh Agril*. 12 (2), 267-272.

Sanou G., Dakouo D. et Ouédraogo I., (2017). Influence du système de riziculture intensif (SRI) sur les attaques des principaux insectes déprédateurs dans les périmètres rizicoles irrigués de Karfiguéla et de la vallée du Kou au Burkina Faso. *Agronomie Africaine*. 29 (2),125 - 136.

SNDR II. (2021). Deuxième génération de la Stratégie nationale de développement de la riziculture. Ouagadougou, Burkina Faso.129p.

Thiombiano A. et Kampmann D., (2010). Atalas de la biodiversitc de l'Afrique de l'Ouest (BIOTA), Tome Il : Projeckttrager im DLR. Bunderminasterium für Bildung und Forchund. Juîlius-Maximilliams-Univerrsität, Würzburg. Burkina Faso. Ouagadougou & Frankfur and Main, 593p.

Togola A., Agbaka A., Anato F., Chougourou D. C., Nwilene F. E., (2010). Connaissance paysanne des insectes foreurs de tiges du riz et leurs dégâts dans différentes zones écologiques du Bénin (Afrique de l'Ouest). *Cah Agric*, 19 (4), 262-266.

Thiombiano B. G., 2015. Genre et prise de decision au sein du menage au Burkina Faso. *Cahiers Québécois de Démographie*, 43 (2), 249-278.

Umeh E. D. N., Joshi R. C. et Ukwungwu M. N., (1993). Les insectes nuisibles du riz au champ en Afrique: biologie et méthodes de lutte. Guide de recherche de l'IITA No. 43. Programme de la formation, Institut international d'agriculture tropicale (IITA), Ibadan, Nigeria, 30p.

Urge M., Negeri M., Selvaraj T. et Demissie G.. (2020). Farmers' indigenous knowledge, perception and management practices of American fall army worm (*Spodoptera frugiperda* J. E. Smith) in maize crop productions in West Hararghe Zone, Ethiopia. *Global Journal of Agricultural Research*, 8(4), 1-19.

Zerrouki N., Bouchaabou S. et Djeffal A., (2021). Etude de la cytotoxicité induite par un insecticide la deltaméthrine chez le rat wistar. Université L'Arbi Ben Mhidi Oum El Bouaghi Algérie,102p.