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RESEARCH ARTICLE

SOCIO-ECONOMIC, AGRONOMIC AND ENVIRONMENTAL DETERMINANTS OF PESTICIDE USE IN THE KONNI IRRIGATED AREA

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ABSTRACT

Farmers in the Konni irrigated perimeter face challenges related to climate variability and increased crop pest attacks, leading to intensified pesticide use to enhance agricultural production. Environmental pollution associated with pesticide use remains a major public health and ecosystem sustainability concern. This study aimed to analyze the socio-economic, agronomic, and environmental determinants of pesticide use in the Konni irrigated perimeter. The study was conducted in selected sites within the irrigated perimeter located in several villages/neighborhoods of the urban municipality of Birni N'Konni. A total of 420 farmers were randomly selected. Data were collected through interviews and field observations. The majority of respondents were male (65%), with a sex ratio of 1.85. The mean age was 38 years (SD = 12), with the 25–45 age group representing 60% of the sample. More than half of the respondents (55%) had no formal education, and 71.4% had no access to agricultural credit. Only 25% had recently received agricultural or phytosanitary training. Access to agricultural information was mainly informal, particularly through peers and pesticide vendors. Market gardening was practiced by 86% of farmers. Overall, 57.1% of respondents reported using pesticides. Herbicides were the most commonly used (70%), followed by insecticides (65%). Regarding adaptation strategies, 50% reported increased pesticide use, 35% practiced crop diversification, and 45% changed their sowing dates. Multivariate analysis showed that phytosanitary training (OR = 2.0; 95% CI: 1.3–3.1; $p = 0.002$), market gardening (OR = 2.3; 95% CI: 1.5–3.6; $p < 0.001$), increased pest pressure (OR = 1.3; 95% CI: 1.2–1.4; $p = 0.002$), and access to agricultural information (OR = 1.5; 95% CI: 1.0–2.3; $p = 0.04$) were significantly associated with pesticide use. These findings indicate that phytosanitary training, crop type (market gardening), pest pressure, and access to information are key determinants of pesticide use in the Konni irrigated perimeter. Promoting integrated pest management, biopesticides, and strengthened agricultural extension services is essential for fostering sustainable adaptation strategies.

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INTRODUCTION

Global agriculture must feed 7 billion people, yet agricultural activities occupy only 4% of the Earth's surface. This food challenge leads to environmental problems because feeding a growing population requires expanding agricultural land, resulting in deforestation and the overuse of chemicals to improve agricultural yields (Adjovi *et al*., 2020). Faced with this situation, the United Nations (UN) and the Food and Agriculture Organization of the United Nations (FAO) advocate for market gardening to address food security needs, particularly in cities in developing countries (Ba, 2007). Market gardening It helps to reduce financial risks and improve producers' incomes (Ahouandjinou *et al*., 2010). It also contributes to the local supply of fresh food for the population (Gravel, 2016). This is the case in Niger, where irrigated agriculture plays a strategic role in food security and socio-economic development, particularly in semi-arid areas where water availability is a major constraint. The Konni irrigated perimeter, located in the south-central part of the country, is one of the oldest and most important centers of irrigated agricultural production. However, producers in this area face challenges including climate variability and pest infestations (RECA, Niger, 2018). Thus, the risks of increased pest pressure due to disturbances in the environment and agro-ecosystems are real (Christian *et al*., 2015). Crop losses (approximately 30%) attributable to pest damage constitute a major agricultural problem for market gardeners. These losses lead to a drastic decrease in yield and poor product quality. Thus, the fight against pests and diseases is essential for farmers (Boni *et al*., 2017). However, the intensification of agricultural practices, the historical use of pesticides, and the proximity of inhabited areas and sensitive ecosystems raise concerns about the quality of irrigation water and the potential risks to human health and the environment. More than 98% of sprayed insecticides and 95% of herbicides reach destinations other than their intended targets, and in the environment, they can undergo transformations leading to the formation of an entity even more dangerous than the original one (M. Coxall *et al*., 2014). Pesticides constitute a very heterogeneous group of chemical substances adapted to the control of unwanted plants and animals; they mainly include herbicides, fungicides, insecticides, acaricides, nematicides, and rodenticides (Garry, 2004). For several years, environmental pollution associated with pesticides has remained a major public health and ecosystem sustainability issue (Garry, 2004). In most cases, farmers receive neither guidance nor continuing education. They purchase pesticides on the local market without knowing their toxicity or how to use them and their choice of pesticides is often not tailored to the specific pests they are targeting (Ahouangninou, 2011). In an area like the urban commune of Konni, where the local economy depends primarily on irrigated and rainfed agriculture, understanding the factors associated with pesticide use is essential to reducing health risks, limiting environmental degradation (soil and water pollution, biodiversity loss, etc.), and raising awareness among producers regarding prevention and regulations on agricultural practices. The literature reveals that many studies on this topic focus on socio-economic determinants without holistically integrating other dimensions, such as agronomic and environmental factors.

Study Objective

The objective of this study is to determine the socio-economic, agronomic, and environmental factors influencing pesticide use. This work is justified by the growing need to understand pesticide use dynamics in a particularly vulnerable Sahelian context. specifically:

- Describe the socioeconomic characteristics of the farmers;
- Identify the factors associated with pesticide use in the Konni irrigation area;
- Make recommendations on best practices in plant protection.

MATERIALS AND METHODS

Background of the study area: The urban commune of Konni covers an area of 732.5 km2. It is bordered to the east by the rural commune of Tsernaoua and Malbaza, to the west by that of Bazaga and Alléla , to the south by the Federal Republic of Nigeria and to the north by the department of Illéla (M. Adamou Mamane and H. Kiari Fougou , 2021). The study was conducted at the Konni irrigated perimeter and cover an area about 2452 ha (Figure 2).

Figure 1 provides an overview of the study area and figure 2 shows the location of the Konni irrigated perimeter

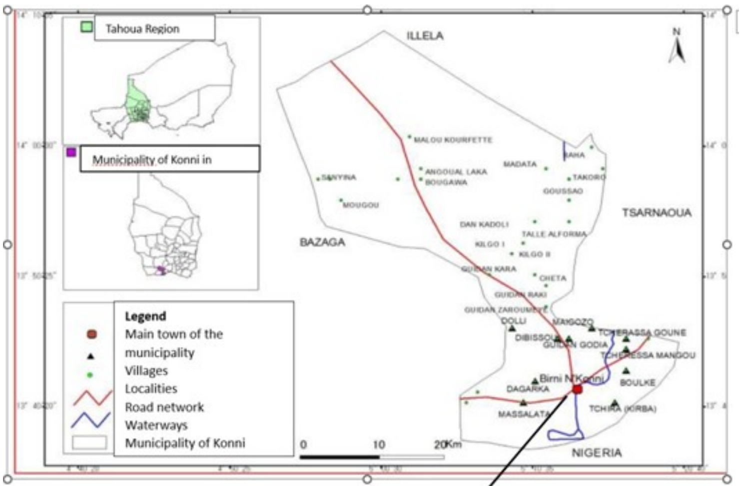

Figure 1: Location map of the study area (Source: AGRHYMET data, 2016)

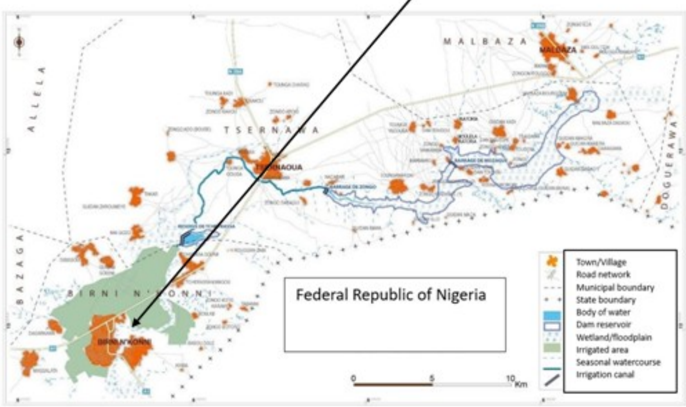

Figure 2: Map showing the location of the irrigated area (Source: StudiInternational, 2018)

The Birni N'Konni department is characterized by a tropical Sahel-Sudanian climate structured around two distinct seasons: a short rainy season from June to September marked by brief but intense rainfall; a long dry season from October to april. Located along the 500 mm isohyet, the area is one of the wettest in the Tahoua region, with annual rainfall ranging between 450 and 700 mm, though marked by strong interannual variability and occasional flooding events. Average maximum temperatures exceed 32°C, while winds are dominated in the dry season by the Harmattan, a dry and dusty wind from the Sahara Desert, and during the wet season by the monsoon from the Gulf of Guinea. Relative humidity varies considerably across seasons, depending largely on temperature and continentality. From a physical standpoint, geologically, the area lies within the Iullemenden Basin, composed of thick sedimentary formations. Soils are typical of the southern Sahelian zone and include fertile clayey valley soils, sandy dune plains, glacis, and lateritic plateaus. Several superimposed aquifers, including that of the Maggia Valley are observed. Agricultural land consists of both rainfed areas (dunes and lowlands) and irrigated perimeters, the latter supporting cereals, legumes, fruit trees, and market garden crops during the dry season. This valley forms the main hydrographic feature, with an active drainage network during the rainy season, dams regulating groundwater recharge, and several permanent ponds that support off-season farming. Agriculture is the primary economic activity and main source of income for households, particularly in rural areas. It is based on two complementary systems: rainfed farming focused on staple crops (millet, sorghum, peanuts, and cowpeas), and irrigated or recession agriculture largely oriented toward market gardening and cash crops. Practiced mainly on small family farms with limited mechanization, agriculture is characterized by low levels of intensification, minimal use of modern inputs, and variable yields, contributing to persistent food insecurity.

- Sampling and data collection
- Study sites sampling and target population

All villages/neighborhoods in the urban municipality of Birni N'Konni affected by the irrigation perimeter rehabilitation project funded by the Millennium Challenge Account (MCC) were included in this study. These are Cérassa Gouné, Cérassa Mangou, Boulké, Tapanni, Gotaro, Kirba and Kaoura, Mallamawa, Tagajia, Matankarawa, Massalata, Da Garka, Dibissou, Guidan Godia, Mai Gozo, Fada, Rimi, Roumdji, Mallamawa, Matankarawa, Mounwadata I and II, Sabon Gari, and Tagajia. The choice of respondents was made at random. The selected sites are provided in the table 1: In the second stage, target populations for this study are pesticide user' farmers. Inclusion and exclusion criteria were set. Farmer's residence ≥ 6 months in Konni, people aged 18 and over, direct or indirect user of pesticides were used as inclusion criteria while. People unable to respond because of illness, cognitive impairment, lack of consent were excluded. Then, farmers were randomly selected within each chosen village. The number of farmers selected per site was proportional to the total number of active farmers in each village.

Sample size determination: The sample size was calculated using

$$n = \frac{\text{DEFF} \times N \times p(1-p)}{\left(\frac{d^2}{Z^2_{1-\alpha/2}}\right)(N-1) + p(1-p)}$$

Where:

N: Population size of the urban municipality of Konni: 206794
P: Estimated proportion in a population: 50%+/-5
1-p: Represents the proportion that does not have this characteristic.
Z1-α/2: Critical value of the normal distribution, corresponds to the desired confidence level for the confidence interval.
E.g**.**: for a confidence level of 95%, Z_0.975=1.96.
d: Confidence limits, maximum tolerated error of 5%.
Confidence level (%): 95%
DEFF: Calculation factor (for group surveys) = 1
Design Effect (Sampling plan effect), corrects for sampling complexity.
DEFF = 1 → simple random sampling
n: Sample size = 382 is the number of individuals to be included in the study to obtain reliable results.
Adding the 10% non-response rate, the sample size of **420** people surveyed was obtained, it becomes 384 + (384× 10%) = 420.

Table 1. Study sites and their sample size

Site	Geographical coordinates		Sample size
	Latitude N	Longitude E	
Cérassa Gouné	13.8332	5.2990	16
Cérassa Mangou	13,8279	5,2943	13
Boulké	13,8617	5,1894	10
Tapanni	13,83OO	5,1880	14
Gotaro	13,8622	5,2194	14
Kirba	13,7864	5,1394	11
Kaoura	13,7958	5,2472	50
Mallamawa	13,7903	5,2533	20
Tagajia	13,8361	5,2556	17
Matankarawa	13,7931	5,2514	13
Massalata	13,7834	5,2085	15
Da Garka	13,8026	5,2213	11
Dibissou	13,8447	5,2382	19
Guidan Godia	13,8333	5,4333	12
Mai Gozo	13,8543	5,2888	13
Fada	13,7920	5,2545	25
Rimi	13,7951	5,2569	21
Roumdji	13,7861	5,2514	15
Mounwadata I	13,7908	5,2448	29
Mounwadata II	13,7875	5,2431	30
Sabon Gari	13,7950	5,2514	52

To determine the proportion of producers to be surveyed per village/neighborhood, the distribution was carried out in proportion to the population size of each village/neighborhood.

The general formula (Cochran, W. G. (1977):

$$n_i = \frac{N_i}{N_{\text{total}}} \times n$$

Where:
ni = number of producers to be surveyed in village i
Ni = total population of village i
N_{total} = sum of the populations of all villages/neighborhoods
n= total sample size (420)
The total population N total is calculated.
Then we calculate the proportion of each village/neighborhood: $\text{Proportion}_i = \frac{N_i}{N_{\text{total}}}$
Then we multiply by the total sample size.
So n_i= Proportion $_i$ × 420

Data collection

The data used for this study were collected using both quantitative and qualitative methods to ensure comprehensive coverage. Structured questionnaires were administered in face-to-face interviews, supplemented by an interview guide when qualitative information was needed. Field observations of agricultural practices further enriched the data. The main data collection tools were questionnaires and a field observation checklist, with information drawn from the interviewed farmers, their plots, and institutional sources such as the Regional Plant Protection Directorate and the ONAHA offices in Tahoua and Konni. The main tools used for the individual survey were: (1) an interview guide; (2) a data collection form. This multi-source approach provides a robust and reliable dataset for analysis.

Study variables

Dependent variable (outcome): Intensive or non-intensive use of pesticides (binary)
→ Independent variables:

The variables are classified according to the following categories:

Table 2. The different variables analyzed

Variables	Variable types	Expression
	Socio-economic variables	
Age (year)	Continuous Quantitative	Percentage of age groups/ average
Sex (Male/Female)	Qualitative nominal binary	Percentage/sex ratio
Education level (none, primary, secondary and above)	Qualitative ordinal	Percentage
Access to credit (Yes/No)	Qualitative nominal binary	Percentage
Access to outreach/training services (Yes/No)	Qualitative nominal binary	Percentage
	Agronomic variables	
Types of crops grown (Market gardening/Rainwater)	Qualitative nominal	Percentage
Pest and disease pressure (Yes/No)	Binary qualitative	Percentage
Farmers' adaptation (Yes/No)	Qualitative nominal binary	Percentage
Crop diversification (Yes/No)	Qualitative nominal binary	Percentage
Increased use of pesticides	Binary qualitative	Percentage
	Environmental variables	
Local climatic conditions (Yes/No)	Binary qualitative	Percentage
Perceived pollution or contamination (Yes/No)	Binary qualitative	Percentage
	Self-reported climate factors	
Perceived temperature variation (Yes/No)	Binary qualitative	Percentage
Perceived variation in rainfall (Yes/No)	Binary qualitative	Percentage
Perceived effect of climate on pests (Yes/No)	Binary qualitative	Percentage

Data analysis and processing

Descriptive analysis: The description of the socio-demographic, agronomic, and environmental characteristics of the people surveyed at the Konni irrigated perimeter was carried out using Epi-info software version 7.2.5.0. The mean and standard deviation for continuous data, and the percentage and frequency for categorical data were calculated.

Bivariate analysis: Chi-square tests and logistic regression analysis were performed to determine the association between the dependent and independent variables. Logistic regression analysis was used to adjust for confounding factors . All explanatory variables associated with the dependent variable in the bivariate analysis with a *p- value* less than 20%, along with crude odds ratios, were selected and further analyzed. Odds ratios and 95% confidence intervals were used to determine the effect of potentially associated variables on the dependent variable, controlling for confounding factors.

Multivariate analysis: Variables associated with pesticide use with a p-value < 20%, as well as various confounding factors identified in the literature, were included in a stepwise backward multivariate logistic regression to determine adjusted odds ratios (ORs). All variables with a p-value < 5% were considered statistically significant associations, with adjusted ORs. The Hosmer-Lemeshow test was used to assess the model's goodness of fit.

Methodological limitations

Memory bias: In this study, the data collected relies primarily on farmers' recollections of past pesticide use, application frequencies, and the effects experienced after handling these chemicals. In a context where agricultural records are rarely kept and seasonal routines lead to repetitive practices, the accuracy of these reports may be compromised. This memory bias limits the reliability of retrospective information and can lead to an underestimation or overestimation of actual practices in the study area.
1.5.2.Underestimated or overestimated declaration. The statements of those surveyed may also be influenced by social desirability or by administrative concerns related to the non-compliant use of certain products. Some respondents may downplay their practices, while others may exaggerate them to attract technical or financial assistance. This variability in reporting affects the accuracy of the analysis of the socio-economic and agro-technical determinants of pesticide use.

Lack of direct measurement of pesticides: The study does not include physicochemical analyses to measure pesticide residues in soil, water, air, or agricultural products. This lack of direct measurements limits the ability to empirically verify contamination levels. Constraints related to the agricultural calendar also play a role.

RESULTS AND DISCUSSION

Results

Descriptive analysis of the respondents (n=420)

Socio-economic characteristics

Table 3 shows the distribution of the people surveyed according to sex and age.

Table 3. Distribution of respondents by sex and age

Variables	Number (n)	Percentage (%)
Sex		
Male	273	65%
Female	147	35%
Age ranges (years)		
< 25	33	7.9
25 – 45	252	60%
≥ 50	135	32.1

The study focused on 420 farmers in the Konni commune. The majority of respondents were male (65%), with a sex ratio of 1.85. This situation could be due to the simple fact that men are more involved in agriculture. Male predominance may influence decisions related to pesticide use. Pepijn Schreinemachers *et al.* (2017) found that pesticide use was 42% lower when a woman was in charge of pest control and 31% lower when farmers had adopted biopesticides. These results suggest relevant entry points for interventions aimed at reducing pesticide reliance. The population is predominantly adult and active. The average age was 38 years (standard deviation = 12 years), with a predominance of the 25-45 age group (60%). These results could be explained by the simple fact that young people are increasingly involved in agriculture. However, Nah Sarrah *et al.* (2022) in Côte d'Ivoire found that the majority of producers surveyed were adults (55%), aged 40 and over, compared to 45% of young people aged 18-39.

Education level: Figure 3 shows the distribution of respondents according to their educational level

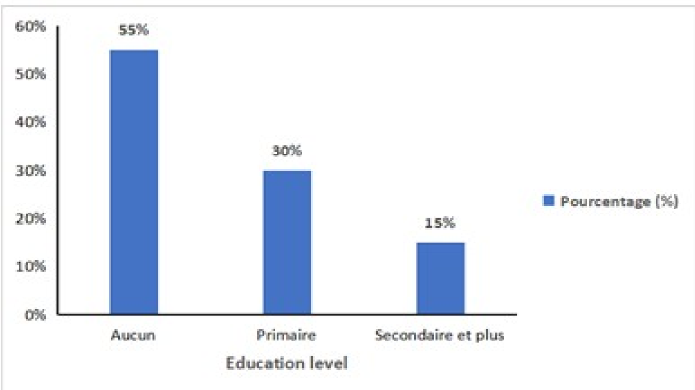

Figure 3. Distribution of respondents according to their level of education

Figure 2 shows that more than half of the respondents (55%) had no formal education. However, illiteracy represents a significant obstacle to understanding and adhering to pesticide use guidelines. The results regarding the producers' education level correlate with those obtained by Sawadogo (2012), who, in a study of the toxicological risks associated with pesticide use in market gardening in Ouagadougou, reported that 72% of market gardeners were illiterate and 28% had a very low level of education. A higher level of education would play a positive role in the adoption of agroecological practices, potentially reducing pesticide use.

Training on agricultural practices

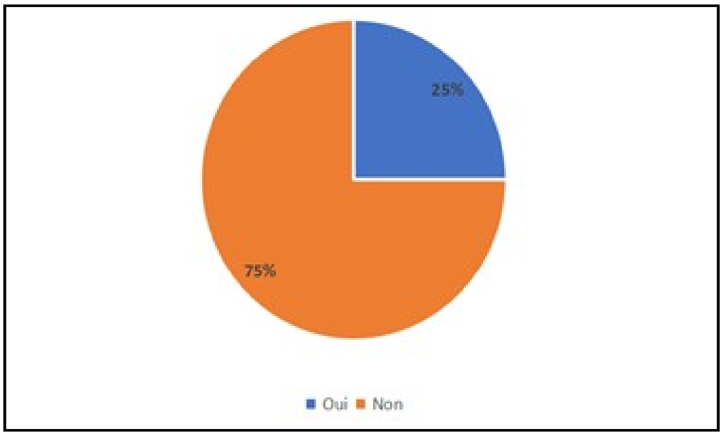

Figure 4. Distribution of farmers according to training in agricultural practices

Figure 4 shows the distribution of respondents according to their training in agricultural practices.

Analysis of the results revealed that only 25% of farmers had received recent training on agricultural or phytosanitary practices. Access to training from an extension agent, an NGO, or an agricultural development project could have a significant impact on the adoption of various agro-ecological practices beyond organic and mechanical methods, and the use of alternatives to pesticides. The positive effects of access to training on agricultural practices through NGOs or projects have been highlighted by several authors (Roussy *et al*., 2015; Issoufou *et al*., 2017).

Access to agricultural credit

Figure 5 shows the distribution of the people surveyed according to their access to agricultural credit .

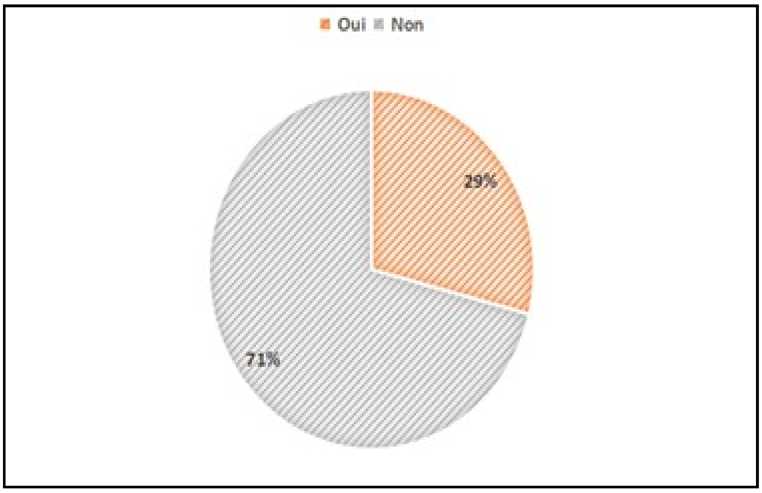

Figure 5. Distribution of respondents according to access to agricultural credit

The figure shows that 28.6% of respondents had access to agricultural credit. Our results corroborate those of Claude *et al*. (2019), who found that access to credit appears quite problematic for off-season crop producers in the Niger Valley. Only 32.07% of the producers surveyed have access to agricultural credit. Producers obtain an average of 177,489 FCFA from microfinance institutions.

Access to agricultural information

Table 4 shows the distribution of farmers according to their sources of information on agricultural practices.

Table 4. Sources of agricultural information

Main source	Number (n)	Percentage (%)
Pesticide sellers	203	48.4
Technical Services/NGO	91	21.6
Other farmers	126	30

Access to agricultural information was dominated by informal sources, particularly peers and pesticide vendors. Limited access to reliable information could lead to empirical or incorrect pesticide use. This finding partially supports the findings of Issoufou *et al.* (2017), who found in their study that farmers in contact with extension services benefit from closer support. They therefore have easier access to information and training on new technologies.

Types of crops: Table 5 shows the distribution of the types of crops grown in the irrigated area of Konni.

Table 5. Distribution of cultural practices

Crops	Number (n)	Percentage (%)
Market gardening	361	86
Rain	59	14
Polyculture practiced	168	40

Market gardening was dominant (86%). However, (Moussa *et al.*, 2018) found in their research in the Tahoua region that rainfed crops were dominant.

Types and frequency of pesticide use: Table 6 shows the distribution of surveyed farmers according to pesticide use

Table 6: Use and frequency of pesticides

Variables	Number (n)	Percentage (%)
Use of pesticides		
Yes	240	57.1
No	180	42.9
Herbicides	294	70
Insecticides	273	65
Fungicides	126	30
Pesticide families		
Organophosphates	168	40
Carbamates	105	25
Pyrethroids	147	35
Biopesticides	39	<10%

In total, 57.1% of respondents reported using pesticides. 70% of the pesticides were herbicides, followed by insecticides (65%). This use of plant protection products could be one of the adaptation strategies to climate change and the attack of crop pests that severely impact the agricultural sector. Our results corroborate those of G. Abdoul *et al.*, 2018, who state that cashew producers frequently use chemical inputs (herbicides, insecticides, etc.) to increase their agricultural yields. Indeed,

Farmers' adaptation: Table 7 shows the distribution of surveyed farmers according to adaptation measures

Table 7. Farmers' Adaptation

Farmers' adaptation	Number (n)	Percentage (%)
Change of sowing date	189	45
Crop diversification	147	35
Increased use of pesticides	210	50

The analysis reveals that 50% of respondents have increased their pesticide use, 35% have diversified their crops, and 45% have changed their planting dates as an adaptation to climate change. Climate change is altering agricultural practices, which could exacerbate pesticide use and the associated risks.

The literature on adaptation strategies indicates that the use of drought-resistant seeds combined with agroforestry, delayed planting dates and irrigation (Abid *et al.*, 2015; Sarr *et al.*, 2015; Ofuoku, 2011), efficient water and fertilizer management (Bagula *et al.*, 2013), and crop diversification are among the preferred adaptation options (Torquebiau, 2017; Makate *et al.*, 2016). However, the implementation of these strategies varies from one production system to another, depending on opportunities, socio-economic factors, and farmers' perceptions of climate change (Asayehegn *et al.*, 2017; Abid *et al.*, 2015; Ofuoku, 2011).

Bivariate analysis of factors associated with pesticide use: The bivariate analysis of factors associated with pesticide use showed that education, training, increased pest infestation, and crop type had P values below 20% and were therefore selected for stepwise downward multivariate logistic regression.

Table 8. Bivariate Analysis

Variable	Category	n users	n non-users	% users	Raw gold [95% CI]	p-value
Age	25 – 45	183	69	72.6	1.2 [1.1–1.4]	0.02
	≥ 50	41	94	30.3	1.4 [1.1–1.9]	0.02
	< 25	16	17	48.5	Ref	-
Sex	Man	180	90	66.7	1.5 [1.1–2.1]	0.02
	Women	60	90	40	Ref	-
Education	primary	80	30	72.7	1.8 [1.2–2.7]	0.004
	≤ primary	160	140	53.3	Ref	-
Plant protection training	Yes	80	15	84.2	2.2 [1.4–3.5]	0.001
	No	160	155	50.0	Ref	-
Increased pests	Yes/No	240	180	57.1	1.2 [1.2–16]	0.001
Income	Pupil	120	60	66.7	1.6 [1.0–2.4]	0.05
	Weak	120	120	50	Ref	-
Agricultural information access	Yes	130	50	72.2	1.7 [1.1–2.6]	0.01
	No	110	130	45.8	Ref	-
Market gardening	Yes	50	10	83.3	2.5 [1.6–3.9]	<0.001
	No	190	170	52.8	Ref	-
	Weak	160	130	55	Ref	-

Multivariate Analysis

Final Logistics Model

Table 9. Multivariate logistic model (Epi Info)

Variable	Category	Adjusted gold (95% CI)	p-value	Interpretation
Plant protection training	Yes vs. No	2.0 [1.3–3.1]	0.002	Trained farmers are twice as likely to use pesticides correctly
Market gardening	Yes vs. No	2.3 [1.5–3.6]	<0.001	Market gardening encourages the use of pesticides.
Increase in pests	Yes vs. No	1.1 [1.2–14]	0.002	The increase in pests encourages the use of pesticides.
Access to information	Yes vs. No	1.5 [1.0–2.3]	0.04	Access to information influences pesticide use
Sex	Man vs. Woman	1.2 [0.8–1.8]	0.25	Not significant
Age	≥ 50 vs (25 – 45)	1.4 [0.8–1.8]	0.02	Not significant
Income	High vs. Low	1.3 [0.9–2.0]	0.10	Not significant
Education	> primary vs ≤ primary	1.4 [0.9–2.2]	0.12	Not significant

Factors associated with pesticide use include: Plant protection training (OR = 2, CI (95%) = [1.3-3.1], p-value = 0.002). Trained individuals are twice as likely to use pesticides correctly. In practice, producers rely on advice from more experienced producers or pesticide suppliers. Those who are literate consult the instructions for use on pesticide packaging.

DISCUSSION

Factors associated with pesticide use include: Plant protection training (OR = 2, CI (95%) = [1.3-3.1], p-value = 0.002). Trained individuals are twice as likely to use pesticides correctly. In practice, producers rely on advice from more experienced producers or pesticide suppliers. Those who are literate consult the instructions for use on pesticide packaging. A lack of training leads to poor practices such as underdosing or using active ingredients unsuitable for the target pest, thus resulting in the development of resistance in organisms (Aké, A. *et al*., 2023). Our results corroborate those of Traoré (2004), who revealed in his work that a lack of training and a deficit in medium- and long-term awareness make it difficult for populations to internalize good socio-environmental practices in their various activities. Furthermore, the high use of pesticides in vegetable production can be explained by insufficient monitoring and support of producers by agricultural extension agents (Son *et al*., 2017), by inadequate training of producers on good phytosanitary practices (Nabie *et al*., 2017), or by the failure to assimilate the content of this training due to their low level of education. Part of the responsibility can be attributed to the low expectations of consumers, the vast majority of whom are unaware of the presence of pesticide residues in vegetable products.

For vegetable farming, OR = 2.3, CI (95%) = [1.5-3.6], p-value <0.001. Vegetable farming promotes pesticide use. Indeed, vegetable farming plays a significant role in human food production. In West Africa, it appears as one of the main components of urban and peri-urban agriculture, playing a crucial role in the economic development of cities (FAO, 2012). Pest pressure has been identified as the major constraint due to the crop losses inflicted on vegetable farmers (Kanda *et al*., 2014). Thus, to improve yields and meet ever-increasing market demand, the use of synthetic pesticides by producers is almost systematic (Kanda *et al*., 2013; Mondédji *et al*., 2015). For increased pests, OR = 1.1, CI (95%) = [1.2-1.4], p-value = 0.002. Increased pests encourage pesticide use. However, James *et al*. (2010) found that poor agricultural practices among producers promote the proliferation of certain pests (Helicoverpa armigera and Plutella xylostella caterpillars) and the spread of diseases (Son *et al*., 2017). These practices include intercropping tomatoes or cabbage with corn, okra, or strawberries, and rotating tomatoes with peppers. However, uncomposted manure, applied by the majority of producers (91.4%), combined with high doses of nitrogen and excessive irrigation, promotes the development of fungal and bacterial diseases in tomatoes (Schiffers, 2011) and nematode infestations in lettuce (James *et al*., 2010). The study shows that the damage caused to crops by diseases and pests can be severe, leading the vast majority of producers to resort to chemical pesticides to control them. Repeated pesticide use can lead to the development of resistance (Assogba-Komlan *et al.*, 2007) as well as the destruction of beneficial insects and, consequently, a proliferation of pests (Boyer *et al.*, 2017). For access to information, OR = 1.5; CI (95%) = [1.0-2.3], p-value = 0.04. Access to information promotes pesticide use. Producers, who are in contact with extension agents, benefit from closer supervision. They therefore have easy access to information and training on new technologies (Issoufou *et al.*, 2017).

Fit quality of the model: The Hosmer-Lemeshow test was not significant (p = 0.45), indicating good model fit. The correct classification accuracy was 72%.

CONCLUSION AND RECOMMENDATIONS

To cope with the challenges of climate change, farmers are using pesticides. Although these chemicals improve agricultural yields, they have very negative impacts on humans and the environment. The results show that phytosanitary training, the type of crops (market gardening), the increase in pests and access to information are factors associated with the use of pesticides at the level of the irrigated perimeter of Konni. Pesticide use in Konni is heavily influenced by socio-economic, agronomic, and climatic factors. Contrary to expectations, training and education levels alone do not reduce chemical intensification, likely due to the lack of accessible alternatives. This underscores the urgent need to promote sustainable adaptation strategies that integrate integrated pest management, biopesticides, and strengthened agricultural extension services. Furthermore, the low level of education among most farmers, along with a lack of support, information, and training on pesticide use, leads market gardeners to adopt poor phytosanitary practices.

REFERENCES

ADAMOU. M *et al.*, 2021. Pression foncière autour du périmètre irrigué de Birni N'Konni et dégradation de l'environnement dans la vallée de la Majia au Niger. Revue espace géographie et société marocaine N°54, pp. 83-

ABDOUL-IBRACHI Gouda, *et al.*, 2018, « Pratiques phytosanitaires et niveau d'exposition aux pesticides des producteurs de coton du nord du Bénin », Cahiers Agricultures, vol 27, Juin 2018, pp 1-9.

Abid, *et al.*, 2015. Perceptions des agriculteurs et stratégies d'adaptation au changement climatique et à leurs déterminants : le cas de la province du Pendjab, Pakistan, Earth Syst. Dynam., 6, 225–243, https://doi.org/10.5194/esd-6-225-2015, 2015

Adjovi *et al.* ; 2020. Les pratiques d'utilisation des pesticides par les maraichers au Benin : perspectives sociologiques, Global Journal of Arts, Humanities and Social Sciences 8(2), 22-45.

Affougnon AM, 1996. Utilisation de l'extrait aqueux des grains de neem en cultures maraîchères (Tomate). Fiche technique, Abidjan. 7 p.

Ahouandjinou *et al.*, 2010. Adoption et impact socio-économique de la semi mécanisation du procédé de transformation des amandes de karité en beurre au Nord-Bénin. Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa

Ahouangninou *et al* ;2011. Evaluation des risques sanitaires et environnementaux des pratiques phytosanitaires des agriculteurs maraîchers dans la commune rurale de Tori-Bossito (Sud-Bénin). *Cah Agric*. Epub ahead of print 2011. DOI: 10.1684/agr.0485.

Aké *et al*, 2023. Analyse Socio-Démographique des Agriculteurs et des Pesticides Utilisés dans la Zone de Marnage du Lac Buyo (Côte d'Ivoire). European Scientific Journal, ESJ, 19 (18), 119.

Assogba *et al.*, 2012. Les légumes traditionnels dans la lutte contre les bioagresseurs des cultures maraîchères : associations culturales avec le Tchayo (Ocimumgratissimum) et le Yantoto (Launaeataraxacifolia). Fiche technique. Cotonou, Bénin : INRAB.

Asayehegn *et al.*, 2017.ORCID : https://orcid.org/0000-0002-3183-6658 (2017). Perception du changement climatique et des choix d'adaptation au niveau des fermes dans le centre du Kenya. « Cahiers Agricultures », vol. 26 (n. 2) ; pp. 1-11. ISSN 1166-7699. https://doi.org/10.1051/cagri/2017007.

Ba, A. 2007. Les Fonctions reconnues à l'agriculture intra- et périurbaine (AIPU) dans le contexte dakarois ; caractérisation, analyse et diagnostic de durabilité de cette agriculture en vue de son intégration dans le projet urbain de Dakar (Sénégal). Thèse de Doctorat, Université Cheikh Anta Diop, Dakar, Sénégal et AgroParisTech, Paris, France : 378 p

Bagula *et al.*, 2013. Efficience des techniques de gestion de l'eau et de fertilité des sols sur le rendement du maïs dans les régions semi-arides : cas de la plaine de la Ruzizi (Sud-Kivu, République Démocratique du Congo). https://doi.org/10.4000/vertigo.13922

Boni *et al*, 2017.Plantes pesticides et protection des cultures maraichères en Afrique de l'Ouest (synthèse bibliographique). P-288-304.

Boyer F *et al.*, 2017. Les auxiliaires de cultures, biologie, écologie, méthodes d'observation et intérêt agronomique. ACTA, Paris, France. 263p.

AEASA, 2010. Conference, Cape Town, South Africa, September 19-23,. 27p. DOI : http://dx.doi.org/10.22004/ag.econ.9618 6.

Cissé *et al*, 2003. Usage incontrôlé des pesticides en agriculture périurbaine : cas de la zone de Niayes au Sénégal. Cah Agric 12 : 181-6.

Cilas Christian, *et al*. 2015. Bioagresseurs des cultures tropicales face au changement climatique : quelques exemples. In : Changement climatique et agricultures du monde. Torquebiau Emmanuel (ed.). Versailles : Ed. Quae, 75-83. (Agricultures et défis du monde).

Claude *et al*., 2019. Déterminants socio-économiques de l'adoption des pratiques agro-écologiques en production maraîchère dans la vallée du Niger au Bénin. Int. J. Biol. Chem. Sci. 13(7): 3103-3118, December 2019 ISSN 1997-342X (Online), ISSN 1991-8631 (Print). Available online at http://www.ifgdg.org

Damalas *et al*., 2016. Farmers' exposure to pesticides: Toxicity types and ways of prevention. Toxics 4(1): 1–10. https://doi.org/10.3390/toxics4010001.

FAO, 2012. Growing greener cities in Africa. First status report on urban and peri-urban horticulture in Africa. Roma: FAO

INRAN, 2018, Programme quinquennal de recherche sur les cultures irriguées. Département des cultures irriguées,

Issoufou *et al*., 2017. Déterminants de l'adoption et impact des variétés améliorées sur la productivité du mil au Niger. African Crop Science Journal, 25(2) : 207 – 220. DOI : http://dx.doi.org/10.4314/acsjv25i2.6.

James *et al*., 2010. Gestion intégrée des nuisibles en production maraîchère : Guide pour les agents de vulgarisation en Afrique de l ' Ouest. Institut international d'agriculture tropicale (IITA), Ibadan, Nigeria, 120 p.

Kanda *et al*., 2013. Application des pesticides en agriculture maraichère au Togo. *VertigO*, 13(1), 4-8.

Kanda *et al*., 2014. Diversité des espèces cultivées et contraintes à la production en agriculture maraichère au Togo. *Int. J. Biol. Chem. Sci*., 8(1), 115- 127.

Li B. A. 2022« Dichloro-diphenyl-trichloroethane (DDT): An unforgettable and powerful pesticide. » *Journal of Humanities and Social Sciences*. jhss.scholasticahq.com

Garry *et al*,2004. Pesticides and children. *Toxicol Appl Pharmacol* 2004; 198: 152–163.

Gravel A. 2016. Les pratiques agroécologiques dans les exploitations agricoles urbaines et périurbaines pour la sécurité alimentaire des villes d'Afrique subsaharienne. Essai présenté au Département de biologie en vue de l'obtention du grade de maître en écologie internationale (M.E.I.). Faculté des sciences, Université de Sherbrooke, Québec, Canada, p.104.

Makate *et al*., 2016. Diversification des cultures et moyens de subsistance des petits exploitants au Zimbabwe : gestion adaptative pour le changement environnemental. Volume 5, numéro d'article 1135, (2016)

M. Coxall, 2014 « ethical eating » Ed guy caswell

Mondédji *et al*., 2015. Analyse de quelques aspects du système de production légumière et perception des producteurs de l'utilisation d'extraits botaniques dans la gestion des insectes ravageurs des cultures maraichères au Sud du Togo. *Int. J. Biol. Chem. Sci*., 9(1), 98- 107.

Moussa *et al*., 2018. Agriculture familiale face aux défis de la sécurité alimentaire des ménages dans les pays du sud : cas de la région de Tahoua au Niger. Algerian Journal of Arid Environment (AJAE), Revue académique, Numéro 2, ISSN,2170-1318. P4.

Nabie *et al*., 2017. Analyse des pratiques phytosanitaires et des facteurs d'adoption de la gestion intégrée des nuisibles en production maraîchère en milieu urbain et périurbain

au Burkina Faso : Cas de la ville de Ouagadougou. http://hdl.handle.net/2268.2/5071

Nah Sarrah *et al*, 2022. La production durable de l'anacarde dans un contexte de changement climatique en Côte d'Ivoire : enjeux sanitaires et environnementaux liés à l'usage des intrants chimiques dans le village de Lapkolo (commune de Korhogo). Le Journal des Sciences Sociales N°23 – Juin 2022 ISSN 2073-9303 Page 55

Ofuoku, 2011.Rural farmers' perception of climate change in central agricultural zone of delta state, Nigeria. armers' perception of climate change ... Indonesian Journal of Agricultural Science 12(2), 2011: 63-69

Pepijn Schreinemachers *et al*, 2017. Trop de choses à gérer ? Dépendance aux pesticides des petits maraîchers d'Asie du Sud-Est. DOI : 10.1016/j.scitotenv.2017.03.181

République du Niger. 2018. Résultats définitifs de l'enquête sur les productions horticoles 2017/2018, 58 p. CSP (Comité sahélien des pesticides), Les listes des pesticides autorisés depuis la 43ème session ordinaire du CSP en Novembre 2018, (2018), http: //www.insah.org/ doc/liste_pesticides_autorises_43e_Session_ CSP_Nov-2018

Roussy *et al*., 2015. Adoption d'innovations par les agriculteurs : rôle des perceptions et des préférences. Working Paper N°15-03. SMART-LERECO https://ageconsearch.umn.edu/bitstream/ 206036/2/WP15-03.pdf. Consulté le 25 mars 2019.

Sabljic *et al*., 2009. ENVIRONMENTAL AND ECOLOGICAL CHEMISTRY - Volume I: EOLSS Publishers Company Limited.

Sarr *et al*., 2015. Perception et observation : les principaux risques agro-climatique de l'agriculture pluviale dans l'ouest du Niger https://www.bing.com/ck/a

Sayada *et al*,2019. Diversité des pesticides et leur utilisation... |Reca-Niger, https://recaniger.org.10pages.

SAWADOGO V. R., 2016. *Pratiques paysannes d'utilisation des pesticides en cultures maraîchères et leurs effets induits dans la Vallée du Sourou : Cas du périmètre de Di.* Mémoire d'Ingénieur, IDR/UPB, Bobo Dioulasso, Burkina Faso, 72 p.

Schiffers B., 2011. Itinéraire technique de la tomate cerise (Lycopersicon esculentum). COLEACP/PIP, 46 p.

Schiffers B., 2011. Analyse des risques et autocontrôle en production. Manuel N°3, édité par le COLEACP/PIP, 154 p.

Son *et al*, 2017. Pratiques phytosanitaires des producteurs de tomates du Burkina Faso et risques pour la santé et l'environnement. Cahiers Agricultures 26: 25005. DOI: 10.1051/cagri/2017010

Son *et al*., 2017. First record of Tuta absoluta (Meyrick, 1917) (Lepidoptera: Gelechiidae) in Burkina Faso. African Entomology http://dx.doi.org/10.4001/003.025.0259. 25(1): 259–263. DOI :

Tarnagda *et al*., 2017. Évaluation des pratiques agricoles des légumes feuilles : le cas des utilisations des pesticides et des intrants chimiques sur les sites maraîchers de Ouagadougou, Burkina Faso. Journal of Applied Biosciences 117: 11658 11668

Tourneux Henry., 2021, « Pictogrammes et utilisation des pesticides en Afrique », Linguiste, Langage, Langues et cultures d'Afriques noire, IRD Editions, pp 263-273.

Torquebiau, 2017. Climate-smart agriculture : pour une agriculture climato-compatible. Cah. Agric. 2017, 26, 66001 © E. Published by EDP Sciences 2017 DOI: 10.1051/cagri/2017048 www.cahiersagricultures.fr

Traore, 2007, « De la sensibilisation des populations à la gestion de l'environnement urbain dans les quartiers précaires de la ville d'Abidjan », African Population Studies, vol 22, No 2, pp. 154-173

Traoré *et al*., 2023. Les pesticides dans les eaux souterraines : cas du sous-bassin du Massili au Burkina Faso. J. P. Soaphys, Vol 4, N°1 (2024) CJKA02 http://dx.doi.org/10.46411/jpsoaphys.2024.CJK.002

Turusov *et al*., 2002. « Dichlorodiphenyltrichloroethane (DDT): ubiquity, persistence, and risks. » *Environmental Health Perspectives.* 2002 Feb;110(2):125-128. doi:10.1289/ehp.02110125. pmc.ncbi.nlm.nih.gov

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