GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

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Perceptions of Pesticide Use by Populations in Daloa Commune (Central Western Côte d'Ivoire)

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GSC Biological and Pharmaceutical Sciences, 2025, 33(03), 015-023

Publication history: Received 21 October 2025; revised on 01 December 2025; accepted on 03 December 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.33.3.0481

Abstract

Agricultural pesticides are increasingly denounced around the world because of their negative consequences on environment and human health. In order to find out the opinion of the population of Daloa Commune on phytosanitary products, a survey was conducted. It involved 100 individuals in the agricultural population and another 100 in the non-agricultural population. The results revealed that herbicides, insecticides, fungicides, and growth regulators are the known pesticides of both population types. The majority of the non-agricultural population (96%) found pesticide use to be disadvantaged, while few farmers (14%) took a dim view of the use of pesticides. In terms of receptivity to pesticide use, 93% of farmers were in favor of their use compared to 20% of non-agricultural population. In addition, a relationship has been observed between susceptibility to pesticide use and two population sociodemographic characteristics: population origin and socioeconomic category. In terms of the origin of the populations, natives tend to be in favor of pesticide use. In terms of socio-economic groups, farmers are more receptive to pesticide use. For agrosystem sustainable management and human health preservation, farmers in Daloa Commune must be trained in good phytosanitary practices, organic farming and integrated pest management.

Keywords: Pesticides; Agriculture; Population; Opinions; Daloa Commune; Côte d'Ivoire

1. Introduction

Agriculture plays a crucial role in Côte d'Ivoire's economic growth [1]. It represents the main source of employment and income for the majority of Ivorian population, averaging 66% [2]. It is therefore undeniable that consequences of climate change and climate variability, such as disruptions to the agricultural calendar, weeds proliferation, and crop diseases and pests, will have a significant negative impact on Côte d'Ivoire's economy. These disruptions can sometimes lead to production losses exceeding 30% [3]. This has led farmers to turn to the use of pesticides in large numbers. Indeed, between 1995 and 2014, the volume of pesticides sold in Côte d'Ivoire tripled, reaching approximately 10,000 tons in 2014, for a value of 49 billion CFA francs [4]. Herbicides, for exemple, saw a sharp increase in all regions of Côte d'Ivoire starting in 2010 [5].

The effectiveness of pesticides in controlling pests and improving crop yields is undeniably proven. However, their excessive use in agriculture causes soil and water pollution, leads to weed, insect and pathogens resistance, and harms many beneficial organisms, particularly pollinating insects [6]. According to WHO, millions of people are poisoned each year by chemical pesticides, resulting in more than 20,000 deaths annually [7]. Biodiversity also suffers [8, 9] and water sources are likely to be contaminated [10, 11, 12, 13].

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In the Daloa department, in the Central Western Côte d'Ivoire, agricultural activity is currently experiencing a sharp decline due to the scarcity of arable land, environmental changes, and decreased rainfall [14]. To cope with this situation, farmers are using large quantities of agricultural pesticides [15, 16]. It is therefore essential to examine the local population's views on pesticide use. This research project falls within this framework, aiming to determine the opinions of the population of the Daloa commune regarding pesticide use in order to improve its application.

2. Materials and Methods

2.1. Study Site

This study was conducted in Daloa Commune. This locality is situated in the Central Western Côte d'Ivoire, specifically in the Haut-Sassandra region. It was chosen because it is an area of high agricultural production where pesticides are widely used.

2.2. Data collection methods

To conduct this study, a survey was carried out with 200 people, including 100 farmers and 100 non-farmers. A survey form containing questions was prepared beforehand. The questionnaire addressed the perceptions of pesticides held by the residents of the municipality. The survey method was a structured direct interview. This method offers greater opportunities to assess the respondent's understanding and interpretation of the questions, and to clarify any ambiguity regarding the meaning of a question or answer.

2.3. Data analysis method

After fieldwork phase, the survey forms were manually detached and entered into Excel. The results were summarized and presented in tables and graphs. Furthermore, the collected data were categorized by individual (agricultural and non-agricultural residents). Using the following formula, the frequency of each variable was calculated based on the number of farmers interviewed:

$F = ni/N \times 100$

With F, the frequency (%), N, the total number of people surveyed and ni, the size of the modality.

The Chi-square test was also carried out to assess the relationship between receptiveness to pesticide use and population socio-demographic characteristics.

3. Results

3.1. Knowledge of pesticides

The majority of the agricultural and non-agricultural population in Daloa commune know pesticides (Table 1). However, a significantly higher proportion of agricultural population (95%) has a better understanding of pesticides compared to the non-agricultural population (84%). Pesticides mentioned by the population are: insecticides, fungicides, herbicides, and growth regulators. Among these, herbicides are the most familiar to the population, while nematicides are the least familiar.

Table 1 Knowledge of pesticides among the population of Daloa Commune

	Population non agricole		**Population agricole**	
	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
Knowledge of pesticides	84	84%	95	95%
Ignorance of pesticides	18	18%	5	5%
TOTAL	100	100%	100	100%

3.2. Pesticides used by farmers

Figure 1 shows the types of pesticides used by farmers in their agro-ecosystems, in Daloa commune. Herbicides, insecticides, growth regulators and fungicides are the most used, with respective proportions of 95%, 84%, 78% and 38%.

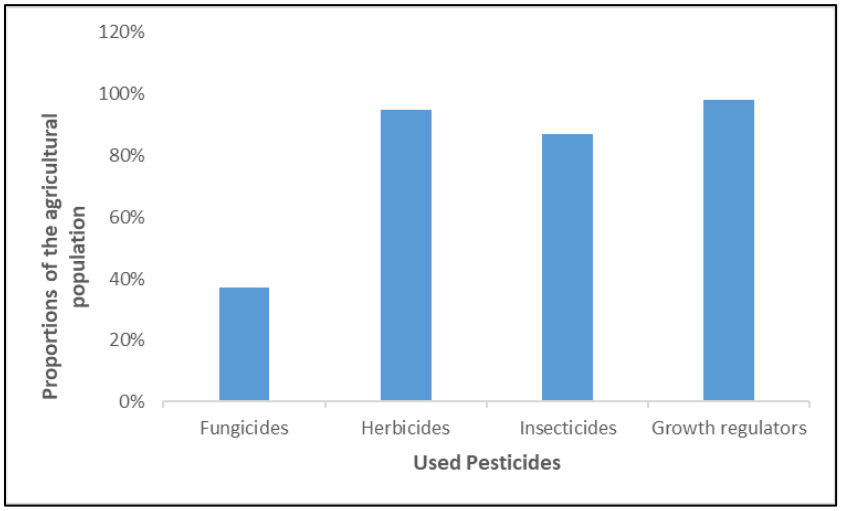

Figure 1 Proportions of pesticides used by farmers

3.3. Reading pesticide labels before use

The majority of farmers in the Daloa commune (87%) do not read pesticide labels before using them. Only 13% of growers read the labels.

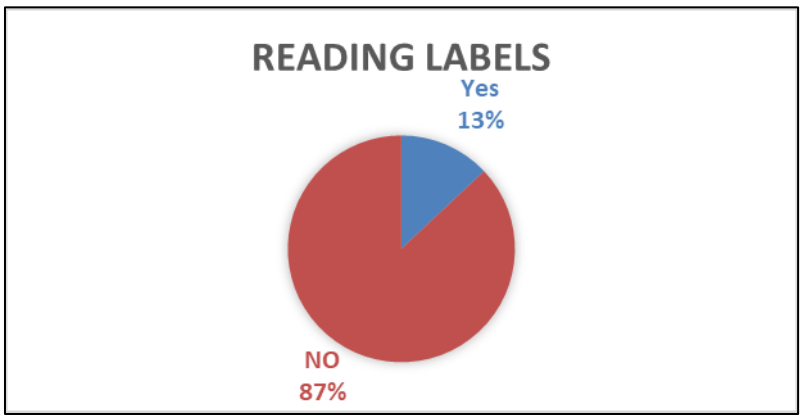

Figure 2 Proportion of farmers who read pesticide labels before use

3.3. Use of protective tools by farmers

In Daloa Commune, only 11% of farmers use protective equipment when applying pesticides (Figure 3). The majority of farmers in this area (89%) are therefore directly exposed to the harmful effects of plant protection products.

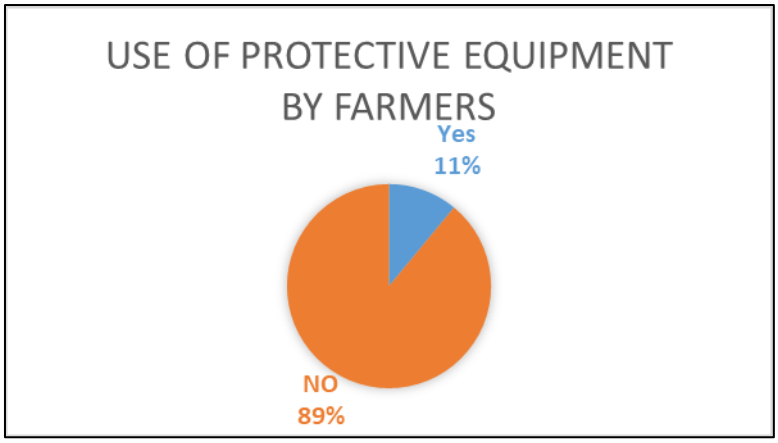

Figure 3 Proportion of farmers protecting themselves during pesticide application

3.4. Pesticide use advantages

In Daloa Commune, all the surveyed farmers considered pesticide use advantageous, compared to 76% of the non-agricultural population (Table 2). The most frequently cited pesticides advantages by farmers were: reduced labor (38%), time savings (24%), less effort required (17%), and increased yields (12%). Those most frequently cited by the non-agricultural population were: crop protection (36%) and yield increase (22%).

Table 2 Distribution of pesticide benefits

Benefits of pesticides	**Non-agricultural population**		**Agricultural population**	
	Number	Proportion	Number	Proportion
Yield increase	22	22%	12	12%
None	24	24%	0	0
Crop protection	36	36%	9	9%
Less tiring	8	8%	17	17%
Save time	4	4%	24	24%
Fewer workers	6	6%	38	38%

3.5. Pesticide use disadvantages

Data analysis showed that 96% of the non-agricultural population found drawbacks to pesticide use, compared to 14% of the agricultural population (Table 3). The most frequently cited drawbacks of pesticide use among the non-agricultural population were disease (83%), crop poisoning (47%), mortality (29%), and environmental pollution (33%). Those noted by farmers were soil degradation (5%) and high costs (9%).

Table 3 Drawbacks related to pesticide use cited by the population

Pesticide use disadvantages	**Non-agricultural population**		**Agricultural population**	
	Number	Proportion	Number	Proportion
Disease	83	41.9%	0	0
Crop poisoning	47	23.7%	0	0
Mortality	29	14.6%	0	0
weed flora shift	1	0.5%	0	0
Environmental pollution	33	16,7%	0	0

Land degradation	1	0.5%	5	5%
High pesticide costs			9	9%
None	4	2%	86	86%
Total	198	100%	100	100%

3.6. Alternatives to the use of agricultural pesticides

In this study, 80% of the non-agricultural population proposed alternatives to the use of agricultural pesticides, compared to 20% of the agricultural population (Table 4). The alternatives presented by the non-agricultural population included: cooperatives (pooling resources to manage different agro-ecosystems), fallow, agricultural mechanization, and manual labor. In addition to these alternatives to pesticides, farmers proposed organic farming.

Table 4 Distribution of the proportions of alternatives to pesticides

Alternatives to pesticides	**Non-agricultural population**		**Agricultural population**	
	Number	Proportion	Number	Proportion
Cooperative	38	38%	6	6%
Fallow	22	22%	8	8%
Machine	1	1%	2	2%
Machete work	19	19%	6	6%
Organic fertilizer	0		2	2%
No alternative	20	20%	76	76%

3.7. Public susceptibility to pesticides

Table 5 presents the receptiveness of the population in Daloa commune to pesticide use. Generally, agricultural population is in favor of pesticide use, while non-agricultural population is against this. Receptiveness rate among agricultural population is 93%, compared to 20% among the non-agricultural population (Table 5).

Table 5 Proportion of populations susceptible to pesticide use

	Non-agricultural population		**Agricultural population**	
	Nombre	**Proportion**	**Nombre**	**Proportion**
Susceptibility to pesticides	20	20%	93	93%
Not susceptible to pesticides	80	80%	7	7%

3.8. Evaluation of the relationship between population sociodemographic characteristics and their susceptibility to pesticide use

The evaluation of the relationships between sociodemographic characteristics socioeconomic categories, type of crops , agricultural and non-agricultural populations, origin, education level, and receptiveness to pesticide use, revealed that two sociodemographic characteristics influence receptiveness to pesticide use (Tables 6, 7, 8, and 9): socioeconomic categories and origin. Thus, unlike non-farmers, farmers are in favor of pesticide use. Similarly, compared to non-native and non-native residents of Daloa commune, the local population is receptive to pesticide use.

Table 6 Receptiveness to the use of agricultural pesticides and crop types

Receptiveness to the use of agricultural pesticides (n =) P-Value ⩽ 0.05			
Crops	93,67%	No	Total
Cash crops and food crops	83,33%	6,33%	100%
Food crops	100%	16,67%	100%
Food crops and Market gardening	100%	0%	100%
Market gardening	88,89%	0%	100%
Total	93,18%	11,11%	100%

Pearson's chi-square = 1,831 (Sig. P =,767)

Table 7 Receptiveness to the use of agricultural pesticides and the type of populations surveyed

Types of populations	**Receptiveness to the use of agricultural pesticides (n =) P-Value ⩽ 0.05**		
	Yes	**No**	**Total**
Farmers	93%	7%	100%
Non-farmers	20%	80%	100%
Total	56,5%	43,5%	100%

Pearson's chi-square n = 108,412 (Sig. P = 0,000)

Table 8 Receptiveness to the use of agricultural pesticides and the origin of populations

Origin	**Receptiveness to the use of agricultural pesticides (n =) P-Value ⩽ 0.05**		
	Yes	**No**	**Total**
Natives	66.06%	33.94%	100%
Non-natives	44.12%	55.88%	100%
Allogenes	43.48%	56.52%	100%
Total	51.22%	48.78%	100%

Pearson's chi-square = 9,833 (Sig. P = 0,007)

Table 9 Public receptiveness to the use of agricultural pesticides and the level of education of the population

Level of education	**Receptiveness to the use of agricultural pesticides (n =) P-Value ⩽ 0.05**		
	Yes	**No**	**Total**
Illiterate	53,33%	46,67%	100%
Primary school	66,20%	33,80%	100%
Secondary School	50%	50%	100%
University degree	53,19%	46,81%	100%
Total	55,68%	44,32%	100%

Pearson's chi-square = 3,814 (Sig. P = 0,282)

4. Discussion

Herbicides, growth regulators, and insecticides are the most well-known and widely used pesticides in our study area. [17] made the same observations, noting that these pesticides are the most commonly used in Côte d'Ivoire.

During this study, it was observed that, unlike the non-agricultural population, farmers are very favorable to pesticide use. The severe land degradation in the study area can explain farmers' pesticide acceptance [15]. Other contributing factors include demographics, industrialization spread, and advancement of new technologies [18]. As for the behavior of the non-agricultural population, it can be explained by chemophobia. Indeed, according to [19] chemophobia influences the population's acceptance of pesticides.

Farmers in the study area do not adhere to good phytosanitary practices when applying pesticides. This situation may be linked to the fact that most of the area are illiterate or have only a primary school education. This view is shared by [20, 14]. Indeed, these authors argue that illiterate users would have difficulty respecting prescribed dosages, which represents a real risk of ecosystem contamination. For the effective use of pesticides, these farmers must therefore be trained in good phytosanitary practices and integrated pest management.

The results of our study showed a relationship between receptiveness to pesticide use and socioeconomic status and population origin. The correlation between socioeconomic status and receptiveness to pesticide use can be explained by the fact that, apart from farmers, the majority of other socioeconomic groups live in cities. Indeed, city dwellers tend to fear the harmful effects of pesticides. This trend was noted in Europe by [21].

No relationship was observed between farmers' education level and their receptiveness to pesticide use. These results do not align with those of [22], who observed that the education level of cocoa farmers in Ghana influences their perceptions of pesticides.

5. Conclusion

The aim of this study was to identify the perceptions of populations in Daloa commune on pesticide use. The results revealed that, among agricultural pesticides, the inhabitants of Daloa are familiar with herbicides, insecticides, fungicides, and growth regulators. Within the agricultural population, few people take precautions when applying pesticides. Similarly, very few farmers in this area read pesticide labels before use. Both agricultural and non-agricultural populations perceive advantages in pesticide use. The most frequently cited advantages by farmers are: reduced labor (38%), time savings (24%), reduced effort (17%), and increased yields (12%). Those recognized by non-farmers are crop protection (36%) and increased yields (22%). Unlike the non-agricultural population, few farmers consider pesticides harmful. The drawbacks of pesticides cited by farmers are: soil degradation (5%) and the high cost of pesticides (9%). Those known to non-farmers are disease (83%), crop poisoning (47%), and mortality (29%).

Within the population of the Daloa commune, the majority of farmers favor the use of pesticides, while few people in non-agricultural population are receptive to these inputs. A relationship has been detected between receptiveness to pesticide use and two sociodemographic characteristics of the Daloa commune population: origin and socioeconomic status. Regarding origin, compared to immigrants, native population tends to favor the use of plant protection products. As for socioeconomic status, unlike other socio-professional groups (merchants, laborers, salaried employees, etc.), farmers are more receptive to pesticide use.

The study showed that the majority of farmers in the Daloa commune use agricultural pesticides without adhering to good phytosanitary practices. It therefore appears necessary to assess the biological diversity in the agro-ecosystems of this area where pesticides are applied. For sustainable management of agro-ecosystems and preservation of human health, farmers in Daloa commune must be trained in good phytosanitary practices, organic farming, and integrated pest management.

Compliance with ethical standards

Acknowledgments

The authors express their gratitude to the population of Daloa Commune for their collaboration and for providing views on pesticide use during the fieldwork.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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