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# Evaluation of the Use and Management Practices of Fertilizers and Pesticides by Farmers in the Municipality of Sadio (Senegal)

Dame Cisse[1], Birame Ndiaye[1,*], Ibrahima Diagne[1], Cheikh Tidiane Dione[1], Momar Ndiaye[1], Maoudo Hane[1], Sitor Diouf[1], Mame Mor Dione[1], Abdoulaye Diop[1] and Maurice Millet[2]

[1] Faculty of Science and Technology, Laboratory of Organic Physical Chemistry and Environmental Analysis (LCPOAE)-UCAD, Dakar, Senegal

[2] Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES), University of Strasbourg, France

[*] Corresponding author. e-mail: biramendiaye85@yahoo.fr

## Abstract

To reduce losses and increase agricultural yields, farmers, in addition to fertilizers, use pesticides to achieve their objectives. With the absence of recognized commercial companies in the sale of pesticides, growers buy these products in the local market. Most of its farmers are not trained in the management and use of pesticides, so they are often the first to introduce them. To evaluate the management and utilization of its products, a survey of 50 producers indicates that more than 20 commercial specialities are registered, of which 15 names are known. The most the pesticides are emulsifiable concentrate (EC) and two are granules. This study has shown that 76% of farmers are combined chemical fertilizer and composts and 72% of them are used pesticides for the insects. Used one week by 68% growers, 41.18% of packaging and bottles are discarded in the environment after and 5.88% of containers are brought at home. Despite frequent contact with these toxic products with different symptoms, many producers are not consulted after their campaigns for a health check-up.

## 1. Introduction

In Senegal, with the economy generated by market gardening, wetlands such as the

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niayes and the Senegal River Valley are no longer the only farmland. As a result, many farmers in rural areas are more interested in market gardening than they consider cereal crops to be more cost-effective (Gueye et al. [7]). So these same economic reasons push the farmers of the commune of Sadio are interested to advantage in the market gardening and in 2022, 381 fields are counted. The products produced by its producers are in addition to local consumption, are destined for other markets such as Kaolack, Touba or sometimes even the castor market. However crop losses from vegetable products are still a major problem. Estimated losses of 30% in the field and 15-20% in storage are partly caused by pests and parasites. To minimize these losses and increase yields, growers use pesticides (Brévault et al. [21]). Thus, the sale and use of fertilizers and especially pesticides covers several regions of the country (Ministry of Agriculture). Like others, pesticides are also used by Sadio's gardeners. In addition to other pests, nematicidae-affected soils continue to be a problem in the region. The use of these chemicals has consequences for the environment and human health. These health consequences are more serious especially when their uses are not well controlled (Ahouangninou et al. [1]).

In this study, the survey conducted and the exchanges with the growers allowed us after the socio-economic characteristics of the market gardeners to list the pesticides by identifying their active ingredients and their types of formulations.

## 2. Methodology

### 2.1. Study site

The municipality of Sadio of coordinates (14.79793-15.54318) is located at the extreme east of the region 45 km from the departmental capital (Mbacké). The climate is Sudanese-Sahelian characterized by a rainy season between July and September and a dry season from October to June. The estimated population in 2019 is 25242 inhabitants with an area of 235 $Km^2$ of which 23500 hectares are arable. In the municipality there are sandy soils that are suitable for all crops, sandy-clayey soils that are often exploited with inputs and stony soils that require a high valuation (Ministry of decentralization and local authorities). The choice of this municipality is motivated by the fact that it has more vegetable fields. Given its water potential, the SEN EAU project has made the area the source of fresh water for the municipality of Mbacké. So in addition to the population of Sadio, the contamination of water resources will affect more.

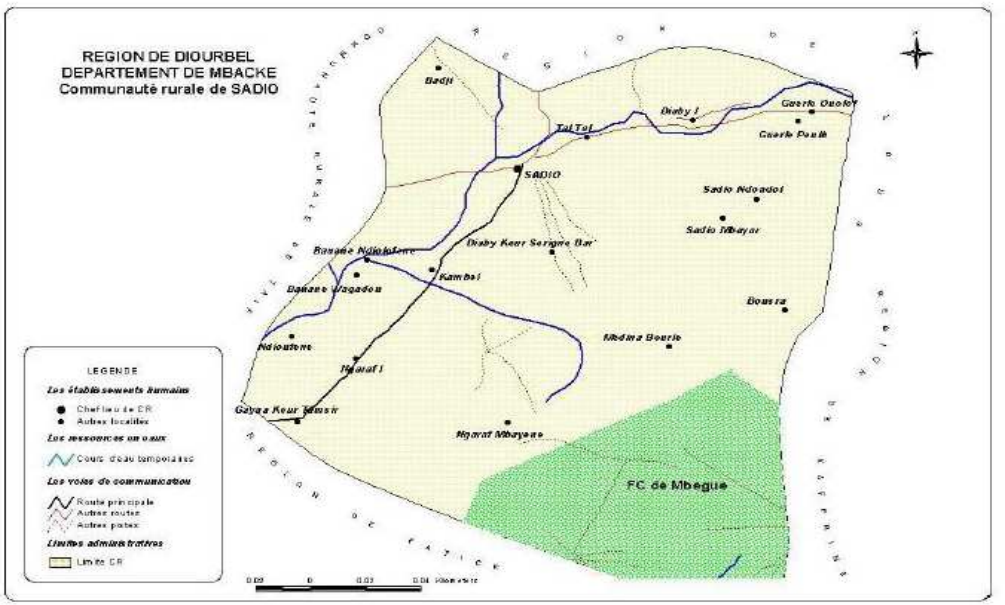


**Figure 1.** Card of the municipality of Sadio.

## 2.2. Investigation

A survey was conducted between September and October 2021 among 50 farmers of different ages. The majority of these farmers are between 18 and 30 years old: 61.36% and 36.36% of them are over 30 years old. During the survey, questionnaires relating to age, sex, number of years of experience, fertilisation practices and pest control, management of empty containers, their levels of information on the effects of pesticides were completed. During the survey, the level of training of farmers was also discussed. Their methods of protection against the products used were also identified. During this study, the cultivated species are also surveyed, and the cultivated areas on each partial are also estimated. These surveys of 50 farmers show that the local women are not yet interested in market gardening because all these farmers are male. The difficult access of women to land and the lack of means for the implementation of modern irrigation systems (drip) do not encourage their implications in this sector. They are often used as contractors during harvest. On the other hand, in the area of niayes, women are under different aspects of market gardening (Senegalese Press Agency).

## 3. Results and Discussion

In the following tables we have listed the socio-economic characteristics, the commercial specialities and their active ingredients, as well as the management and use practices of pesticides.

**Table 1.** Socio-economic characteristics and pesticide use practices.

| | | |
|---|---|---|
| Genre | M | 100% |
| | F | 0% |
| Age | < 18 years | 2.27% |
| | [18-30] | 61.36% |
| | > 30 years | 36.36% |
| Experience | [1-3] | 63.63% |
| | [4-6] | 18.18% |
| | [7-9] | 6.81% |
| | ≥10 years | 11.36% |
| Fertilization | Fertilizer | 15.78% |
| | Fertilizer + compost | 76.32% |
| | Compost | 7.89% |
| Pesticides | Insecticides | 72% |
| | Insecticide + Herbicide | 20% |
| | Herbicides | 8% |
| Frequency of use | 1x/week | 68% |
| | 2x/month | 20% |
| | about Constance | 3% |
| Label reading | Yes | 41.02% |
| | No | 53.85% |
| | Sometime | 5.13% |
| Know the effects of pesticides | Yes | 79.49% |
| | No | 20.51% |
| After-Work consultation | Yes | 32.50% |
| | No | 67.50% |

| | | |
|---|---|---|
| Container management | Throw down | 41.18% |
| | Bury | 32.35% |
| | Keep | 14.70% |
| | Bring home | 5.88% |
| | Burn | 5.89% |
| Protective equipment | Surgical mask | 64.86% |
| | Glove | 8.10% |
| | Scarf | 2.70% |
| | No | 24.32% |

**Table 2.** Toxicology record of pesticides used.

| **Commercial Specialty** | **Active Ingredients** | **CAS** | **Class** | **Toxicity** |
|---|---|---|---|---|
| CALFOS 500 EC | Profenofos 500 g/L | 41198-08-7 | Insecticide | Decreased kidney weight (bird) |
| ARSENAL 500 EC | Profenofos 500 g/L | 41198-08-7 | Insecticide | Irritation, Lesions, Corrosion |
| CLORSBAN 5% GR | Chlorpyrifos Ethyl 50 g/Kg | 52315-07-8 | Insecticide | Skin allergy reproduc Toxicity |
| DICOFORT 112 EC | Pyribaen 102g/L<br>Abamectin 10g/L | 96489-71-3<br>71751-41-2 | Insecticide | Toxicity (bees, algae) |
| MALATHION 500 EC | Malathion 500 g/L | 121-75-5 | Insecticide | Probable human carcinogens (IARC) |
| Maneb | Maneb | 12427-38-2 | Fungicide | Acute renal failure |
| PACHA 25 EC | Acetamipride 10 g/L<br>Lambda-Cyhalothrine 15g/L | 135410-20-7<br>91465-08-6 | Insecticide | Irritation (lung) |
| DIMETO 400 EC | Dimatoate 400g/L | 60-51-5 | Insecticide, Acaricide | Eye injury |
| PYRICAL 5G GR | Chlorpyriphos-Ethyl | 52315-07-8 | fungicide | ------ |
| VYDATE EC 240 | Oxamyl 240 g/L | 23135-22-0 | Insecticide<br>Nématicide | Harmful (Contact) |

| | | | | |
|---|---|---|---|---|
| DIMETRA | Dimatoate | 60-51-5 | ------ | ------ |
| Rocket | Chlorpyrifos 20% | 2921-88-2 | Insecticide | ------ |
| ATTAKAN EC 344 | Imidaclopride 144g/L<br>Cypermethrine 200 g/L | 138261-41-3<br>52315-07-8 | Insecticide | Sub-lethal (bee)<br>aquatic toxicity |
| DECIS | Deltaméthrine | 51918-63-5 | Insecticide | Toxic by ingestion |
| SULFUS 80%WDG | Soufre 800 g/L | 77004-34-9 | fungicide | low acute toxicity |

### 3.1. Crop rotation and fertilization

In these fields, the cultivated areas are estimated at ($35_x35$) m² and there almost all the areas are made up of tomato and small portions are reserved for the varieties of chilli, aubergines and pepper. Because of lack of means, market-gardening is often limited only in wintering. For fertilization, 76.32% of its growers combine composts and chemical fertilizers, 15.78% use only N-K-P or urea chemical fertilizers. Only 7.89% use only livestock manure to fertilize the soil. This use of chemical fertilizers could contribute to the increase of nitrogen and phosphate ions in the environment. Excessive fertilisation by these chemical fertilizers can contribute to the eutrophication of fresh water and climate change. Accidents related to storage, transport and use of chemical fertilizers resulted in fatalities as in 2015 in Tianjin (China) with 173 deaths and in 2020 in Beirut (Lebanon) with 220 deaths (UN, 2022).

### 3.2. Pesticide applications

The majority of pesticides identified in this locality are used against insect pests. The number of compounds considered as insecticides by farmers represents 72% of the pesticides identified. These Sadio farmers generally use pesticides without proper protective equipment. These gardeners use sprayers and treatment is often done in the evening after 6 pm and in the morning before 8 am. To treat fields against pests, 68% of farmers use pesticides once a week and the rest 1 every 15 days. During this survey, more than 10 commercial specialties are registered with the 50 growers. For the pesticides identified, only PYRICAL and SULFUS are fungicides and the remainder are insecticides. This is in line with their targets as 72% of growers use these products against insects (Table 1). Similarly in Benin in 2011, 68% of farmers used pesticides to kill harmful insects (Ahouangnioun et al. [1]). In general, all pesticides are combined with other solid or inert liquid substrates for proper application. These combinations, called formulations, come in different forms. The formulations of its identified pesticides

are mostly concentrated emulsifiable (EC), thus in homogeneous liquid forms like the case MALATHION 500 EC. The EC formulation is often used in cases where the active ingredients do not easily penetrate the foliage. Most organochlorine pesticides are formulated as concentrated emulsifiers (Zimdahl et al. [20]; Feng et al. [6]). SULFUS hydrodispersible granulated formulation (WDG), PYRICAL 5G and CLORSBAN 5% granulated formulation (GR) are ready-to-use solid products. These granules (GR) with diameters up to 3 mm, often contain a small percentage of active substances. Gardeners must wear gloves during use. Pellets (WDG) must be mixed with water before use and the advantage in this formulation is the high charge of the active ingredient and can be up to 90%. After the use of WDG-formulated pesticides, the equipment can be sources of long-term pollution because its cleaning is difficult (Yanagisawa et al. [19]).

### 3.3. Management and protection from pesticides

A good number of farmers, 64.86% use inadequate surgical masks for the protection of these chemicals, 24.32% of farmers do not even have equipment, 2.70% protect themselves with scarves and 8.10% have gloves. The same is true for the market gardeners of niayes who also use products without protective equipment (Cissokho et al. [18]). Respirator masks with cartridge are recommended. During this survey, 79.49% of farmers claim to know the dangers of pesticides and yet 53.85% of them do not read labels that often contain information related to use and toxicity (GHS Purple Guide, first revised edition 2005 [8]). Only about 20% claim without knowing the effects of pesticides. After their campaigns, 67.50% of them do not make a consultation for a health check. After use, a small number of these farmers burn the containers, others bury them and 41.18% of the bottles are thrown into the environment. Even worse, according to the information gathered, 5.88% of the gardeners bring the bottles home after use. These acts of management of containers of products used in fields increase the risk of pollution in all compartments of the environment (Mushagalalusa Balasha et al. [15]).

### 3.4. Pesticide consequences and risks

These listed pesticides, some with different trade names have the same active ingredient. Examples include CALFOS and ARSENAL, which are organophosphates with the same active substance Profénofos (Diarra et al. [12]). There is also CLORSBAN and PYRICAL, whose active ingredient is Chlorpyriphos-Ethyl. In a study conducted in freshwater fish shows that Chlorpyriphos-Ethyl is toxic (Ntiendjui et al. [16]). Similarly, dimatoate is the active ingredient in DIMETO and DIMETRA can cause eye damage. In

dimatoate can cause bee mortality with a lethal dose DL40. Similarly, imidacloprid, the active ingredient of ATAKAN, is also sub-lethal. Lambda-Cyhalothrine, which is the active ingredient in what can be irritating to the lungs and eyes (Human Health Assessment Branch [10]). Deltamethrin can cause facial, nasal and ocular irritation in humans. It is also highly toxic to aquatic wildlife (Dejoux [5]). These persistent, possibly carcinogenic pesticides can also disrupt reproduction and the immune system (Guyton et al. [9], Salim [13], Charvet [3], INERIS [11], Aubertot [2]).

## 4. Conclusion

The survey of Sadio farmers shows that many combine composts and chemical fertilizers for fertilization. Almost all the products used are insecticides and are often formulated concentrated emulsifiers (EC). These farmers who lack adequate training treat their fields without the means of sophisticated protection against pesticides. Thus, it is necessary to strengthen the capacity of pesticides to reduce contamination through training. Training in this area can increase their sales capacity for their products. It is thus a duty of the authorities concerned to assist the farmers in the improvement of seeds and in the fertilisation system, especially for the exploitation of rocky soils. It is also a duty for especially local authorities to create specialized areas where fields are grouped before prohibiting fields in certain houses.

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