



# Biosecurity in Fish Farming: Implementation of the HACCP System at the Djissoumakö Fish Farming Centre - Urban Commune of Siguiri, Guinea

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors BT, LM, AMC, LH and FB participated in the conception of the theme, the collection, organisation of the scientific information provided and submission of the article. Authors LWS, MM, OMK and SAT participated in the reading and correction. All authors read and approved the final manuscript.*

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## ABSTRACT

This study was carried out from 10 January to 20 February 2022 in the urban and peri-urban area of Siguiri and aimed to learn about the application of biosecurity measures in some fish farms in Siguiri. To this end, 6 fish farms were surveyed on the basis of a targeted sampling based on the criteria of accessibility, cooperation of fish farmers and the functional state of these farms, and 20 biosecurity variables were taken in to account.

Of all the fish farms surveyed, only one (1) farm applied biosecurity measures, i.e. 15%, and the other five (5) said they had no knowledge of biosecurity, i.e. 85%.

In conclusion, the knowledge and application of biosecurity measures could undoubtedly help prevent diseases in fish farms, even though they are rare, and improve the productivity of fish farmers.

*Keywords: Biosecurity; fish farming and HACCP.*

## 1. INTRODUCTION

The consistent application of biosecurity measures is essential to the success of any type of animal production. Biosecurity reduces the risk of disease introduction and the financial losses resulting from infection. However, in several sectors, the practice of biosecurity or its observance is sporadic and variable, whether in cattle, pig, poultry or aquaculture farms [1].

However, failure to apply biosecurity measures often results in serious losses due to

- reduced growth and production of fish ;
- increased feeding costs due to waste of uneaten feed caused by poor appetite of the fish;
- increased sensitivity to any quality degradation;
- high fish mortality [2].

However, in the majority of fish farms in Africa, the main species of fish raised are from the tilapia and catfish group whose resistance to certain infections is now being questioned, these diseases can be spread naturally through the water, farmed fish infected by wild fish, vectors of an infectious gene and even humans can be carriers of a gene such as *Mycobacterium marinum*, responsible for tuberculosis in fish and also observed in workers on fish farms [2].

Furthermore, fish farms in the Republic of Guinea lack a real policy of biosecurity measures compared to those in the sub-region. Thus, no study on the real practices of fish farmers in terms of hygiene seems to be available. This work is the first in a field of research that will lead to the proposal of a guide of good biosecurity practices in the country's fish farms.

## 2. MATERIALS AND METHODS

### 2.1 Materials

Brief presentation of the urban commune of Siguiri.

The urban commune of Siguiri is the capital of the prefecture of the same name. It is bounded:

- to the east by the rural commune of Bankon.
- to the west by the rural commune of Kintinian;
- to the north by the rural commune of Doko;
- to the south by the rural commune of Kiniebakoura.

### 2.2 Methods

#### 2.2.1 Identification and assessment of biosecurity measures on fish farms

##### - Selection and coding of surveyed fish farms

The selection of farms was based on the criteria of accessibility, cooperation of fish farmers and functional status of the farms and all submitted farms were coded using the first two letters of the farm name in upper case followed by the serial number of the surveyed farms.

##### - Questionnaire design and identification of biosecurity measures

The questionnaire was developed on the basis of the minimum biosecurity measures. These measures covered 20 variables on which our questions were oriented, so the administration of the questions was done in the form of an interview.

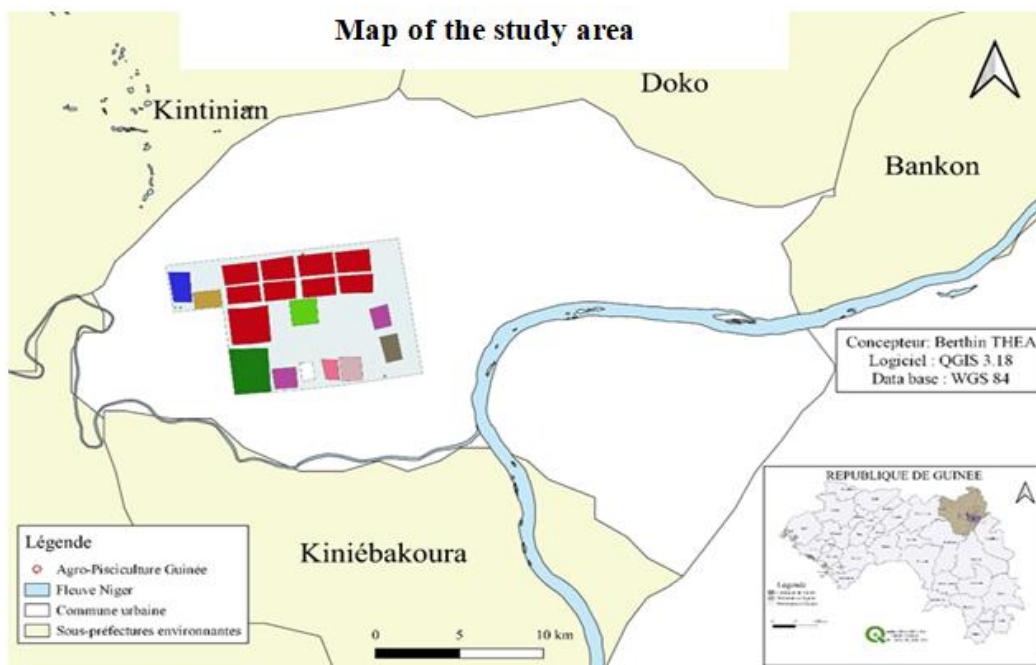
After the interview, direct observation of certain variables allowed us to assess the quality of the answers obtained.

**- Parameters of the biosafety measures assessed**

The variables of interest were the recommendations of [3] regarding biosecurity measures applied in aquaculture.

**2.2.2 Mapping of surveyed fish farms**

For the mapping of the surveyed fish farms in the study area, we used a GPS (Android). The operation consisted of collecting GPS coordinates, namely longitude and altitude. Finally, the data was used in QGIS3.18 software to be processed to produce the map.



**Fig. 1. Map of the urban commune of Siguiri**

**Table 1. Biosecurity variables considered**

Number	Variable	Codes
1	Types of farming structure	TFS
2	Physico-chemical analysis of water	PCAW
3	Working clothes for staff	WCS
4	Working clothes for staff	WCS
5	Protection of livestock structures	PLS
6	Knowledge of biosecurity measures	KBM
7	Farm Isolation	FI
8	Fish processing	FP
9	Knowledge of fish diseases	KFD
10	Disinfection of farm equipment before use	DFEBU
11	Disposal of dead fish	DDF
12	Disinfection of farm equipment after use	DFAU
13	Visitor contact with water	VCW
14	Veterinary visit	VV
15	Presence of animals on the farm	PAF
16	Inter-farm exchange of livestock equipment	IFELE
17	Fish treatment products	FTP
18	Quarantine of new fish	QNF
19	Frequency of water renewal	FWR
20	Visit	V

### 2.2.3 Elaboration of the HACCP system of the djissoumakö fish farm

The implementation of the HACCP system of the Djissoumakö fish farming centre according to the ISO 22000 standard concerned the 5M which is one of the methods applied in food hygiene and safety and which makes it possible to check the possible sources of contamination of food.

### 2.2.4 Collection and processing of statistical data

In this study, the method of analysis used is a descriptive one, so three computer programs were used for raw data entry, statistical analysis, map design and presentation of results.

- Sphinx iQ2 Version 7.4.0 was used to develop surveys based on biosecurity variables and to collect data;
- QGIS Version 3.18 was used to design the thematic data (map);
- Microsoft Excel Office 2019 was used to create the tables.

## 3. RESULTS AND DISCUSSION

In terms of knowledge and practice of biosecurity measures applied on the different fish farms surveyed, our results reveal that more than 85% of the fish farms do not apply biosecurity measures and 15% apply preventive measures but in a discontinuous manner. This would have

had consequences for the health of fish and staff. Our surveys showed that 94% of the farms have fish ponds and 6% have tanks, 66.66% have other animal species on their farms, 88% have not disinfected the farming equipment and 100% of the farms have not allowed veterinary visits and 88% do not take physico-chemical parameters. Furthermore, our results also indicated that 88% of the fish farms did not apply quarantine to new fish and 94% renewed the water once a month.

The analysis of the different values from the biosecurity practices shows that the majority of the fish farmers do not have on biosecurity and those who apply preventive measures accumulate fair practices that can expose their fish and staff to risks of infection or infestation. Looking at the values from another angle, we find that the fish farmers in the study area do not have any preventive policies for their farms.

However, our results are similar to those observed by [4] among aulacode farmers in the Sud-Comoé and Agnéby regions of Côte d'Ivoire, who stated that in most aulacode farms basic prophylactic measures are not applied by the farmers and that the neglect of preventive practices is due to the lack of qualified professional training of the farmers. The latter are also, for the most part, illiterate and would have learned the profession of animal husbandry on the job.

**Table 2. Geographical coordinates and coding of surveyed fish farms**

N°	Farm	Code	NAltitude	Longitude W
1	Agro Pisciculture Guinea	AP01	11°25.892	009°14.307'
2	Eco Farm Djoliba	EC02	11°43.718	009°01.955'
3	Cisse Farm	FC03	11°25.329	009°15.987'
4	Barry Farm	FB04	11°21.285	009°10.049'
5	Manden Mansa Farm	FM05	11°25.936	009°10.766'
6	Paracetamol Farm	FP06	11°26.396	009°08.348'

**Table 3. Biosecurity features related to the management of fish farm staff and visitors**

Biosecurity aspects	Modalities	Frequency (%)
Working clothes for staff	No	88
	Yes	12
Working clothes for staff	No	94
	Yes	6
Knowledge of biosecurity measures	No	94
	Yes	6
Visit	1-25/month	100
	0/month	0
Visitor contact with water	No	100
	Yes	0

**Table 4. Biosecurity features related to the management of rearing equipment on fish farms**

Biosecurity aspects	Modalities	Frequency (%)
Types of farming structure	Basins	94
	Tanks	6
Physico-chemical analysis of water	No	88
	Yes	12
Protection of livestock structures	Protected	94
	Unprotected	6
Farm Isolation	Fenced	100
	Not fenced	0
Presence of animals on the farm	No	66,66
	Yes	33 ,34
Disinfection of farm equipment before use	No	88
	Yes	12
Disinfection of farm equipment after use	No	88
	Yes	12
Inter-farm exchange of livestock equipment	No	100
	Yes	0

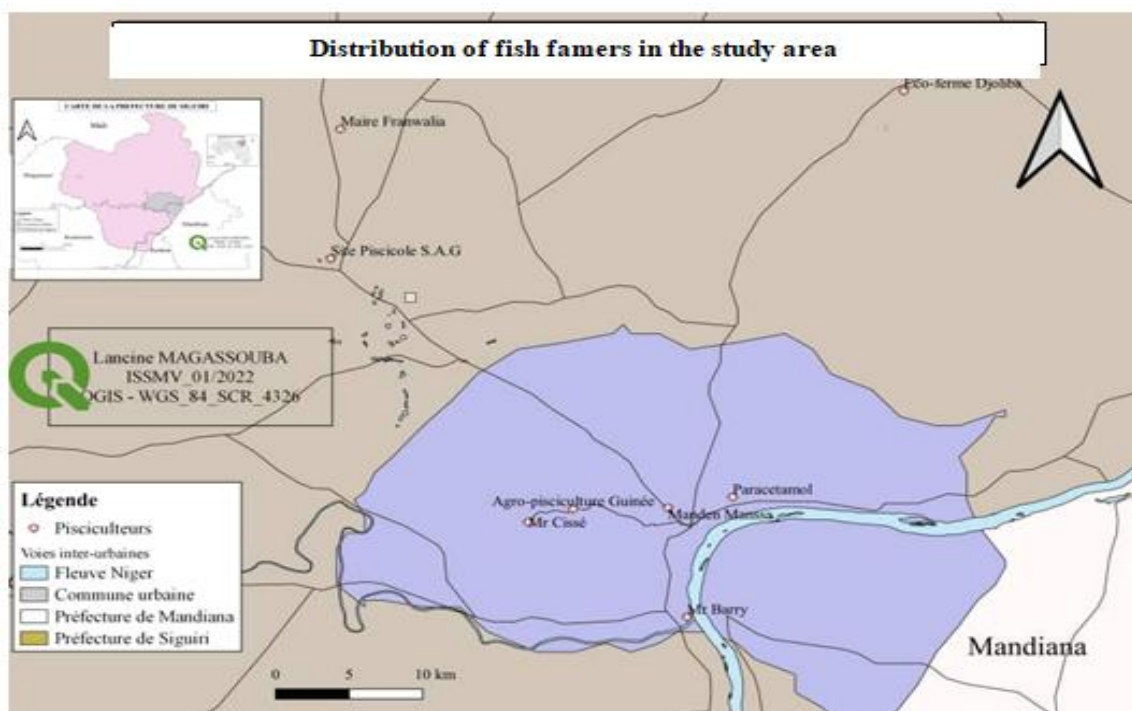
**Table 5. Biosecurity features related to fish management**

Biosecurity aspects	Modalities	Frequency (%)
Fish processing	No	94
	Yes	6
Knowledge of fish diseases	No	88
	Yes	12
Disposal of dead fish	Consumed	100
	Discarded	0
Veterinaryvisit	No	100
	Yes	0
Fish treatmentproducts	Oxytetracilin	45
	No-iodizedsalt	55
Quarantine of new fish	No	88
	Yes	12
Frequency of water renewal	Every two week	94
	Every month	6

**Table 6. HACCP system of the Djissoumakö fish farm according to the ISO 2200 reference standard**

5M		Highlights	Period of execution	Coordinators	Enforcers
Fish		Supply	Daily	Production Assistant	Fish Farmers
		Water renewal	Weekly	Production Assistant	Fish Farmers
		Monitoring of physico-chemical parameters	Weekly	Production Assistant	Fish Farmers
		Monitoring of biological parameters	Monthly	Production Manager	Production Assistant
		Sanitary monitoring	Monthly	Production Manager	Production Assistant
Environment	Hatcheries	Cleaning	Daily	Production Assistant	Fish Farmers
		Washing and	before and	Production	Fish Farm

<b>5M</b>		<b>Highlights</b>	<b>Period of execution</b>	<b>Coordinators</b>	<b>Enforcers</b>
	Shed	disinfection Cleaning	after reproduction Weekly	Manager Production Assistant	Workers and Assistant Fish Farmers
	Tanks	Washing and disinfection Washing	Monthly Weekly	Production Manager Production Assistant	Fish Farm Workers and Assistant Fish Farm Workers and Assistant
	Feed storage	Washing and disinfection	Before loading and after total fishing Weekly	Production Assistant	Fish Farm Workers and Assistant
	Waste water reception tank	Cultivation of water hyacinths (purification)	None	Technical team	Manager, Assistant and Workers
	Disinfection room	Washing and disinfection	Daily	Fish Farmers	Maintenance workers
	Toilets	Cleaning and disinfection	Daily	Fish Farmers	Maintenance workers
	Green areas	Cleaning	Weekly	Fish Farmers	Maintenance workers
	Wastewater drainage channels	Cleaning	Monthly	Production Assistant	Maintenance workers and fish farmworkers
Labour	Equipment	Mandatory wearing of uniforms, boots, gloves, aprons, safety waistcoats and jackets	Each activity	Production Assistant	Technical team
	Visit certificate	Medical check-up	Monthly	Administrators	Staff
	Medical follow-up	Knowing the state of health of the staff recruited	On hiring	Administrators	Recruited
Working materials	Breeding equipment	Washing and disinfection of equipment	before and after reproduction	Production Assistant	Production Assistant
	Fishing equipment	Maintenance	after use	Production Assistant	Fish Farmers
	Biological monitoring equipment	Maintenance	after use	Production Assistant	Fish Farm Workers and Assistant
Working method	Work rate	Avoid rough handling of fish	During control and total fisheries	Production Manager	Fish Farm Workers and Assistant



**Fig. 2. Identification map of surveyed fish farms**

Our results revealed that most of the fish farms surveyed have other animal species that have access to the environment due to the absence of controlled access zones on the farms. This constitutes a failure of other biosecurity measures, regardless of their level of implementation. The presence of other animal species can constitute a risk of introducing germs, as highlighted by [5]. Indeed, it has been shown that some avian species can be carriers of germs and be sources of contamination for others that are more susceptible to these germs. This mixture of species therefore creates an environment favourable to the emergence of various avian diseases.

The implementation of the HACCP system at the Djissoumakö Fish Farm is a tool for the application of bio security measures and its could be noted that in the Siguiri prefecture fish farms are concentrated in urban and peri-urban areas.

#### 4. CONCLUSION

The analysis of the biosecurity measures variables showed that in almost all the fish farms surveyed, biosecurity measures are not applied, which undoubtedly has consequences in terms of productivity. It appears that the fish farming stakeholders in the peri-urban and urban area of Siguiri do not have extensive information on the

application of biosecurity measures in fish farming, however, the application of the HACCP system presented in this article could be considered as a good practice guide for biosecurity measures in fish farms and will allow for a profitable and environmentally friendly production.

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#### COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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