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Survey on the biosecurity of poultry flocks in the wilaya of Bouira

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to my teachers who have helped us through this journey,
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Rima

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LISTOFABBREVIATIONS:

AI: AvianInfluenza

ANSES: Agencenationaldesécuritésanitairedel'alimentationetl'environnementdetravail(French AgencyforFoodandEnvironmentalHealth)

ASP: BiologicalSafetyAgent
FAO: FoodAgricuturalorganisation
HACCP: Hazardanalysiscriticalcontrolpoint
Mg:milligram
Ml:milliliter
Ph:hydrogen potential
SAS: SecureAccessSystem
ZAC: Controlledaccess zone
ZAR: Zone d'accès restreint

Introduction

INTRODUCTION

In 2019, the United Nations Food and Agriculture Organization (FAO) estimated the global numbers of domesticchickensandducksatover18billion and1billion,respectively .Considering the number of animals, poultry represents the world 'slargest domestic animastock (Fao, 2020). This sector is dominated by commercial farms, and Algeria has seen considerable b developm en tinrecent years.

In many countries, including Algeria, poultry rearing and consumption are associated with socio-cultural elements such as festivities (Wilson, 2010), as well as with economic elements of the farm and the country (Fasina et al, 2008). In addition, there are infectious diseases in poultry that are zoonotic, which can result in mild symptoms in humans (such as NewcastleDisease)(AchaandSzyfres,2003),arangeofmildtoseverediseases(suchascampylobacteriosis or psittacosis) (Beeckman and Vanrompay, 2009) or serious consequences in both poultry and humans, such as the highly pathogenic avian influenza virus. (HPAI)A/H5N1.

According to WHO (2011), some of these viruses have given rise to public health concerns. Biosecurity measures are implemented on farms to prevent hazards to human health and economic losses. These measures include isolation, circulation control and/or sanitation, to prevent the introduction, persistence or spread of infectious agents. The rapid development of intensive poultry production, combined with the increased worldwide movement of animals and people, has greatly contributed to the emergence of new pathogens (HPAI A/H5 N1 or H9N2). However, in certain situations,there is evidence of sustained dissemination of the seavian viruses between intensive and semi-extensive poultry flocks(Lothet al.,2011).

The main aim of our study is to assess biosecurity practices and their level of application on selected poultry farms in the state of Bouira, more specifically in the six communes studied.

In order to achieve this, we divided our work into a literature review comprising two chapters dealing with: biosecurity on poultry farms and the evaluation of biosecurity methods and their importance.

Andanexperimentalsectiondedicatedtomaterialsandworkingmethods,where wedrewupa survey sheet comprising a number of self-imposed questions based on certain criteria such as: experience, number of years of experience, number of staff, poultry farm characteristics,feed characteristics, farm management, visitor management and hygiene and cleaning of farm buildings .Statistical study and discussion of the results obtained.

At the end of the study, the results and recommendations for developing and improving biosecurity in the state of Bouira were summarized, along with further training for the region

'slivestock farmers.

CHAPTERI

BIOSECURITYONPOULTRYF ARMS

1 Definition of biosafety

Biosecurity refersto all actions takent oreduce the risk of introducing and spreading pathogenic organisms. Biosecurity requires individual stoad optaset of attitude esandbehaviors adapted to minimize this risk in all activities involving domestic animals, captive orexotic animals, wild animals and their by-products. Biosecurity measures are designed to prevent the introduction of pathogensin to aherd or farm(external biosecurityorbio-exclusion), and to prevent the spread of disease to uninfected animals within a herd, farm or other operations when the pathogenis already present(FAO,2024).

2 Different levels of biosecurity in poultry farming (from Biosecurity Basics of poultry farms, 2010)

2.1 Conceptualbio

- Location of building inrelation to hend ensityand species.-

The distance between the henhouse, hatching, processing and packaging areas.

- The henhouseis connected to communic ationroutes.

Structural health safety:

- The farm Is enclosed to prevent entry.

It is essential to secure the farm again strodents and wild birds byusing aconcrete floor and adapting extraction fans appropriate lyto avoidairborne disease transmission.

Ensuring adequate ventilation and drainage ethrou ghout the building is equally crucial.

- Ensurean additional water supply from pathogen-free sources.

2.2 Operation alsafety:

- Develop an operational manual for standard farm procedures. - Disinfect and decontaminat elive stock facilities priortorein stallation.

- Establish special protocols for the entry and exit of people such as farm staff, supervisors and visitors. - Maintain strict control of backyard birds and avoid contact with exotic birds. – Establish an appropriate evaccination protocol.

3 Prevention of diseases transmissible from on eanimal to another(accordingtoFAO,2008)

3.1 Isolation or segregation

The first step is segregation. This doesn't mean isolating species, but protecting animals likely to be contaminated from those that are not.Segregationshouldensureahighlevelofbiosecurity. There will be no infection without the introduction of the virus into a production unit. Unless there is an absolute emergency, animals and equipment of any kindmustnot enterorleave production units.(FAO,2008)

Segregation consists of:

- Create barriers to restrict access.
- It's essential that obstacle saremad eupofmat erialand/ortim eresources where possible,and of procedures where this is not feasible.

- But they are only effective if they are controlled to avoid the existence of animals or object slikely to be contaminated. In this type of measure, anyone crossing the barrier can be asked to change shoes and clothing, oraccess to vehicles can be restricted.

It's important to stress that even, and perhaps even more so, in large-scale, highly integrated production systems, where output is high and margins low, and where biosecurity is essential lbecause disease canhave disastrous consequences, segregation is essential form ostbiosecurity measures, from the farm gate to individual poultry houses. Segregation is the most important and essential protection.(FAO,2008)

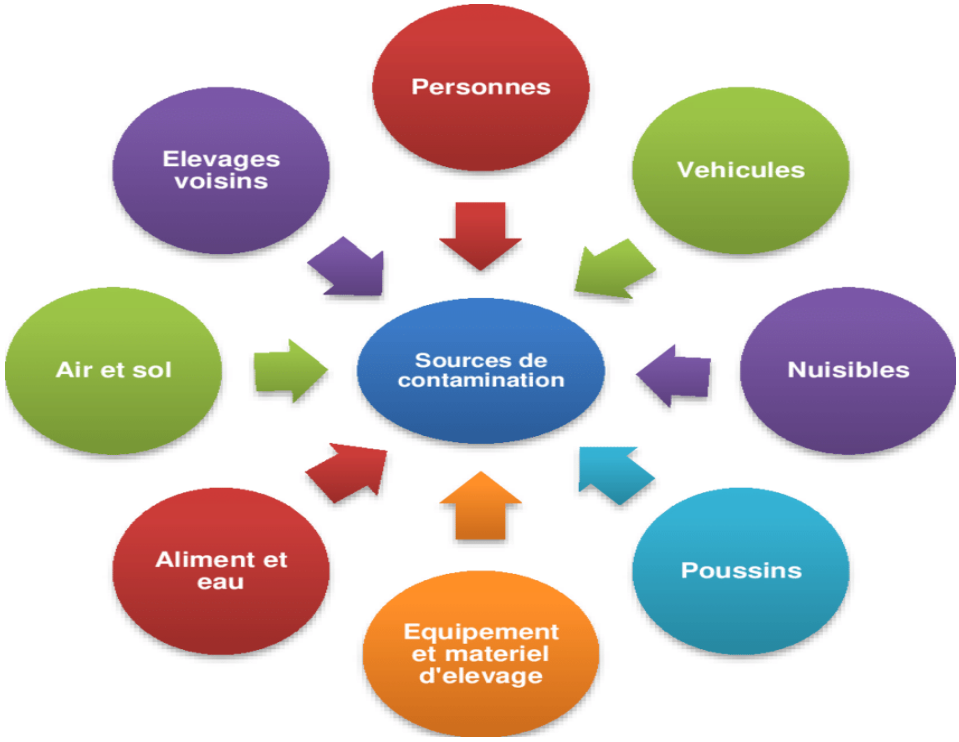

Figure 1: *Sources of contamination on a poultry farm****(Boukerrou,2019)***

3.2 Sanitation

3.2.1 Cleaning

Cleaning stand soutasthe second stepinbio security because of its effectiveness.The feca lproducts of infected animals or their respiratory secretions,which at tachthemselvesto

surfaces, are generally the source of contamination of objects. Purification eliminates most viruses. All materials passing through the sanitarybarrier must be thoroughly cleaned(whether entering orleaving).This means that the reisnotraceofdirt (Fao,2008).

Small objects can be cleaned with soap, water an dabrush,but large vehicles, such as trucksortractors,need to be cleane dathighpressure(maximumpressure110-130bar). The difficulty of maintaining large objects, such as trucks, confirms that's egregation is the first and most effective protection measure.(FAO,2008).

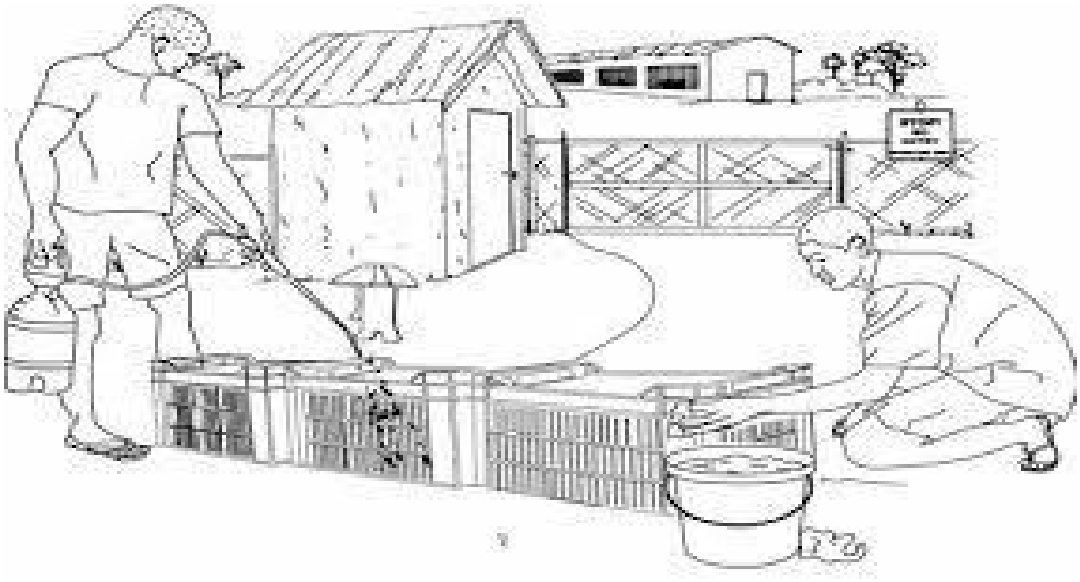

Figure 2: *One person washes the crates and the other disinfects them after cleaning the organic materials* ***(FAO, 2020).***

3.2.2 Disinfection

Disinfection only concerns clean surfaces.Itconcernsequipment,water pipesand surfaces. I tshould be not edthat the effective enessof disinfection can be compromise dbythe characteristics of the water used:

An acidic or basic pH, the presence of organic substances and a high level of hydrotimetric "Hard water" are elements that hinder the effectiveness of many disinfectants. (Guide to Bio security in poultry farm sin the Middle East and North Africa, 2018)

It is vital to emphasize the importance of preventing the spread of the virus to farms and villages that are free from "bio exclusion" infection in terms of bi o security in family poultry farming.Oncean out break has been identified,"bio-containment "becomes themost essential lmeasure. However, given the difficulties of implementing containment, prevention appears to be them ost effective way of mana gingthe disease.(FAO,2008).

3.2.3 Sanitary vacuum

It is strongly recommended to carry out a sanitary vacuum after cleaning and disinfecting abuilding. The total duration of thestamping-out period is 15 days. This corresponds to aperiod when birds are absent, resulting in a dry building, which can be improved by heating and additional disinfection if necessary(Guèrin,2016).

As a result, this period will be longer in winter and summer. The quality of disinfection

depends on the configuration of the site, access to all points of the building for disinfection,the material used in the site, whether it is more or less porous or absorbent, the disinfection capacity of the product and the effectiveness of the disinfection material .It is there for eessential that the quality of the sanitary vacuum is not limited to its duration, but also to the effectiv en essofth edisinfection(Fedida,1996).

3.2.4 Deratting

Deratting encompasses all actions and methods used to monitor and eliminate populations ofrats and other threatening rodents in a specific environment, with the aim of preserving publich ealth,property and foodstuffs.(WHO,2022)

3.2.5 Pestcontrol

Disinsectisation includes all measures taken to control and eliminate insect pests present in a given environment. This action aims to protect the population, prevent the spread of insect-borne diseases, and protect food and material goods from damage caused by these insects (Guèrin,2016).

3.3 Wild birds

Ducks are a good means of long-distance transport. Infected wild birds have the capacity to introduce AI (Avian Influenza) into a home. In waterfowl, the influenza virus is transmitted via the fecal-oral route. The virus is excreted by waterfowl during annual migrations to waterbodies,wher eit cansurvive form on thsatcold temperatures and transmit the infection too ther birds.Domesticpoultry can be contaminated by wild bird faeculesby consuming ontaminated feed orwater.

It is also possible for contaminated feathers and dust to transmit the AI virus and contaminate the environment. The influenza virus, once it has entered poultry, can rapidly spread through susceptible hosts(Guèrin,2016).

3.4 Pets

In addition to rodents,which can be accidental hosts for certain parasites and breeding grounds for various diseases, pet cats are also a problem.

It is therefore important not to allow these animals on an avine farm, as they can carry insects (fleas)and microbes (salmonella). The same applies to cattle. According to a 1998 study,cattle are a significant source of Campylobacter in broiler farms. Transmission via cattle bootshas been demonstrated. It is therefore necessary to limit the presence of Campylobacter

to asingle type of animal per productionsite.

If this is t possible (for example,turkeyand chicken productionon th esamesite),biosecurity measure smutbe adjusted tominimize cross-contamination between species(Jeanne etal.,2015).

4 Prevention of diseases that spread from humans to animals

Biosecurity is based on the epidemic of diseases transmitted from humans to animals, in particular top reserve animal health and reduce the risk of disease transmission to humans.
He reares om essential preventive measures:

4.1 Health protection

4.1.1 The autoluve

This is a space designed for vehicle wheels to disinfect in a bath. This disinfectant bath can beadded to or renewed as required. Additional spraying (on wheels, chassis or mudguards, oreven the whole vehicle) can provide a finishing touch and bring vehicle disinfection to an end. Tractor tires haved eeperradiiand arelong erthanth etirecircum ference (FAO,2024).

Figure 3: *Autoluve regularl ymaintained* ***(Guide de Biosécurité dans les élevages avicoles au Moyen Orient et en Afrique du Nord,2017).***

4.1.1.1 Foot bath

This is a device (basin, tub, foam...) containing a disinfectant product and placed at the entrance to the farm premises to clean the feet. The solution should be replaced every two days if you're a regular visitor to the farm, especially if there's a lot of foot traffic. So aking in the foot bath should last at least30 seconds,if not 1to2minutes.(FAO,2024).

Figure 4: *Pediluve regularly maintained* ***(Guide de Biosécurité dans les élevages avicoles au Moyen Orient et en Afrique du Nord, 2017)***

4.2 Preventing various types of contamination

To protect a poultry farm from various types of contamination,it is crucial to considera few essential preventive measures:

4.2.1 Clothing and boots

It is advisable for workers to wear specially made farm clothing and boots, and to be as signed to a farm on a daily basis. The risk of pathogens spreading between farm buildings is reduced by offering disposable plastic boots rather than reusable, washable boots for visitors to many farms. These boots, however, are not suitable for farm staff. Experts such as veterinary surgeons will have the option of choosing rubber boots that are cleaned and disinfected with each use. (ChenafietTchoketch, 2019).

Boots and clothing must be changed between buildings where birds are kept. If a farm has more than one team, start with the youngest and finish with the oldest, unless the young estteam is suspected or confirmed of having an infectious disease (ChenafietTchoketch,2019).

4.2.2 Hand hygiene

In contact with birds and farm equipment, hands are exposed to a variety of micro-organisms, and proper hand cleaning is essential to reduce this risk. The use of a no-rinsed is infectanthas been shown in human medicine to be microbiologically more effective and easier to use, saving time compared with hand washing. On the other hand, in the hospital environment ,hand saren otvisiblydirty, unlikein animal husbandry.It is therefore advisable to

wash, rinse and, above all, dry hands thoroughly when this is the case.

Indeed, once washed with water, an interface forms due to residual moisture, which favorsthe spread of micro-organisms between hands and contact surfaces. It is therefore vital to dry the mafte rwashing to avoid cross-contamination.(Jeanne etal.,2015).

4.2.3 Equipment and vehicles

Equipment used in poultry plants can be carriers of disease, including equipment used to handle, sow, treat or remove poultry. Public roads could also be infected with the AI virus.When ever possible,all vehicle sand equipment shoul dbekeptout o f the PHA.(Information guide for the applicationofchickenbiosecurity,2019).

Records of vehicle and equipment movements must be kept and submitted to the relevantre gulatory bodies for investigation. Vehicles and equipment shared with other poultry operations may not be entered unless other options are available and instructions arefollowed.(Information g uide forthe applicationofchickenbiosecurity,2019).

Employ eetraining to ensur evehicle cleanliness would beessential,and thesite biosecurity plan should identify points to be checked to ensure effective hygiene and disinfection. Impure vehicles and equipment should not be allowed on site until effective cleaning and disinfection have been carried out. (Information guide for the application ofchickenbiosecurity,2019).

Figure 5: Cleaning and disinfection of poultry equipment and vehicles **(MANUAL OF OPERATIONAL PROCEDURES, FAO, 2018)**

4.2.4 Water and food hygiene

Feed should come from well-established, hygienic sources, and care should be taken to keepfeedin appropriate areas thatare safefrom rodents and parasites. Humidification of feedisnot recommended, as it can encourage the multiplication of harmful fungi in feed, leading todeath and reduced production in birds.Be sure to use dry food and dry hands when handling, and keep the mealat least on emetre abovethe ground(WHO,2006).

5 Checking entrances and circulation in the poultry plant

5.1 Instructions forvisitors

Some essential advice on how visitors should behaveon apoultry farm:

5.1.1 Restrictvisitor access

Veterinarians, service providers and representatives of regulatory bodies are the only visitors authorized to enter the Controlled Access Zone (CAZ) and the Restricted AccessZone (RAZ). Non-essential visitors, such as friends and family, are not permitted to entertheCAZorRAZ,unless they are essential toproduction-(CanadianFoodInspectionAgency,2024).

5.1.2 Regulations bconcerning essential visitors

It is essential that essential visitors wear appropriate protective clothing (clean over all sand boots, or those reserved for the ZAR). They must also clean their hands before entering the ZAR. The visitor must be accompanied by a farm employee in the BIA and the RDA, unless the visitor is already aware of and complies with the biosafety proceduresin force. A detailed farm register must be signed and completed by visitors (name, date,time, contact details,etc.) (CanadianFoodInspectionAgency,2024).

5.1.3 Poultry farm traffic

Strict traffic control is essential to ensure biosecurity and prevent the spread of disease. It is also essentialt okeepall vehicles,equipment and materials not required fortheoperation outside this zone. Vehicles and equipment used for poultry operations must becleaned and disinfected on entering the farm, to avoid any presence of organic matter or pathogens. The building's axis should be oriented East-West to limit the influence ofsunlightandstrongwinds.Keepingaregisterofvisitorsisalsoessential to nsure traceabili ty inthe even t of disease.(FAO,2024).

6 Poultry farm hygien emanagement

6.1 Food and water management

- Feed and water are indispensable elements in intensive breeding. However, the quality of both must be maintained through out there aringprocess.
- Water is of paramount importance.

In deed,it is used for various activities during rearing (cleaning, disinfection, watering, vaccination and use of medicines)-(FAO,2017).

- Surface water bodies (reservoirs, ponds, lakes and streams), groundwater and rain water harvesting systems are all sources of water like lytobe contaminated bypathogens.
- Various measures are used to reduce or eliminate pathogens: purification, disinfection and sanitation of water systems. Water quality must be regularly monitored (see Table 01).Water troughs must be kept clean(BoukerrouandDib.2020).

Tables 1: *Microbiological and physicochemical standards for different types of water* ***(Hubbard, 2017).***

	Unit	Very purewater	Drinking water	Suspectwater	Badwater
Totalgerms	Number /ml	0à10	10à100	1000à10000	100000
Salmonella	Number /ml	0	0	>0	>0
E. Coli	Number /ml	0	0	10à50	100
Hydrometricdegree		5à15°	15à30°	30°	30°
MatièreOrganique	Mg /liter	0	1	3	4.6
Nitrates	Mg /liter	0	0à15	15à30	30
Ammonia	Mg /liter	0	0	2	10
Turbidity			5units		25units
Iron	Mg /liter		0.3		1
Manganese	Mg /liter		0.1		0.5
Copper	Mg /liter		1		1.5
Zinc	Mg /		5		15

	liter		
Calcium	Mg /liter	75	200
Magnesium	Mg /liter	50	150
Sulfates	Mg /liter	200	400
Chlorides	Mg /liter	200	600
PH		77à8.5	6.5à9.2

6.2 Litter control

Bedding is a key element in ensuring animal warmth. Humidity and disease control (ITAVI etal. 2012).Thus, litter quality is partially influenced by the type of substrate used (shavings, sawdust from). It is possible to use wood, straw, chopped paper or used and treated litter, as wellas breeding techniques. However, it is import an tto consider the following criteria:

- Choice of substrate.
- It is vital to keep the litter dry and crumbly; it should never be wet. The presence of dust, urban concentration or humidity(OIE,2019).

6.3 Managemen to fsick and dead animals

Rapid isolation of sick animals from the rest of the herd is essential to prevent the spread of the disease. It is essential to monitor them closely and provide them with the care they need to encourage their recovery. The infirmary must be disinfected regularly to avoid contamination. Corpses must be carefully disposed of, by incineration or burial, to protect them from wildlife and other animals. Burial should be carried out in a specially prepared trench, without grouping the bodiestog ether to encourage emicro bial activity. The application of limet ob odi esisnotre commended, asit can cause hazards during collection by rendering-(Herman,2014).

CHAPTER II

EVALUATION OFBIOSECURITYMETHODSA NDTHEIRIMPORTANCE

1 Preamble

The importance of biosecurity on today's poultry farms is paramount in preventing the introduction and spread of diseases such as avian influenza. The use of single-band or "all-in all-out" systems is recommended for all contemporary poultry farms, regardless of size,to improve biosecurity. The key role of biosecurity in contemporary poultry operations lies in its essential role in preventing the introduction or spread of diseases in livestock.(FAO,2024).

2 Global objectives

The FAO stresses the need to ensure biosecurity in poultry markets to prevent the spreadof zoonoses, emphasizing the importance of strict compliance with biosecurity standards by all suppliers and traders. The guide stresses the importance of cleaning,disinfectin gand certifying vehicles and cages dedicated to transporting poultry to and from markets inordert ominimize the risk of spreading diseases-(FAO,2024).

In Algeria, biosecurity measures in poultry farming are hampered by a lack of awareness, training and enforcement of standards among farmers, which can pose health hazards, and the absence of a national biosecurity guide. Tailor-made biosecurity guides, seminars to raise farmers'awaren essand on going training to improve biosecurity practices aread vocated-(FAO,2024).

3 Improving biosafety in the live stock sector

Itisessentialtounderstandthefactorsthatinfluencedecision-makingabouthealthbehaviors in order to find ways to improve their monitoring (Kok et al. 2016)-In the field of veterinary medicine, research aimed at understanding the decision-making processes of livestock farmers usually ends with suggestions for future strategies (Ritter et al. 2017).However, these action plans are rarely carried out and scientifically supervised to evaluate their effectiveness (O'Kane etal.2017).

3.1 Drawing up an action plan

3.1.1 Hazard assessment

- Examine potential risks such as natural disasters, bird diseases, power failures, etc.
- Assess the company'svuln erability,taking in to consideration its geographical location, equipment,etc.(Rerambyath,2018).

3.1.2 Crisis management

Once a risk or disease has been identified, implement the plan. Check that poultry are confined, that buildings a reprotected and that electricity is cut off if necessary, by observing reinforced biosafety measures (disinfection, restricted access,etc.).

Reward and crisis recovery

- Offer breed ersremun eration for animals slaughtered and economic losses.

- Encourage the implementation of a monitoring system for breeders and cooperatives to monitor the situation.

- Develop the criteria and time frames required to returnt on ormality(Imadalou,2023).

3.2 Assessmen to fbiosafety implementation

Biosafety is the study and management of risks affecting the life and health of animal sand plants,as well as environment talrisks.

The ministerial order of February 8, 2016 in Algeria There have always been biosecurity measure sin poultry farming, but they werestrictlyframedin2016afterthehighlypathogenic avian influenza episode of 2015-2016. According to the ministerial decree of February 8, 2016, biosecurity measures are established as mandatory for all holders ofbirds on poultry farms and other captive birds as part of the prevention against avian influenza (DGAL,2016).

3.3 Creation of a biosafety system

The best way to design an effective biosafety program is to analyze the risks and control the critical or essential point susing the HACCP method. The HACCP approach consists of analyzing hazards and critical control points. On the one hand,this appro achwillseektoidentifyandassesstherisksofhazardsassociatedwiththedesign,construction,installa tion and layout of poultry production buildings, and on the other, to establish the measuresan drul esrequired to control these "hazards"(Maamri,2021).

The general approach to planning an on-farm biosecurity plan involves system atically identifying the elements that can lead to disease outbreaks, and controlling them by installing physical barriers or modifying methods(Maamri,2021).

A protocol will have to be developed to reduce them to a reasonable level. It is impossible to completely eliminate certain risks; the only way to control them is to

develop appropriate protocols. Since every farm is different, it may be necessary to make exceptions to the general recommendations to avoid insurmountable obstacles. Once the biosecurity plan has been drawn up,it must be implemented in accordance with the principle ofnon-derogation(Maamri,2021).

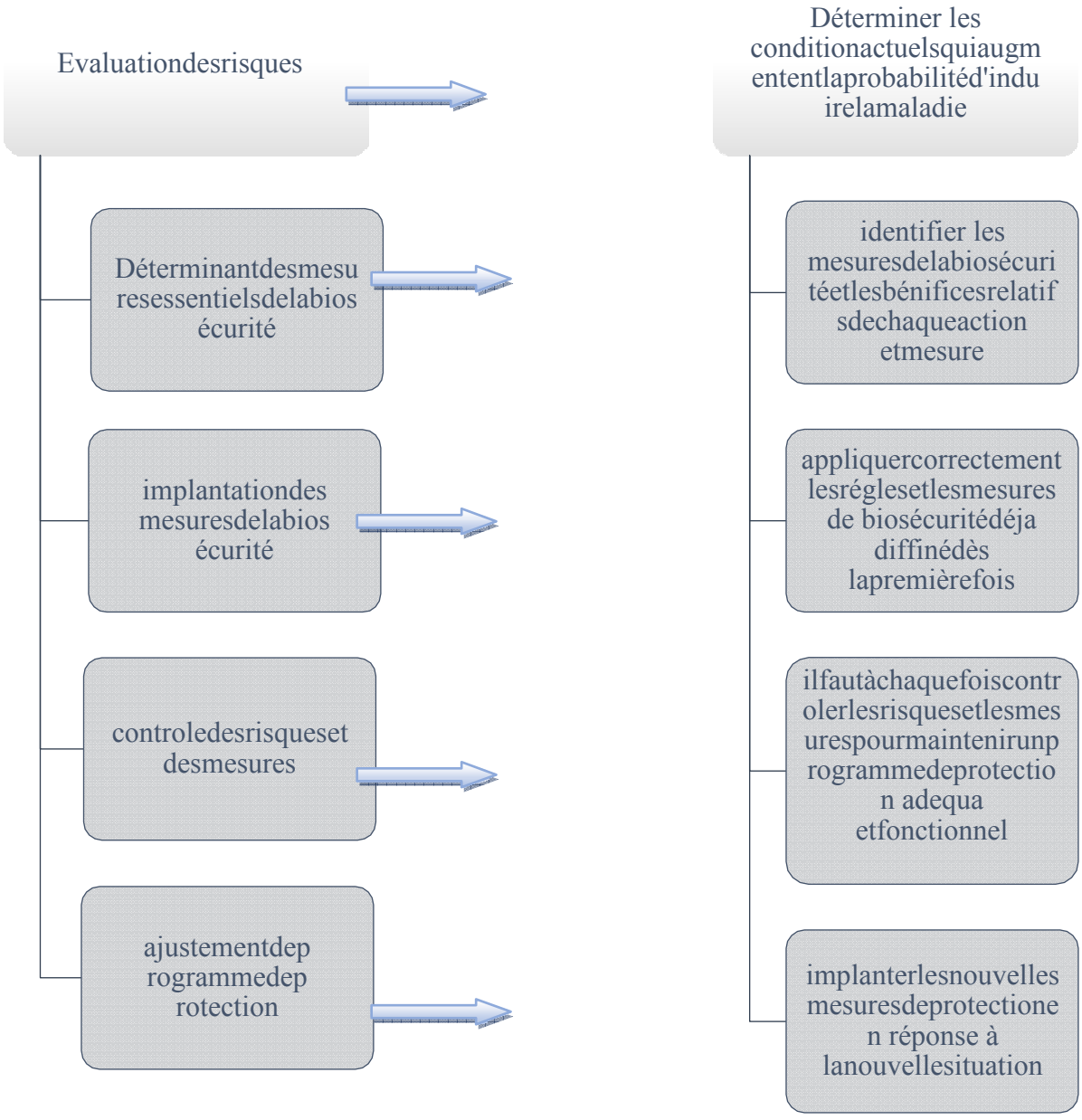

Figure 6: *Diagram showing the various steps involved in implementing a sound biosafety program* ***(Vaillancourt, 2002).***

3.4 Monitoring biosecurity on the farm

In reality,it's not clear whether biosecurity measures are indeed beingre spected on poultry farms. Ideally, there shouldbe a directand continuous means of visualizing practices. In part, the installation of cameras meets these criteria. For poultry farming in Canada,aspart of aseriesof studies on the application of biosecurity, surveillance cameras werein stalle dinthe

careroom so fbuildings(Racicotet al.2011).

3.4.1 Facilitating the implementation of measures

- Simplify the day-to-dayimplementation of biosafety procedures by simplifying them (Biosafety: backtobasics/search for henhouses with layingstock).
- Of ferm or efeedbackandfollow-up to farm erson the application of measures,like "safety officers"whoevaluate practices (biosecurity backtobasics).

3.4.2 Ensuring support for breeders

- Raise farmers' awareness of the need for and effectiveness of biosecurity measures, as35%arenotconvinced.
- Offe rbreed erspersonalize dtraining and support to help the mimplement the measures a ppropriately.
- Incorporateotherplayerssuchasveterinariansandauthoritiestocontributetheirexpertiseandlistentothedifficultiesfaced bybreeders((Racicotetal.2011).

4 The importance of biosafety

Biosecurity play sacrucia l rolein reducing financial losses due to epidemics, highmortalityrates,reduced production, poorfeed uptake and treatmentcosts.

4.1 Health importance

Biosecurity plays an essential role in two areas: the health of farm animals and the safety of food products of animal origin. According to the Agencenationale de sécurité sanitairede l'alimentation, de l'environnement et du travail (ANSES, 2022), biosecurity actions aimto reduce the risk of pathogens spreading between animals. This helps to preserve animalhealth and prevent the emergence of animal diseases likely to have an impact on publichealth(ANSES,2022).

4.2 Theimportance of biosecurity infood safety

Biosecurity isessential for ensuring food safety atvarious levels:

4.2.1 Protecting the health of animals and plants

Biosecurity plays a crucial role in food safety by protecting animals and plants fromharmful pathogens such as viruses, bacteria and parasites, ensuring the health of farm animal sand the sanitary quality of plants use dinfood(Dikamar,2023).

4.2.2 Food safety

The importance of biosecurity in food safety lies in preserving food quality throughout

the food chain,from initial production toprocessing. Processing plant smustimplementrig orousbiosaf et yprotocol s to ensures afety when receiving, storing and handlingingredients(Dikamar,2023).

4.2.3 Economic importance

Biosecurity is essential for preventing and managing animal and plant diseases, leading to higher productivity and lower production costs.According to studies ,pigfarms that implementmore effective biosecurity practices have improved technical performance,such a s ahigherfeed conversionratio and optimal piglet survivalrate(Snider,2021).

EXPERIMENTAL PART

The main objective of our study is to assess the biosecurity practices implemented on local poultry farm sin the wilaya of Bouira.

As a result, a number of important questions were asked: Do poultry farmers comply with recommended biosecurity measures? Are poultry farmers aware of the importance of applying biosecurity measures on their farms? What are the reasons for farmers' lack of awareness of thes emeasures?

To answer these questions, we drew up a questionnaire for a field survey of poultry farms in the wilaya of Bouira.

Chapiter III

Materiel and methods

1 Study area

The wilaya of Bouira is located southeast of Algiers. It covers an area of 4454 km2 and has apopulation of 742,855. It is bordered by Boumerdes and Tizi-Ouzou to the north, M'sila andMédia to the south, Bejaia an d Bordj Bou Arreridj to the eastand Blida and Médéa to thewest. We conducted our survey using a questionnaire applied to a number of regions in thewilaya of Bouira, namely Haizer, Taghzout, Chorfa, Ain Bessam, El Hachimiya and Sour ElGhozlane.

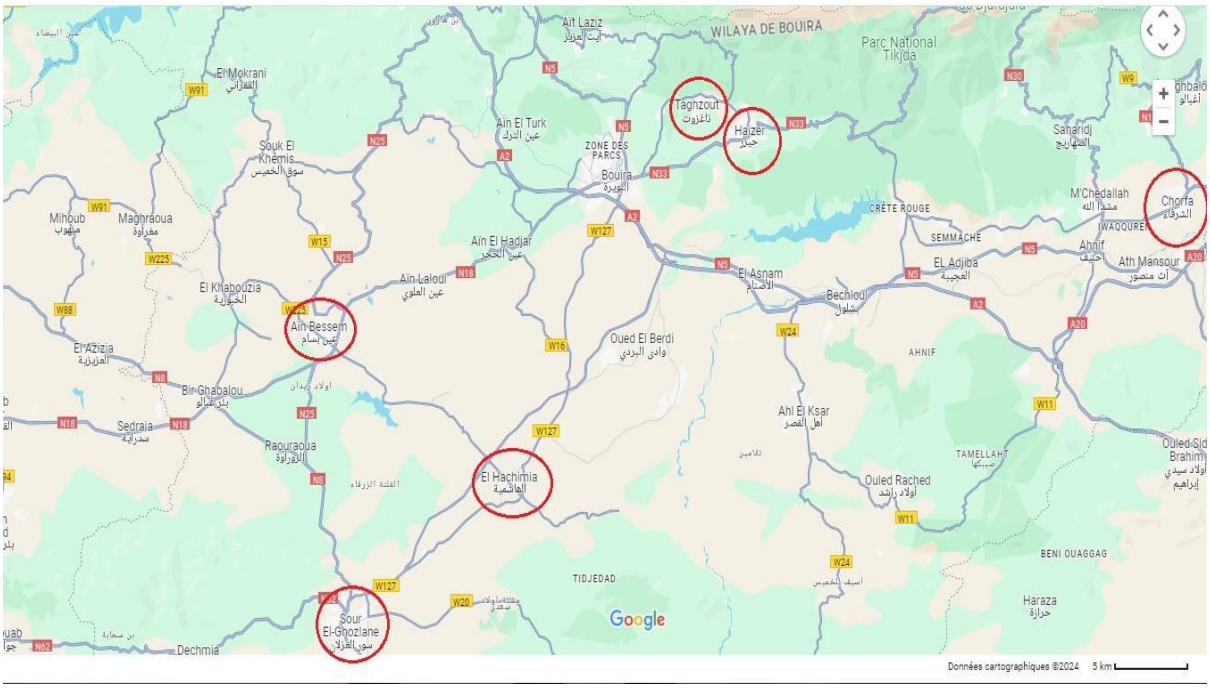

Figure 7: *Geographical map of the wilaya of Bouira with the location of the study area* ***(Google Maps, 2024).***

1.1 Questionnaire

Our questionnaire was drawn up according to the Biocheck grid from the University of Gent(Belgium).Biocheckisascoringsystemthatevaluatesbiosafety.Itcomprises79dichotomous or trichotomous questions, divided into different sub-categories for external andinternalbiosafety.Eachsectioncomprisesbetween2and 19questions.

A score ranging from zero (if the measure is not implemented at all) to one (if the measure is fully implemented) is awarded fo rea chquestion.

The score per question is multiplied by a weighting factor according to the importance of aspecific biosafety measure. The final level of internal and external biosecurity can vary from zero, meaning that there are no biosecurity measures described fully implemented; to 100,meaning that there is full implementation of the measures described. The questionnaire is available on the followingwebsite:http:
//www.biocheck.UGent.be(SeeAppendixN°01)

Questionnaire survey:

Our methodology was based on a preliminary survey of poultry farms in the wilaya of Bouira,visiting the wilaya agricultural directorate on several occasions. The aim of these visits was to get an ideao f the farms (address,contacts,etc.)and to obtainau thorization tovisitthem.

Secondly, we also visited the subdivisions of the communes listed below to obtain contacts and access to the farms.

During our visit to the farms, and before completing the questionnaire, we examined the hygiene, ventilation,lighting, drinking troughs, feed ersand heatingsystems in the barns.

Wefilled in the questionnaires ourselves,based on the breeders'responses.

2 Results and discussion

2.1 Breeding and caracteristics

2.1.1 Years of experience

Theaverageyearsofexperienceofthefarmownerssurveyedis13.92±9.20years,and over50%ofownershavemorethan10years'experience(figure08).Thisindicatesthatthe majority of farm owner sin the wilaya have good experience in this sector.

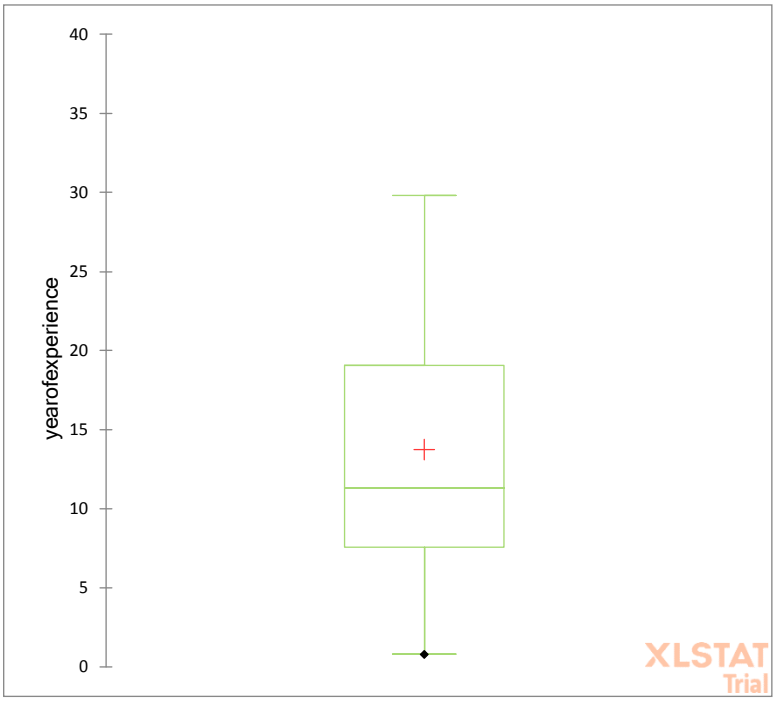

Figure 8: *Boitte in moustache of years of experience of surveyed farm owners*

2.1.2 Employees

The number of people working on the farms surveyed was 6.79±9.35 persons + per farm,and 50% of farms had only 3 workers (figure 09). This can be explained by the use of advance dmachinery to manage farms with a small workf orce,in order to increase profitability.

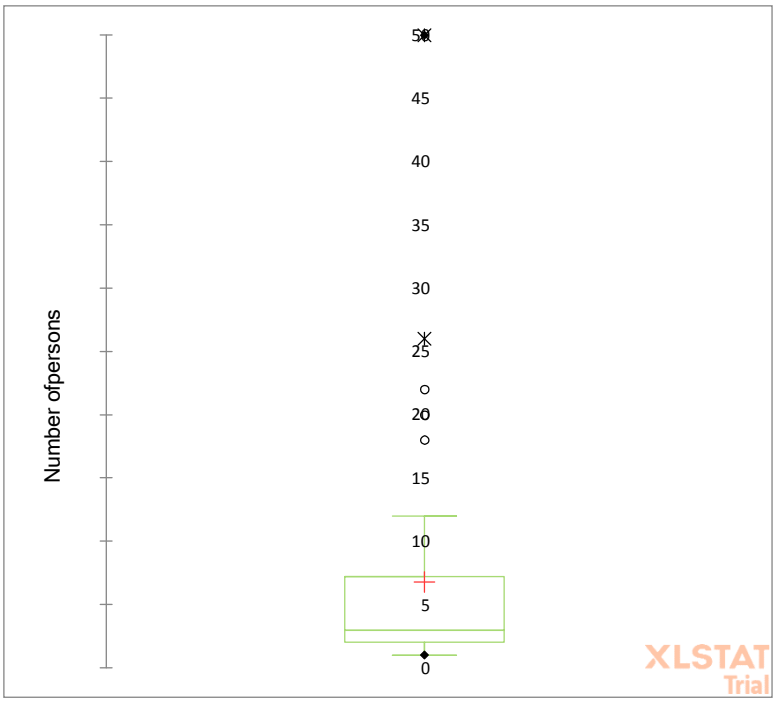

Figure 9: *Number of employees on surveyed farms*

2.2 Other farm characteristics

Tables 2: *Frequencies and confidence intervals (95%) of farm management parameters for the farms studied.*

Variable	Categories	Number	Frequency	Confidenceinterval(95%)	
Chickprovenance	Several suppliers	26	66.66	51.87	81.46
	asinglesupplier	13	33.33	18.53	48.13
Aretheday-oldchickspurchased delivered to yourfarm first, i.e. before other farms are deliver edusingt hesametransportvehicle?	Always	19	48.72	33.03	64.41
	Never	1	2.56	0.00	7.53
	Sometimes	19	48.72	33.03	64.41
Are transport vehicle scleaned and disinfected beforeloadingday-old chicks?	No	17	43.59	28.03	59.15
	Yes	20	51.28	35.60	66.97
How many times a year areday-old chicks delivered toyourfarm?	Less than3 timesayear	10	25.64	11.94	39.35
	Between3and 6timesaday	20	51.28	35.60	66.97
	Morethan6 timesa	8	20.51	7.84	33.19
Is thepoultry transport vehicle empty on arrival atthefarm?	Always	11	28.21	14.08	42.33
	Never	4	10.26	0.74	19.78
	Sometimes	24	61.54	46.27	76.81
Isthepoultrytransportvehicle always cleaned anddisinfectedonarrivalatthe farm?	No	17	43.59	28.03	59.15
	Yes	22	56.41	40.85	71.97
Do the driver and catchingcrew receive and wear farm-specificordisposableclothing/shoes duringpoultryloading?	Never	11	28.21	14.08	42.33
	Always	10	25.64	11.94	39.35
	Sometimes	17	43.59	28.03	59.15
Are private individuals and retailers authorized to enterpoultry houses, where directcontactwithpoultryis possible?	Always	9	23.08	9.85	36.30
	Never	11	28.21	14.08	42.33
	Sometimes	19	48.72	33.03	64.41
Howmanystepsareinvolvedinde populatingahenhouse?	Inasinglestep	12	30.77	16.28	45.25
	Intwosteps	13	33.33	18.54	48.13
	In addition totwosteps	12	30.77	16.28	45.25
Is the breeding site dividedinto a clean and a dirtyzone?	No	13	33.33	18.54	48.13
	YES	11	28.21	14.08	42.33
	Not known	1	2.56	0.00	7.53
Is there a clear separationbetween clean and dirtyareasofthebreeding premises?	No	12	30.77	16.28	45.25
	Yes	24	61.54	46.27	76.81

Table 02 gives an overall assessment of the characteristics of the farms surveyed with regard to methods and conditions of chick transport and management; the majority of farmers receive their chicks from several suppliers between 3 and 6 times a year. Transport vehicles are often cleaned and disinfected before loading, but a significant percentage of farms suggest that this is not systematic.

When they arrive, the vehicles may be empty and often cleaned and disinfected, but in all cases, traders are not allowed to enter the poultry houses. In some cases, poultry houses are depopulated in one or twostages.

As far as site layout is concerned, 1/3 of farms do not distinguish between clean and dirty areas, while around 31% have no clear separation between these areas in the breeding premises.

Thismeansthatdiverseandoftencomplexmethodsareusedtomanageandtransportchicksonpoultryfarms,withthe aim of improving the health and productivity of poultry farms.

By introducing a standardized protocol and regular training,I twouldbepossibletoreducetheriskofcontaminationandhealthhazards,whileimproving over all farming conditions.

2.3 Power supply characteristics

Tables 3: *Frequencies and confidence intervals (95%) of feed management parameters on the farms studied.*

Variable	Categories	Number	Frequency	Confidenceinterval(95%)	
Does the feed supplier haveaccess to hen houses wheredirectcontact withpoultry is possible?	Sometimes	9.000	23.077	9.854	36.300
	Always	7.000	17.949	5.905	29.993
	never	22.000	56.410	40.847	71.973
Are feed silos or storagerooms completelyimpermeabletowater,birdsand pests?	No	14.000	35.897	20.842	50.953
	Yes	22.000	56.410	40.847	71.973
How manytimesayeardoesthe feed company fill silos ordeliverfeed?	A	17.000	43.590	28.027	59.153
	B	15.000	38.462	23.193	53.730
	C	6.000	15.385	4.061	26.708
	C	1.000	2.564	0.000	7.525
Howoftenarebacteriologicalanalyses carried out ondrinkingwater?	Never	1.000	2.564	0.000	7.525
	A	14.000	35.897	20.842	50.953
	C	2.000	5.128	0.000	12.051

AccordingtoTable03,the survey reveals different and sometimes in adequate biosecurity andfeed management practices on poultry farms. The study of various variables highlights majorstren gths and weakness estha trequire improvement to enhance h ealth safety andproductivity.

Most farms (56.41%) prohibit feed suppliers from entering poultry houses, thus reducing theriskofdirectcontamination.Nevertheless,around41%sometimesoralwaysofferthisaccess,repr esenting a potential risk of pathogen spread. Just over half of farms (56.41%) have fully imp ermeable feed silos or storage rooms, promoting effective protection of feed from water,birds and pests. However, at this level, 35.90% of farms report shortcomings, increasing the ris k of food contamination. Most farms benefit from frequent or average deliveries from the feed company,which canguaranteeregular,freshfeed.However,17.95%offarmshavealoworverylowfillingfrequency,w hichcouldhaveanimpactonfeedqualityand availability.

More than half off a rms(56.41%)never carry out bacterio logical analyses o f drinking water,which represents a significant health risk. Bacteriological analyses are carried out by around36% of farms, thus guaranteeing the quality of drinking water. The frequency of analysis onther emaining farms islow orvery low,which could jeo pardize poultry health.

The results underline the importance of harmonizing and consolidating biosecurity and feed management practices on poultry farms. The main recommendations are to restrict suppliers' access to poultry houses to reduce the risk of contamination, improve the impermeability of silo stopres ervefeed quality,optimize the frequency of silo fillin g toguarantee feed quality,and carry out regular bacteriological analyses of water to ensure its safety. By implementing these actions, poultry farms will be able to reinforce their biosecurity practices, improve poultry health and increase yields.

2.4 Corps emanagement

Tables 4: *Frequencies and confidence intervals (95%) of carcass management parameters on the farms studied*

Variable	Categories	Number	Frequency	Confidenceinterval(95%)	
Ismanuredisposedofviathedirtyareaofthefarm?	No	13.000	33.333	18.539	48.128
	Yes	25.000	64.103	49.047	79.158
Isthereaseparatesite forstoringcadavers?	No	19.000	48.718	33.031	64.405
	Yes	18.000	46.154	30.508	61.800
Can carcasses be collected bythe rendering company fromthepublichighway/outside thefarm?	No	16.000	61.538	42.838	80.239
	Yes	10.000	38.462	19.761	57.162
Is the cadaver storage siteenclosedtopreventaccessbydogs, cats, rodents or wildanimals?	No	19.000	51.351	35.246	67.456
	Yes	17.000	45.946	29.888	62.004
Is the cadaver storage sitecleanedanddisinfectedafter eachcollection?	Sometimes	18.000	46.154	30.508	61.800
	Always	20.000	51.282	35.595	66.969
Isthecadaverstoragearearefrigerated?	No	26.000	66.667	51.872	81.461
	Yes	12.000	30.769	16.284	45.254
Doesthebreederwearsingle-usegloves when handlingcadavers, or wash anddisinfect his hands afterhandlingcadavers?	Sometimes	8.000	20.513	7.840	33.186
	Always	13.000	33.333	18.539	48.128
	never	15.000	38.462	23.193	53.730

AccordingtoTable04,theresultsofthisstudyrevealawidediversityofwasteandcarcassmanagement methods on poultry farms, with significant consequences for biosecurity and farmhealth.

Most farms (64.10%) remove manure/muck via the dirty area of the farm, which is a good practice for preventingcontaminationofcleanareas.Ontheother hand,33.33%offarmsdonot follow this practice, which can increase the risk of pathogens spreading. Around half offarms (48.72%) have no cadaver storage facilities, which can lead to biosecurity problems.Separate storageis essential to preventcross-contaminationandaccessbypests.

Most farms (61.54%) prohibit the rendering company from collecting carcasses from the public highway or outside the farm, which is a good practice for reducing the risk of external contamination. However, 38.46% of poultry farms allow this, which can pose biosecurity problems.Worryingly,half

ofallfarms(51.35%)donothaveaclosedcarcassstorageareatopreventaccessbypests.

Adequate protection is crucial to avoid infestation and the spread of disease. It is positive that51.28% of farms continue to follow the practice of cleaning and disinfecting the carcassstoragesiteaftereachcollection.However,46.15%dosoonly occasionally, as this can lead to health hazards. Most farms (66.67%) do not have refrigerated cadaver storage, which can lead to rapid cadaver decomposition and the spread of pathogens. Refrigeration is a method that could considerably improve cadaver management.

Hygienepracticeswhenhandlingcarcassesalsovary.Theproportionoffarmerswho never wear gloves or wash their hands after handling is a worrying 38.46%. Only 33.33% do so system atically,a crucial practice to preventthe spread of disease.

This means that it is essential to improve and standardize waste and carcass managementmethodsonpoultryfarms.Itisessentialtoreinforcebiosecuritymeasurestoreducehealthhazards.

2.5 Visitor management

Tables 5: *Frequencies and confidence intervals (95%) of visitor management parameters on the farms studied.*

Variable	Categories	Number	Frequency	Confidence interval(95%)	
Arevisitorsrequiredto notify you of theirpresencebeforeentering the poultryhouses (e.g. visitors'register)?	Yes	22.000	56.410	40.847	71.973
	Always	2.000	5.128	0.000	12.051
	No	13.000	33.333	18.539	48.128
Do all farm workers(includingthefarm owner) respect accessrules?	Always	15.000	38.462	23.193	53.730
	Never	10.000	25.641	11.937	39.345
	Sometimes	13.000	33.333	18.539	48.128
Is there a period > 12hours without contactwith poultry imposedon visitors before theycan enter thebuildings?	No	21.000	53.846	38.200	69.492
	Yes	17.000	43.590	28.027	59.153
Arevisitorsandfarmworkers required towear farm-specificclothing before beingallowed into poultryhouses?	No	15.000	38.462	23.193	53.730
	Yes	23.000	58.974	43.537	74.412

Do visitors and farmworkers have to wearfarm-specificfootwearbeforeb eingallowed into thepoultryhouses?	No	17.000	43.590	28.027	59.153
	Yes	21.000	53.846	38.200	69.492
Do I have to washand disinfect myhands before enteringthehenhouse?	No	23.000	58.974	43.537	74.412
	Yes	15.000	38.462	23.193	53.730
How many times ayear are visitorsgranted access to thehen houses?	Accessisnevergranted	18.000	46.154	30.508	61.800
	Accessis granted,butless than 12timesayear	16.000	41.026	25.588	56.463
	Access isgrantedmore than12timesbya	5.000	12.821	2.328	23.313
Do any farm workersalso raise poultry orother bird species athome?	NO	1.000	2.564	0.000	7.525
	No	28.000	71.795	57.672	85.918
Aretherefarmworkers who alsoworkonotherpoultry farms?	No	29.000	74.359	60.655	88.063
	Yes	9.000	23.077	9.854	36.300
Doesanyequipmentshare d with otherfarms enter thepoultry houses orcome into contactwithyourpoultry ?	No	30.000	76.923	63.700	90.146
	Yes	8.000	20.513	7.840	33.186
Arespecificmeasurestak en for theintroduction ofequipment (e.g.UVdisinfection unit,alcohol disinfection)?	No	22.000	56.410	40.847	71.973
	Yes	15.000	38.462	23.193	53.730

AccordingtoTable05, the survey reveal sawide diversity of biosecurity practices relating to visitors and farm workers on poultry farms. It is essential to adopt these practices to prevent the spread of disease and ensure the health of poultry.

Notification of visitors' presence before entering poultry houses is requested by most farms,but only 5.13% request it systematically. Farms are exposed to increased risks of external contamination, as a third of farms do not request notifications. Access rules are always respected by around 38.46% of farm workers, while 25.64% never respect them, which is a concern for biosecurity,It is essential for farms to strength enemploye edisciplin e

and training to ensure strict compliance with the rules.

More than half of farmsdonotrequirevisitorstospendmorethan12hourswithoutcontactwith poultry before entering the buildings. Taking this step is crucial to reducing the risk of spreading disease, and most farms ask visitors and workers to wear clean clothes and shoes before entering poultry houses, but a number don't, which can increase the risk of contamination.

In another study conducted in Algeria, it was shown that poultry farmers do not comply with all then necessary biosafety measures,particularly wither gard to health preventionand control of the movemen to fin dividuals(MAAMRI,2021).

A large number of farms (58.97%) do not require visitors and workers to wash and disinfect their hands before entering the poultry houses, a serious shortcoming in biosecurity practices.Around half of farms never allow visitors entry, which is good biosecurity practice.However, a large proportion do allow access, albeit less than 12 times a year, which requiresrigorous controls. Most employees do not raise poultry at home or work on other farms, whichis good forbio security.However, asmal lpro portiondo, which is apotentialrisk.The majority of farms do not share equipment with other farms, which reduces the risk of contamination. But aminority do,which requires trictdisinfection measures.

A study carried out in the wilaya of Blida reported that not all breeders comply with biosecurity measures, in particular health prevention and the management of flows andpeople, which canrepresent major risk factors.This is dueto alack of awarenessonthepartof breeders due to a lack of awareness and training, as well as the absence of a national biosafetyguide(BAHRIandZOUZOU,2019)

Some56.41% offarms do not implements pecific disinfection measures for the introduction of materials, which can cause difficulties. Disinfection measures are crucial to prevent the introductionofpathogens.

This means that,The results of this study highlight the importance of improving biosecurity measures on poultry farms. More rigorous and uniform protocols are needed to ensure the health of poultry.

2.6 Wild animal control

tables 6: *Frequencies and confidence intervals (95%) of wild animal control parameters at the farm level studied*

Variable	Categories	Number	Frequency	Confidence interval(95%)	
Istherearodentcontrolplan?	Never	1.000	2.564	0.000	7.525
	No	18.000	46.154	30.508	61.800
	Yes	19.000	48.718	33.031	64.405
Dopets haveaccess tothehen houses (including thehygienelock)?	No	27.000	69.231	54.746	83.716
	Yes	11.000	28.205	14.082	42.328
Arethereotherlivestockonthesamesite?	No	28.000	71.795	57.672	85.918
	Yes	11.000	28.205	14.082	42.328
Is there standing orrunning water within a one-kilometre radius of thefarm?	No	25.000	64.103	49.047	79.158
	Yes	11.000	28.205	14.082	42.328
Howfaraway(asthecrowflies) is the nearest poultryfarm?	Lessthan500metres	2.000	5.128	0.000	12.051
	Between500metres and1kilometer	22.000	56.410	40.847	71.973
	Overonekilometer	12.000	30.769	16.284	45.254
Is manure from otherpoultryfarmsspreadonneighbouring farmland(within a 500-metreradius)?	Never	16.000	41.026	25.588	56.463
	Sometimes	1.000	2.564	0.000	7.525
	Often	2.000	5.128	0.000	12.051
Do vehicles carryinganimals from other farmsfrequently (atleastonceaday) passalong theroad	No	20.000	51.282	35.595	66.969
	Yes	18.000	46.154	30.508	61.800

nearthefarm(e.g.becauseof theproximityofaslaughterhouse,etc.)?				
Is there a vaccinationprotocolandisitstrictlyadheredto?	No	10.000	25.64111.937	39.345
	Yes	28.000	71.79557.672	85.918
Is the health status of thefarm(e.g.serology,reasonsfor seizure at the abattoir,etc.) assessed regularly (i.e.atleastonceayear)?	No	24.000	61.53846.270	76.807
	Yes	14.000	35.89720.842	50.953
How often are dead birdsremoved from thehenhouse?	Daily	18.000	46.15430.508	61.800
	Everyotherday	8.000	20.5137.840	33.186
	Less than once everytwodays	10.000	25.64111.937	39.345

AccordingtoTable06,the informationhighlightsawidediversityofbiosecurityandmanagementpracticesonpoultryfarms.Thishighlightstheneed forrigorous, uniform protocolstoimprovehealthsafetyandresource management.

About half the farms have arodent controlprogram, which is positive,but almost asmanydonot. Rodent control is essential to biosecurity, as rodents can be vectors of disease, and mos tfarms prohibit pets from entering poultry houses, but around a third allow entry, which canincrease the risk of disease transmission. Most farms do not have other livestock on the samesite, which reduces the risk of cross-contamination between different animal species. Arounda third of farms are close to stagnant or running water, which can be a breeding ground fordisease,especially if contaminated.

Farms are generally at a reasonable distance from other poultry farms, which is advantageous for biosecurity. However, 5.13% of farms are very close together, which increases the risk ofdisease spread between farms.Most farms avoid spreading manure from other farms, which helps prevent disease. Most farms avoid spreading manure from other farms, which helps toprevent disease. However, a minority do so sometimes or frequently, which can create contamination hazards. A virtually equivalent percentage of farms are located close to roads frequented by vehicles transporting animals from other farms, which can increase the risk of disease transmission.

For disease prevention, most farms have a vaccination protocol. However, almost a quarter of farms do not have such a protocol, which can represent a danger to poultry health, and more

than half of farms do not carry out regular monitoring of the health status of their flocks,which can lead to gaps in early detection and disease management, and every day, half offarms clean up dead birds, which is a good biosecurity practice, but a significant proportion do notdo so as often,which can increase the risks of contamination and disease spread.

This implies that the results suggest a variety of biosecurity and management methods on poultryfarms. Toimprov e health safety.

2.7 Hygiene and cleaning of livestock buildings

Tables 7: *Frequencies and confidence intervals (95%) for hygiene and sanitation parameters*

Variable	Categories	Number	Frequency	Confidence interval(95%)	
Are there different agecategories of poultry onyourfarm?	No	25.000	64.103	49.047	79.158
	YES	1.000	2.564	0.000	7.525
Arethererotolocksatthe entrance to thefarm?	No	18.000	46.154	30.508	61.800
	Yes	17.000	43.590	28.027	59.153
Arerotolubersstillinuse?	No	20.000	51.282	35.595	66.969
	Yes	18.000	46.154	30.508	61.800
Arepoultryhousescleaned after eachproductioncycle?	Yes	38.000	97.436	92.475	100.000
	yes	1.000	2.564	0.000	7.525
Are poultry housesdisinfected after eachproductioncycle?	Yes	1.000	2.564	0.000	7.525
	Yes	38.000	97.436	92.475	100.000
Istheeffectivenessofcleaning anddisinfectionchecked, e.g.usingahygienogram, swabs,etc., after eachproductioncycle?	Never	9.000	23.077	9.854	36.300
	Always	12.000	30.769	16.284	45.254
	sometimes	16.000	41.026	25.588	56.463
Is the loading andunloading area cleanedand disinfected aftereachproductioncycle ?	No	20.000	51.282	35.595	66.969
	Yes	18.000	46.154	30.508	61.800
How long (in days) isthe sanitary vacuumperiod after eachproduction cycle?	Less than 3days	6.000	15.385	4.061	26.708
	Between3and 8days	8.000	20.513	7.840	33.186
	Morethan8 days	24.000	61.538	46.270	76.807
Is there a centralhygiene lock on thefarm?	No	27.000	69.231	54.746	83.716
	Yes	11.000	28.205	14.082	42.328

Is there a stricts eparation between theclean and dirty zonesof thecentralhygieneairlock?	Yes	15.000	62.500	43.131	81.869
	no	8.000	33.333	14.474	52.193
Is the reacheckroomwith farm-specific	No	7.000	33.333	13.171	53.495
clothing and footwearin the central hygienelocker?	Yes	14.000	66.667	46.505	86.829
Isthereahygienelockineve ryhenhouse?	No	32.000	82.051	70.007	94.095
	Yes	6.000	15.385	4.061	26.708
Is there a strictseparation between thecleananddirtyareasoft hehygienelockineachhenh ouse?	No	1.000	5.882	0.000	17.067
	Yes	16.000	94.118	82.933	100.000
Aretherefootbaths/boot washers inthe hygiene lock ofeachpoultryhouse?	No	4.000	23.529	3.365	43.693
	Yes	13.000	76.471	56.307	96.635
Is it possible to washand disinfect hands inthe hygiene lock ofeachpoultryhouse?	Never	1.000	5.882	0.000	17.067
	YES	15.000	88.235	72.920	100.000
	no	1.000	5.882	0.000	17.067
Istheliquidinthefootbath immediatelychangedwhen itis visibly contaminated?	No	21.000	53.846	38.200	69.492
	Yes	14.000	35.897	20.842	50.953
	Never	1.000	2.564	0.000	7.525
Is the drinking watersystem properlycleaned and disinfectedinsideand outaftereachproductioncy cle?	Always	11.000	28.205	14.082	42.328
	Never	5.000	12.821	2.328	23.313
	Sometimes	23.000	58.974	43.537	74.412
Are feed systemsproperly cleaned anddisinfected inside andout after eachproduction cycle?	Never	2.000	5.128	0.000	12.051
	Always	11.000	28.205	14.082	42.328
	Sometimes	24.000	61.538	46.270	76.807
Are feed silos cleanedanddisinfectedinsi de?	Never	2.000	5.128	0.000	12.051
	Yes	3.000	7.692	0.000	16.055
	sometimes	24.000	61.538	46.270	76.807
Is there a protocol forcleaning anddisinfecting	NO	13.000	33.333	18.539	48.128
	Always	1.000	2.564	0.000	7.525

equipmentafter each productionrun,andisthisprotocolalwaysfollowed?	Yes	23.000	58.974	43.537	74.412
Arethereseveralhenhousesson thefarm?	No	26.000	66.667	51.872	81.461
	Yes	11.000	28.205	14.082	42.328
Is there clearlyrecognizable anddistinctequipmentforeachhenhouse?	No	19.000	48.718	33.031	64.405
	Yes	16.000	41.026	25.588	56.463
Do you have specificclothingandbootsforpoultryhouses?	No	19.000	48.718	33.03164.405	
	Yes	19.000	48.718	33.03164.405	

AccordingtoTable07,theresultsobtainedconcerninghygieneandmanagementmethodsin poultry farming show that (64.103%) of respondents have no poultry age varieties on theirfarm, which may suggest a simplification of farm management, but could also indicate less genetic diversity or a more homogeneous management strategy. The results show an almosteven split between those using (43.590%) and those not using (46.154%) self-tests. This measure may help to reduce the spread of pathogens between entrance areas and poultryhouses.

A large majority(97.436%)of participants cleanand disinfect their poultry house s afte reach production cycle, which is essential for maintaining a healthy environment and reducing health hazards for poultry. High compliance with this practice is beneficial for animal health nand welfare. Clearly, the results reveal a fairly even split between those who always(30.769%)orsometimes(41.02%)monitortheeffectivenessofcleaning and disinfection.

Regular monitoring is essential to ensure that protocol sare effective. However,thein activecontrolrate(23.077%)suggests that there is a future in hygien emonitoring.

Most (61.538%) observe a sanitary vacuum of more than 8 days after each production cycle.This practice is essential to reduce the presence of microbes in the environment, and demonstrates good practice in preserving poultry health. Most farms (69.231%) do not have acentral hygiene airlock, which is probably due to constraints in terms of central hygiene infrastructure,and could jeopardize biosecurity and sanitary risk management.

The majority (76.471%) of poultry house hygiene systems are equipped with foot baths/boot washers, which is an effective practice for reducing the introduction of pathogens into establishments.However,the factthatthereare23.529%(SAS)without tthiscontrolmeasuresuggests room for improvement. Most (61.538%) occasionally clean and disinfect feed systems, although thisi safrequent practice.

However, more regular cleaning and disinfection could be recommended to reduce health risks, and most farms (58.974%) have a protocol for cleaning and disinfecting equipment aftereach production cycle, which is essential to prevent the spread of disease. On the other hand,the fact that 33.333% of farms have no protocol indicates the need to standardize hygiene practices.

In analyzing the results of our survey in relation to a study carried out on broiler chickens in the NouvelleAquitaineregion, on biosecurity at the time of collection, it wasemphasizedthatthe responsibility for complying with biosecurity lies with the farmer himself, and that hemustprovidehimwiththenecessaryresourcestoapplyit.Asaresult,biosecurityisnotreallyimplementede,(SophiePlanchand,2022)

In general, the results suggest good hygiene practices in poultry farming, such as regular cleaning of poultry houses, the implementation of a sanitary vacuum and the use of control measures such as sampling. There are, however, areas where improvements could been visaged, such as the implementation of centralize dhygieneSAS, regularmonitoringoftheeffectivenessofhygieneprotocolsandregularcleaningoffeedingsystems.

It'spossiblethat thes echanges will furth erenhance biosecurity and overall poultry health on the farm.

General Conclusion

Biosafety can be defined as a set of factions aimed at preventing the introduction the introduction of pathogens and prevent their spread. With this in mind, a study was launched to evaluate certain biosecurity practices on selected poultry farms in the wilaya of Bouira, where it was found that 89% of the farmers surveyed did not comply with biosecurity measures and practices; 58% of farmers complied with the sanitary vacuum, but not with its recommended duration; 75% of farmers complied with cleaning and disinfection protocols, but only 25% of farmers complied with other biosecurity parameters, such as vaccination.

From the results obtained, it is clear that most farmers do not comply with all the biosafety measures required on a poultry farm. In particular, the separation of dirty and clean areas, hygiene SAS and the wearing of farm-specific clothing and boots, and especially hand-washing, can be major risk factors and hazards for poultry.

Recommendations:

In order to improve biosecurity practices on poultry farms in Algeria, it is recommended to:

- Implement rigorous, regularly documented protocols.
- Check that cleaning and disinfection of facilities, including poultry houses and entr anceareas, are carried out regularly after each production cycle.
- It is recommended to maintain the regularuse ofself-testsatthe entrance to restrict the introduction of pathogens.
- Regular lymonitor the effectiveness of these procedures using hygienograms or swabs to identify and resolve any problems quickly.
- Consider installing a central hygiene lock with a strict separation between clean and dirty areas, aswell as specific bchanging rooms with clothesand shoes adaptedto thestaff.
- Implement hygiene systems in every poultry house, such as foot baths for washing boots and hand-washing facilities.
- Replace foot bath flui dimmediately in the event of contamination.
- Clean and disinfect drinking water, feed systems and silos after each production cycle.
- Maintain appropriate sanitary rest periods between cycles to reduce disease pressure. Ensure regularst afftraining and constant monitoring of biosafety practices.

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APPENDICES N°01:

Biosecurityassessmentchecklistforpoultryfarms

Propertyname:.....

Propertyaddress:.....

Biosafetycheckdate:.....

.**Breeding characteristics**

I. How many years' experience does the farm manager have in managing a poultryfarm?
.....
II. How manypeopleworkonthepoultryfarm?
.....
III. Howold(inyears)istheoldestbuildinginwhichpoultryiskept?
.....
IV. Howold(inyears)isthemostrecentbuildinginwhichpoultryiskept?
.....

A. Purch aseofday-oldchicks

1. Dotheday-old chickscomefromasinglesupplierorfromseveralsuppliersoverthelasttwoyears?
   - ○ Afixedsupplier
   - ○ Severalsuppliers
2. Aretheday-oldchickspurchaseddeliveredtoyourfarmfirst, i.e. beforeotherfarmsare deliveredusingthesame transportvehicle?
   - ○ Always
   - ○ Sometimes
   - ○ Never
3. Aretransportvehiclescleanedanddisinfectedbeforeloadingday-oldchicks?
   - ○ Yes
   - ○ No
4. Howmanytimesayear areday-oldchicksdeliveredtoyour farm?
   - ○ Lessthan3timesayear
   - ○ Between3and6timesayear
   - ○ Morethan6timesayear

B. Broilerdepopulation(slaughterhouses,retailers,privateindividuals)

5. Isthe poultrytransportvehicleemptyonarrivalat the farm?
   - ○ Always
   - ○ Sometimes
   - ○ Never
6. Isthepoultrytransportvehiclealwayscleanedanddisinfectedonarrivalatthefarm?
   - ○ Yes
   - ○ No
7. Dothedriverandcatchingcrewreceiveandwearfarm-specificordisposableclothing/shoeswhileloadingpoultry?
   - ○ Always
   - ○ Sometimes
   - ○ Never
8. Areprivate individualsandretailersauthorizedtoenterpoultryhouses,wheredirectcontactwithpoultryis possible?
   - ○ Always
   - ○ Sometimes

- Never

9. Howmanystepsareinvolvedindepopulatingahenhouse?

○ Inasingle step
○ Intwosteps
○ Morethantwosteps

10. Howmanytimesayear aretheanimalsremovedfromthefarm?

○ Lessthan6 timesayear
○ Between6and12timesayear
○ Morethan12timesayear

C. Foodanddrinkingwater

11. Isthebreedingsitedividedintocleananddirtyareas?

○ Yes
○ No(Gotoquestion14)
○ Not known(Gotoquestion14)

12. Isthere a clearseparationbetweenthe cleananddirtyareasofthe breedingpremises?

○ Yes
○ No

13. Canthefeedcompanyfillsilos/deliverfeedwithoutenteringthecleanzone?

○ Yes
○ Onlysomeofthem
○ None

14. Doesthefeedsupplier haveaccesstopoultryhouseswheredirectcontactwithpoultryis possible?

○ Always
○ Sometimes
○ Never

15. Arefeedsilosorstorageroomscompletelyimpermeabletowater,birdsandpests?

○ Yes
○ No

16. Howmanytimesayear doesthefeedcompanyfillsilosor deliverfeed?

○ Lessthan20 timesayear
○ Between20and35timesayear
○ Morethan35timesayear

17. Howoftenarebacteriologicalanalysescarried outondrinking water?

○ Atleastonceayear
○ Everytwoyears
○ Lessfrequentthaneverytwoyears
○ Never(Gotoquestion19)

18. Wherearewatersamplestakenforbacteriologicalanalysis?

○ At thesource
○ Tothelastnippletodrink
○ Inbothplaces,i.e.atthespringandatthelastdrinkingnipple.

D. Manureandcarcassremoval

19. Ismanure/dustdisposed ofviathedirtyareaofthefarm?

○ Yes
○ No

20. Isthereaseparatesiteforstoringcadavers?
○ Yes
○ No(Gotoquestion25)
21. Cancarcassesbecollected bytherendering companyfromthepublichighway/outside thefarm?
○ Yes
○ No
22. Is the cadaver storage site enclosed in such a way as to prevent access by dogs, cats,rodentsorwildanimals?
○ Yes,it'scompletelyclosed.
○ It'sonlypartiallyclosed.
○ No
23. Isthecarcassstorageareacleanedanddisinfectedafter eachcollection?
○ Always
○ Sometimes
○ Never
24. Isthecadaver storagesiterefrigerated?
○ Yes
○ No
25. Doesthebreeder wearsingle-usegloveswhenhandlingcadaversordoeshewashanddisinfecthishands afterhandlingcadavers?
○ Always
○ Sometimes
○ Never

E. Visitorsandfarmworkers

26. Arevisitorsrequiredtonotifyyouoftheirpresencebeforeenteringthepoultryhouses(e.g.visitors'register)?
○ Yes
○ No
27. Doallfarmworkers(includingthefarmowner) respectaccessrules?
○ Always
○ Sometimes
○ Never
28. Isthereaperiod>12hourswithoutcontactwithpoultryimposedonvisitorsbeforethey canenterthebuildings?
○ Yes
○ No
29. Arevisitorsandfarmworkersrequiredtowearfarmclothingbeforebeingallowedinto poultryhouses?
○ Yes
○ No
30. Dovisitorsandfarmworkershavetowearfarmshoesbeforebeingallowedintothepou ltryhouses?
○ Yes
○ No
31. DoIhavetowashanddisinfectmyhandsbeforeenteringthepoultryhouses?

- Yes

○ No

32. Howmanytimesayear arevisitorsgrantedaccesstothepoultryhouses?

○ Accessnevergranted

○ Accessisgranted,butlessthan12timesperyear.

○ Access isgrantedmorethan12timesayear

33. Doanyfarmworkersalsoraisepoultryorotherbirdsathome?

○ Yes

○ No

34. Doanyfarmworkersalsoworkonotherpoultryfarms?

○ Yes

○ No

F. Equipmentsupply

35. Doesanyequipmentsharedwithother farmsenterthepoultryhousesorcomeintocontactwithyourpoultry?

○ Yes

○ No

36. Arespecificmeasurestakenfortheintroductionofequipment(e.g.UVdisinfectionunit,alcoholdisinfection)?

○ Yes

○ No

G. Infrastructureandbiologicalvectors

37. Isitpossibleforpoultrytogooutside?

○ Yes

○ No

38. Ismanure storedonthefarm?

○ Yes

○ No

39. Canwild birdsenter poultryhouses?

○ Yes

○ No

40. Arebird- andvermin-proofgrilles installedonairinlets?

○ Yes

○ No

41. Isthe farmfenced?

○ Yes,it'scompletelyfencedin.

○ It'sonlypartiallyclosed

○ No

42. Isthearea aroundthe farm(nearbuildings)paved andclean(removalofwaste,weeds,etc.)topreventinfestationbyrodents/wildanimals?

○ Yes,it'scompletelypavedandclean.

○ It'sonlypartiallypaved and clean.

○ No

43. Arevermin(i.e. rats,mice,etc.)consideredaproblematthefarm?

○ Often

○ Sometimes

○ Never

44. Istherearodentcontrolplan?
○ Yes
○ No
45. Dopetshaveaccesstothepoultryhouses(includingthehygienelock)?
○ Yes
○ No
46. Do youalsoraise backyardpoultryonyourfarm?
○ Yes
○ No
47. Arethereotherlivestockonthesame site?
○ Yes
○ No

H. Farmlocation

48. Istherestandingorrunning waterwithinonekilometerofthefarm?
○ Yes
○ No
49. Howfar away(asthecrowflies)isthenearestpoultryfarm?
○ Lessthan500meters
○ Between500metersand1kilometer
○ Morethanonekilometer
50. Is manure from other poultry farms spread on neighbouring farmland (within a 500-metre radius)?
○ Often
○ Sometimes
○ Never
51. Do vehicle stransporting animals from other farms frequently(atleastonceaday)pass along the road near the farm (e.g. because of the proximity of a slaughterhouse,etc.)?
○ Yes
○ No

I. Disease management

52. Isthereavaccinationprotocolandisitstrictly adheredto?
○ Yes
○ No
53. Isthehealthstatusofthefarm(e.g. serology, reasons for seiz ureattheslaughterhouse,etc.)assessed regularly(i.e.at leastonce ayear)?
○ Yes
○ No
54. Howoftenaredead birdsremovedfromthehenhouse?
○ Daily
○ Everyotherday
○ Lessthanonce everytwo days

55. Whatistherearing density(based onfinalweight)ofthehenhouse?
○ ≤33kg/m²
○ 34kg/m²

- 35kg/m²

○ 36kg/m²
○ 37kg/m²
○ 38kg/m²
○ 39kg/m²
○ 40kg/m²
○ 41kg/m²
○ 42kg/m²
○ >42kg/m²for

56. Aretheredifferentagecategoriesofpoultryonyourfarm?
○ Yes
○ No

J. Cleaninganddisinfection

57. Arethererotolocksattheentrancetothefarm?
○ Yes
○ No(Gotoquestion59)

58. Aretherotoluddersstillinuse?
○ Yes
○ No

59. Arepoultryhousescleanedafter eachproductioncycle?
○ Yes
○ No

60. Arepoultryhousesdisinfectedafter eachproductioncycle?
○ Yes
○ No

61. Istheeffectivenessofcleaninganddisinfectionchecked,e.g.usingahygienogram,swabs,etc.,aftereachproductioncycle?
○ Always
○ Sometimes
○ Never

62. Istheloadingandunloadingareacleanedanddisinfectedaftereachproductioncycle?
○ Yes
○ No

63. Howlong (indays)isthesanitaryvacuumperiodaftereachproductioncycle?
○ Lessthan3 days
○ Between3and8days
○ Morethan8days

64. Isthereacentralhygienelock onthefarm?
○ Yes
○ No(Gotoquestion67)

65. Istherea strictseparationbetweenthecleanand dirtyareasofthe centralhygieneairlock?
○ Yes
○ No

66. Isthereachangingroomwithclothesandshoesspecifictolivestockfarminginthecentralhygienelocker?
○ Yes
○ No
67. Isthereahygienelockineachhenhouse?
○ Yes
○ No(Goto question71)
68. Isthereastrictseparationbetweenthecleanand dirtyareasofthehygienelockineachpoultryhouse?
○ Yes
○ No
69. Aretherefootbaths/boot washersinthehygienelockofeachpoultryhouse?
○ Yes
○ No
70. Isitpossibletowashanddisinfecthands inthehygienelockofeachpoultryhouse?
○ Yes
○ No
72. Istheliquidinthefootbathimmediatelychangedwhenitisvisiblycontaminated?
○ Yes
○ No
73. Isthedrinkingwater systemproperlycleanedanddisinfectedinsideandoutaftereachproductioncycle?
○ Always
○ Sometimes
○ Never
74. Are feed systems properly cleaned and disinfected inside and out after eachproductioncycle?
○ Always
○ Sometimes
○ Never
75. Arefeedsiloscleanedanddisinfected inside?
○ Yes,afteroneortwoproductioncycles
○ Sometimes
○ Never

K. Materialsandmeasurementsbetweencompartments

76. Isthereaprotocolforcleaninganddisinfectingequipmentaftereachproductionrun,and is thisprotocolalwaysfollowed?
○ Yes
○ No
77. Arethereseveralhenhousesonthefarm?
○ Yes
○ No(Gototheend)
78. Hasclearlyrecognizableanddistinctequipmentbeenprovidedforeachpoultryhouse?
○ Yes
○ No

79. Aretherespecificclothesandbootsforpoultryhouses?

- Yes
- No

Résumé:
La biosécurité implique des mesures préventives externes et internes visant à empêcher l'introduction et la propagation d'agents pathogènes. Les éléments clés sont l'emplacement et la configuration de l'exploitation, une gestion opérationnelle rigoureuse, l'isolement des animaux, le nettoyage et la désinfection des installations, ainsi que la lutte contre les ravageurs et les prédateurs.
Dans le cadre de notre étude, nous avons mené une enquête sur le terrain afin de recueillir des informations sur l'application des mesures de biosécurité dans les exploitations avicoles de la wilaya de Bouira. Nous avons interrogé 39 exploitations avicoles.
Lors de l'inspection des sites et de l'analyse statistique, nous avons constaté que la majorité des éleveurs respectent certaines mesures de biosécurité, telles que le vide sanitaire 58% des éleveurs le respectent, mais pas sa durée, 75 % des éleveurs respectent le nettoyage et la désinfection des bâtiments d'élevage et des équipements, et 25% des éleveurs qui respectent d'autres paramètres.
D'après les réponses des éleveurs interrogés, il semble que la biosécurité ne soit pas toujours respectée, en raison d'un manque de connaissances et de formation de la part des éleveurs.
Mots clés : biosécurité, élevages de volailles, hygiène, maladies, élevage de volailles, Bouira

Abstract :
Biosecurity involves external and internal preventive measures aimed at preventing the introduction and spread of pathogens. Key elements include farm location and layout, rigorous operational management, animal isolation, facility cleaning and disinfection, and pest and predator control.
As part of our study, we conducted a field survey to gather information on the application of biosecurity measures on poultry farms in the wilaya of Bouira. We interviewed 39 poultry farms.
During the site inspection and statistical analysis, we found that the majority of farmers comply with certain biosafety measures, such as the sanitary vacuum: 58% of farmers comply with it, but not with its duration; 75% of farmers comply with the cleaning and disinfection of farm buildings and equipment; and 25% of farmers comply with other parameters.
From the responses of the breeders surveyed, it seems that biosecurity is not always respected, due to a lack of knowledge and training on the part of breeders.
Keywords: biosecurity, poultry farms, hygiene, diseases, poultry farming, Bouira

الملخص:

يتضمن الأمن البيولوجي تدابير وقائية خارجية وداخلية لمنع دخول وانتشار مسببات الأمراض. وتشمل العناصر الرئيسية موقع المزرعة وتكوينها، والإدارة التشغيلية الصارمة، وعزل الحيوانات، وتنظيف المرافق وتطهيرها، ومكافحة الآفات والحيوانات المفترسة.
وكجزء من دراستنا، أجرينا مسحاً ميدانياً لجمع معلومات عن تطبيق تدابير الأمن البيولوجي في مزارع الدواجن في ولاية البويرة. أجرينا مقابلات مع 39 مزرعة دواجن.
ومن خلال معاينة الموقع والتحليل الإحصائي، وجدنا أن غالبية المزارعين كانوا ملتزمين ببعض تدابير الأمن البيولوجي، مثل المكنسة الصحية، حيث التزم 58% من المزارعين بها، ولكن ليس بمدتها، والتزم 75% من المزارعين بتنظيف وتطهير مباني ومعدات المزرعة، والتزم 25% من المزارعين بمعايير أخرى.
من إجابات المزارعين الذين تم استجوابهم، يبدو أن الأمن البيولوجي لا يتم احترامه دائمًا، بسبب نقص المعرفة والتدريب من جانب المزارعين.
الكلمات المفتاحية: الأمن البيولوجي، مزارع الدواجن، النظافة الصحية، الأمراض، تربية الدواجن، البويرة