الجمهوريــة الجزائريــة الديمقراطيــة الشعبيــة
People's Democratic Republic of Algeria
العلمي والبحث العالي التعليم وزارة
Ministry of Higher Education and Scientific Research
قالمة 1945 ماي 8 جامعة
University of Guelma 8 Mai 1945

Domain: Natural and Life sciences

Field: Ecological Sciences

Option: Biodiversity and Environment

Department: Ecology and Environmental Engineering

Study on human-wild boar conflicts in Northeastern Algeria

Dissertation Submitted in Partial Fulfillment for The Requirements of Master Degree

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June 2025

Dedication

In the Name of Allah, the Most Gracious, the Most Merciful

All praise is due to Allah, by whose grace good deeds are completed, and with whose help aspirations are fulfilled. In Him we seek aid, and upon Him we rely.

- To the soul of my beloved grandmother, may Allah have mercy on you and grant you the highest place in Jannah. Your prayers love, and wisdom lit my path, and your memory lives on in my heart.
- To my dear uncle, my support after Allah, your guidance, generosity, and constant encouragement were a blessing. May Allah reward you abundantly for all that you have done for me.
- To my honorable parents, my mother and my father, you are the source of all good in my life, the crown on my head, and the reason I have come this far. I ask Allah to grant you long life and protect you always.
- To my siblings, you are the heartbeat of my life and companions on this journey. Your presence has been a comfort and a source of strength throughout.
- To my nephews, your smiles were a healing balm during times of exhaustion. May Allah bless and protect you all and fill your lives with light and joy.
- To the wife of my uncle and to his son who has always been like a brother, thank you for your kindness and constant support. May Allah reward you generously.

This work is the fruit of your prayers and love. I dedicate it to all of you, asking Allah to accept it from me sincerely for His sake.

Acknowledgements

First and foremost, I would like to express my sincere gratitude and appreciation to my supervisor, **Pr.Saddek Atoussi**, for his invaluable guidance, support, and assistance. I am deeply indebted to him for his kindness and dedication throughout the conduct of this research.

I would like to thank the examiners for their acceptance and for their constructive evaluation of my dissertation. I sincerely appreciate your attention and careful reading of this dissertation: **Dr. Rabeh Zebsa** and **Dr. Amel Mesbah** , your time, awareness, and constructive input are deeply valued.

I would also like to express my heartfelt thanks to Bialystok University of Technology, Poland, for granting me the opportunity to participate in the Erasmus+ program, which greatly enriched my academic and personal journey. I am equally grateful to the Czech University of Life Sciences Prague for its warm welcome, academic support, and the valuable experiences I gained during my mobility period. Thanks to these opportunities, my master's experience was remarkably diverse**,** both culturally and academically, allowing me to grow within international academic environments and broaden my global perspective.

I am also deeply grateful to all those who contributed to the success of this research. My sincere thanks go to the forestry administrations of Guelma, Annaba, and El Taref for their cooperation, logistical support, and valuable insights. I extend my appreciation to the farmers**,** hunters**,** local authorities**,** and the administration of El Kala National Park**,** whose knowledge and availability were instrumental in understanding the dynamics of the human-wild boar conflict. I am also thankful to the inhabitants of Annaba and El Taref for their willingness to participate and share their experiences. The collective support of all these individuals and institutions played a vital role in the realization of this dissertation.

Abstract

This study investigated the increasing human-wild boar (*Sus scrofa*) conflict in Northeastern Algeria,concentrating on rural, urban, and protected areas, including El Kala National Park. Through field surveys, administrative interviews, the research demonstrates the widespread effect of wild boars on urban safety, agriculture, and natural ecosystems. The results reveal that the implementation of hunting campaigns, public awareness and current management strategies remain insufficient. Rural areas are experiencing crop losses despite active hunting, while urban areas report increasing safety concerns due to the frequent presence of wild boars. The study emphasizes the demand for more comprehensive, science-based approaches, including population control, fencing, waste management, and increased public engagement. By handling both ecologial and social dimensions , this research targets to support the development of sustainable and effective conflict mitigation strategies adapted to the algerian context.

Keywords： Human-wildlife conflict, Wild boar (*Sus scrofa*),Crop damage ,Urban wildlife ,Wildlife management, Algeria.

الملخص

تهدف هذه الدراسة إلى تحليل تصاعد الصراع بين الإنسان والخنزير البري (*Sus scrofa*) في شمال شرق الجزائر، مع التركيز على المناطق الريفية والحضرية والمحمية، خاصة حظيرة القالة الوطنية. تم الاعتماد على استبيانات ميدانية مع السكان الى جانب مقابلات مع الجهات الفاعلة في القطاعين الفلاحي والغابي. أظهرت النتائج أن الخنازير البرية تُسبب أضرارًا كبيرة في المحاصيل الزراعية، وتمثل تهديدًا متزايدًا للسكان في المناطق الحضرية، حيث تكثر المشاهدات قرب أماكن رمي النفايات. رغم وجود حملات للصيد ، إلا أن الأدوات التقليدية لإدارة هذا الصراع لا تزال غير كافية. توصي الدراسة باعتماد استراتيجيات شاملة مبنية على البحث العلمي، تشمل السيطرة على أعداد الخنازير، وتدعيم البنية التحتية، وتحسين إدارة النفايات، وتعزيز إشراك المجتمع المحلي في جهود الوقاية والحماية.

الكلمات المفتاحية : الصراع بين الإنسان والحياة البرية , الخنزير البري*(Sus scrofa)* ,الأضرار الزراعية , الحياة البرية الحضرية ,إدارة الحياة البرية, الجزائر.

Résumé

Cette étude a examiné le conflit entre l'homme et le sanglier dans le nord-est algérien, concentré sur les zones rurales, urbaines et les espaces protégés.notamment le Parc National d'El-Kala. À travers des entretiens avec des représentants des secteurs agricole et forestier et des enquêtes de terrain, les résultats divulguent une pression croissante des sangliers sur les cultures , les zones urbaines et les écosystèmes . Bien que des campagnes de chasse et les outils de gestion actuels se révèlent insuffisants. Les régions rurales continuent de subir des pertes agricoles importantes, tandis que les zones urbaines font face à des problèmes de sécurité et d'hygiene. L'etude recommande des approches intégrées et basées sur la science, incluant le contrôle des populations de sangliers , la mise en place de clôtures, la gestion des déchets et la participation communautaire, afin d'élaborer des stratégies durables et adaptées au contexte algérien.

Mots-clés : Conflit homme-faune, Sanglier (Sus scrofa), Dégâts aux cultures, Faune urbaine, Gestion de la faune sauvage, Algérie.

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Introduction

General introduction

Human-wildlife conflict represents one of the most common and complex challenges in conservation biology **(Dickman, 2010; Konig et al., 2020; Mohammadi et al., 2022, 2024; Rezaei et al., 2022a, 2022b; Bombieri et al., 2023)**. This problem has been increasing globally due to continual human expansions into the vicinity of natural territories **(Dar et al., 2009; Almasieh and Mohammadi, 2023**). Human-wildlife conflict encompasses an array of situations that affect wildlife **(Pimentel et al., 2005)**, and puts significant costs upon people living alongside wildlife **(Mohammadi et al., 2021a; Mohammadi and Fatemizadeh, 2021b; Nayeri et al., 2022)**. The most common human costs of these conflicts include loss of domesticated and game species to predators **(Woodroffe et al., 2005)**, damage to crops and food storage **(Pimentel et al., 2005)**, human casualties **(Loe and Roskaft, 2004)**, damage associated with infectious diseases**(Woodroffe et al., 2005)**, and damages to properties and infrastructures. These conflicts can lead to wildlife population declines and reduced biodiversity **(Cai et al., 2008; Ficetola et al., 2014)**.

Wild boar (*Sus scrofa*, Linnaeus 1758) is a wide-ranging species that has come into increased contact with humans across the globe **(Barrios-Garcia and Ballari, 2012; Castillo-Contreras et al., 2018; Yusefi et al., 2019; Colomer et al., 2021; Gonzalez-Crespo ´ et al., 2023)**. It is one of the most widespread terrestrial mammals in the world due to factors such as reduced natural predators **(Massei et al., 1996)**, generalist diet and habitat use (**Irizar, 2005; Herrero et al., 2006; Podgorski et al., 2013)**, and relatively fast reproduction rate **(Fernandez-Llario, 2004)**. The species demonstrates the widest range of mobility and distribution among ungulate herbivores, encompassing semi-arid regions, tropical forests, and grasslands **(Massei and Genov, 2004; Karami and Tavakoli, 2022)**. Also, due to the wide distribution of wild boars and their long-history of interacting with humans, urban habitat is not alien to this species **(Castillo-Contreras et al., 2018; Gonzalez-Crespo et al., 2023)**.

The expanding population of wild boars has led to extensive conflicts with humans and significant economic losses, presenting a major challenge to governing authorities and conservationists globally **(Milda et al., 2023)**. particularly, wild boars cause substantial economic losses to farmers, with damage compensation per claim averaging 2123 euro in Italy **(Amici et al., 2012)**, 477 euro in Croatia **(Novosel et al., 2012)**, and 396 euro in Luxembourg **(Schley et al., 2008)**. Given its broad distribution, the species is capable of functionally and structurally altering ecological communities, the abundance of species, and the food network **(Chavarria et al., 2007)**.

This impact is greater where natural land uses have been converted to agriculture **(Meinecke et al., 2018)**, to the extent that crop damage can be predicted based on crop diversity and the area under cultivation **(Meinecke et al., 2018)**. Their rooting behavior negatively impacts reforestation efforts and contributes to soil erosion, thereby hindering ecological restoration initiatives **(Massei & Genov, 2004; Benotmane et al., 2022).**

Wild boars exhibit a high tolerance for human activities, commonly traversing habitat peripheries, consuming and damaging crops. They maintain a diverse diet, eating rice, wheat, barley, corn, beans, potatoes, sorghum, and beetroots **(Pandey et al., 2016; Schley and Roper, 2003)**. Given the higher nutritional value of crops compared to wild sources, it is unsurprising that conflicts are more common in areas with higher crop diversity and more extensive agriculture **(Meinecke et al., 2018)**. Wild boars in urban areas had larger body size, higher body mass, and better body condition than non-urban wild boars, suggesting their tolerance to human dominated landscapes and their adaptation to anthropogenic food **(Castillo-Contreras et al., 2021)**.They intrusions pose safety risks to residents and have been associated with vehicle collisions and property damage, as documented in similar urban-wildlife conflict studies **(Stillfried et al., 2017; Shammer et al., 2024).**

Protected areas are often perceived as shelters for some species such as wild boars, and are therefore seen as impediments to effective management and population control **(Coffey and Johnston, 1997; Brogi et al., 2020)**.The nature of protected

areas makes them favorable habitats for such species, either throughout the year or during specific periods of intense human activity (e.g., hunting season) **(Colomer et al., 2021)**. On the other hand, some studies have found that the behavior of the wild boar is largely independent of human activities **(Keuling et al., 2008; Brivio et al., 2017; Brogi et al., 2020**). Moreover, the behavioral adaptability of wild boars enables them to utilise resources by circumventing human activities **(Meinecke et al., 2018)**. Knowing the degree of conflict both within and outside protected areas can help design and implement more effective management plans.Globally, such impacts have been well documented, particularly their effects on vegetation structure, soil composition, and plant regeneration **(Barrios-García & Ballari, 2012)**. While hunting is the most commonly used population control measure, its long-term effectiveness and ecological sustainability are still debated in the literature **(Massei et al., 2015; Quirós-Fernández et al., 2017)**. The absence of a comprehensive, science-based management strategy in many regions exacerbates the problem, underscoring the need for integrated and adaptive conflict mitigation frameworks **(Apollonio et al., 2017; Madden, 2004).**

In Algeria, wild boars are present throughout the northern part of the country, but are gradually spreading southward **(Kowalski & Kowalska, 1991)**. This species is mainly found in the forested mountains that extend from the Tell Atlas to the pre-Saharan Atlas. In the Saharan zone, wild boars can only be found in humid areas such as palm groves, north of the Sahara **(in Boumendjel et al., 2017)**. **Boumendjel (2015)** reported the results of a census study carried out in 1987 by a group of Bulgarian forest management experts, which stated that the size of the Algerian wild boar population was estimated at 125,000 individuals. The proportion of wild boars that had to be hunted each year at the time was approximately 10.0 - 20.0% (12,500 - 25,000) **(El Bey, 2012)**. Apart from this census study, there has been no recorded data on the evolution of the size of the wild boar population in Algeria, despite the numerous reports of its demographic expansion, the fact that the species is not subject to any pressure from natural predators, its only predator being humans, and religious

beliefs that mean that the species is not consumed. Added to all these data is the ban on hunting during the black decade (from 1992 to 2002), all factors that undoubtedly played a determining role in the exponential prolificacy of the species. Currently, wild boar hunting, like game hunting, is governed by Law 04-07 of 14 August 2004, which sets out the terms and conditions for the exercise of tourist hunting, the issuing and validation of hunting permits, as well as the terms and conditions for the organisation and management of administrative hunts **(Benotmane,2024).**

Objectives of the Study: This study aims to evaluate the extent and impact of human-wild boar conflict in Guelma, Annaba, and El Taref, with particular focus on agricultural, forestry, urban, and protected contexts. The specific objectives are to:

1. **Quantify agricultural damage** by collecting data from farmers and agricultural stakeholders.
2. **Investigate forest degradation** caused by wild boars through interviews with forestry officials.
3. **Analyze urban intrusions** by examining wild boar presence and disturbance in residential areas.
4. **Examine conflicts in protected areas**, particularly in El Kala National Park, and their impact on conservation goals.
5. **Evaluate the effectiveness of hunting** as a population control method via feedback from hunting associations.
6. **Identify and assess mitigation strategies**, including fencing, regulatory measures, and fertility control **(Indo-German Biodiversity Programme, 2021)**.

Chapter 1: Literature Review

1. Human-wildlife conflict: Definitions and global perspectives

Human-wildlife conflict (HWC) refers to interactions between humans and wildlife that result in negative impacts on human social, economic, or cultural life, or on the environment and wildlife conservation **(Madden, 2004).** These conflicts have intensified globally due to human population growth, land-use change, and declining natural habitats **(Bevins et al., 2014).** As humans expand into wildlife territories, animals often respond by entering farmlands or urban areas in search of food and shelter, sometimes leading to crop losses, livestock predation, or threats to human safety. Retaliatory killings and preventive actions by humans can further exacerbate the situation, creating a vicious cycle of conflict. Addressing HWC requires multidisciplinary approaches that integrate ecological, social, and economic factors for sustainable coexistence **(Madden, 2004; Bevins et al., 2014)**.

2. Ecological and behavioral aspects of wild boars (Sus scrofa)

Wild boars are among the most adaptable large mammals, capable of thriving in forests, agricultural landscapes, and even urban zones **(Stillfried et al., 2013)**. Their behavioral plasticity, such as shifting activity to nighttime to avoid human disturbance, plays a key role in their survival in modified habitats **(Thurfjell et al., 2013)**. They possess a broad omnivorous diet, reproduce quickly, and can disperse over large areas, all of which make population control particularly challenging. In human-dominated landscapes, wild boars often exploit anthropogenic resources, increasing the likelihood of conflict **(Barrios-Garcia & Ballari, 2012).**

3. Drivers of human-wild boar conflict

Several drivers contribute to the rise in wild boar-related conflicts. One key factor is habitat fragmentation and urbanization, which brings human settlements closer to natural boar habitats, facilitating encounters **(Lin et al., 2023)**. In many regions, wild boars have been observed entering urban areas, where they forage in garbage or parks

(Shammer et al., 2024). Another important driver is agricultural expansion, which transforms forests into cropland. These cultivated fields often provide abundant food resources, making them attractive targets for boars **(Zhang et al., 2023)**. Additionally, climate change alters natural food availability and boar distribution. Warmer winters and unpredictable rainfall patterns encourage migration and shift foraging behavior, further increasing the likelihood of human-wild boar encounters **(Shammer et al., 2024)**.

4. Socio-economic and environmental impacts

The consequences of wild boar conflicts are profound and multidimensional. Economically, they cause severe agricultural losses. For example, **Zhang et al. (2023)** documented substantial crop damage in rural China, particularly to corn and sweet potato, resulting in significant financial strain on farmers. In some European regions, similar damage has been estimated in the millions of euros annually **(Lin et al., 2023).** Urban impacts include vehicle collisions, damage to gardens or infrastructure, and risks to public health, particularly through zoonotic disease transmission **(Shammer et al., 2024)**. On the environmental front**,** wild boars cause soil disturbance through rooting and trampling, leading to erosion, loss of plant cover, and damage to native biodiversity **(Barrios-Garcia & Ballari, 2012; Massei et al., 2011)**.

5. Spatial distribution and ecological impacts of wild boars:

5.1 Spatial distribution:

a) Globally:

As highlighted by **Barrios-Garcia & Ballari (2012)**, the wild boar has seen a significant increase in both population size and geographic range in recent decades. Although the *Sus* genus currently includes only eight recognized species, mostly found in Asia **(Herrero et al., 2002)**, historical records indicate a much broader

natural distribution, covering parts of Europe, Asia, and North Africa **(Macdonald & Frädrich, 1991; Oliver, 1995)**.

Today, *Sus scrofa* is found across every continent except Antarctica. Its current distribution spans most of Europe, South and Central Asia, North Africa, Australia, New Zealand, as well as North and South America **(Oliver, 1995)**. According to **Massei et al. (1997)**, it is now considered the world's most widespread and abundant wild ungulate species.

Several factors have contributed to this expansion, including high reproductive capacity, behavioral flexibility, and strong mobility **(Baubet, 1998; Spitz & Lek, 1999)**. Human-mediated translocations, such as deliberate introductions and reintroductions, have also played a crucial role **(Rosell & Herrero, 2007; Oliver, 1995; Randi, 1995; Genov, 1999)**. As a result of this global spread, numerous local variations have emerged, often classified as subspecies or ecotypes, though their exact number remains uncertain.

Recent population growth has also been fuelled by increased food availability from intensified agriculture, as well as milder winters linked to climate change **(Barrios-Garcia & Ballari, 2012; Massei et al., 2015; Vetter et al., 2015, 2020)**. In addition, the relative impact of mortality on population size has declined in recent years **(Massei et al., 2015)**. Nonetheless, hunting remains the main cause of wild boar mortality in Central Europe **(Keuling et al., 2013)**.

Other contributing factors to wild boar proliferation include the decline of natural predators, their high adaptability to diverse environments, and widespread habitat degradation **(El Alami, 2019)** ***(Figure 1)***.

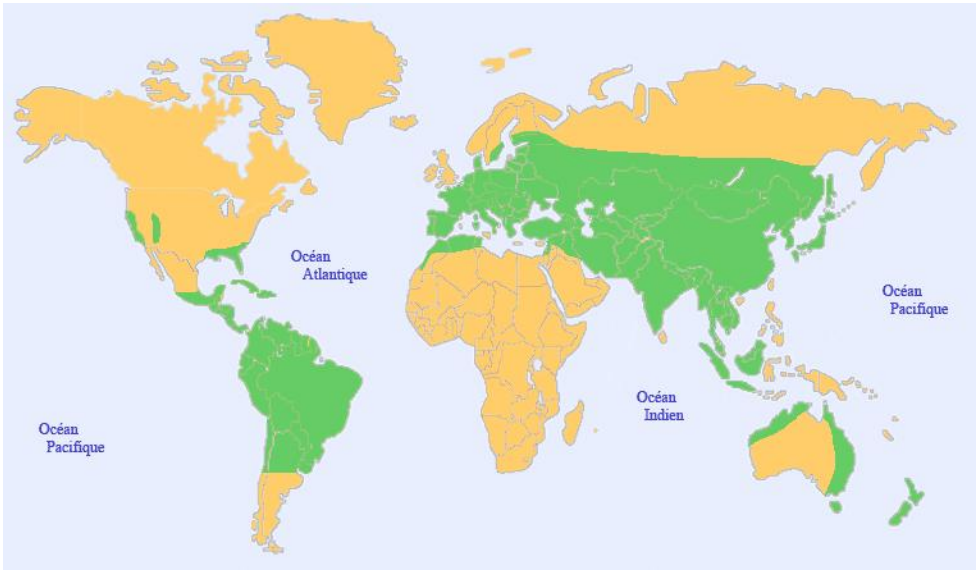


Figure 1: Description of the wild boar's distribution area (in green) (Daucourt & Gaudy, 2018). *Source: www.atlas-mammiferes.fr.*

b) In Algeria:

According to the studies conducted by **Klaa (1991)** and **Kowalski & Rzebik-Kowalska (1991)**, wild boars (*Sus scrofa*) are widespread across the northern Algerian provinces, where forested landscapes dominate. On the High Plateaus, however, their distribution is patchier due to the limited presence of woodland areas as mentioned **Klaa (1991)** . As one move' southward into the Saharan regions, sightings of the species become increasingly rare and tend to occur only in specific habitats such as palm groves, cultivated lands, or near wetlands. This restricted presence in arid zones reflects the species' reliance on moist environments as indicated by **Kowalski & Rzebik-Kowalska (1991)** .

Furthermore, these researchers note that within many parts of its range, wild boars face little pressure from natural predators, with humans being their primary threat. In Algeria, religious and cultural practices discourage the consumption of wild boar meat, which may partly explain the species' unchecked population growth in some regions **(Benotmane , 2024) (*Figure 2*).**

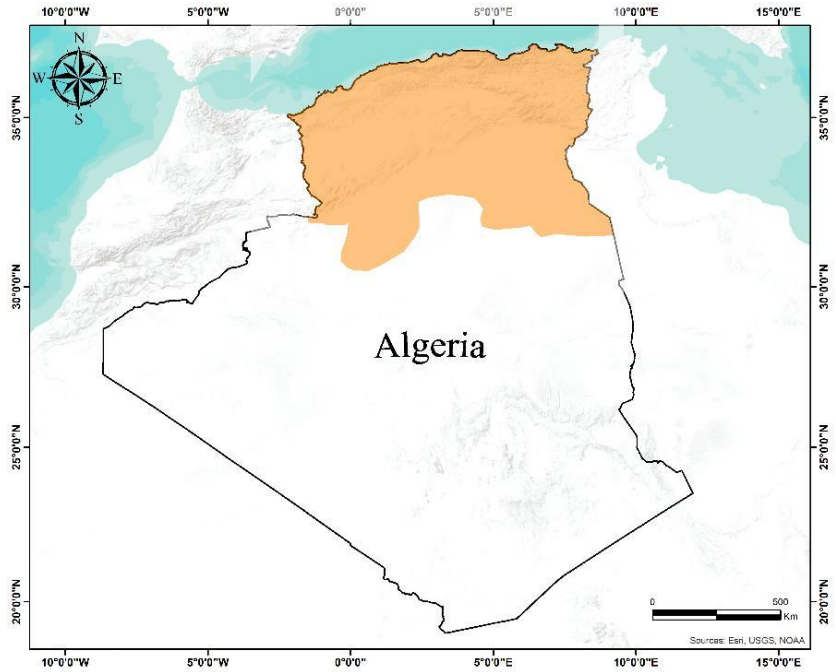
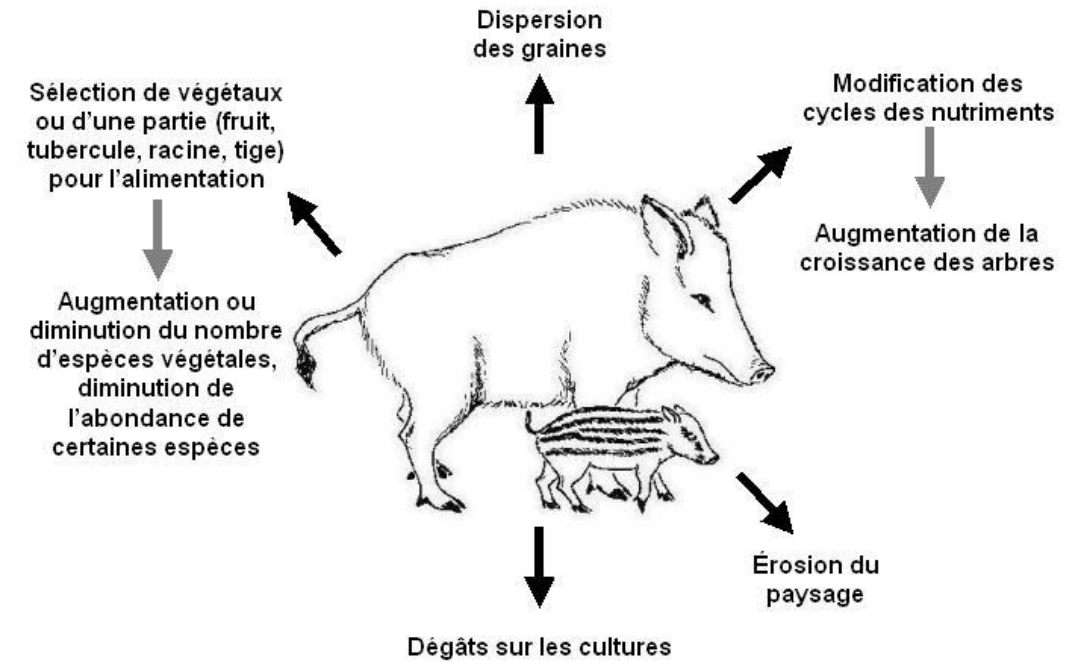


Figure 2: Distribution of sus scrofa in Algeria (Kowalski & Rzebik ZEBIK-Kowalska., 1991) (Modified 2023).

5.2 Ecological impacts:

At the same time, the species *Sus scrofa* is responsible for numerous impacts on wild fauna and flora **(Arrington et al. 1999; Hone 2002; Roemer et al. 2002; Filippi & Luiselli 2002; Engeman et al. 2003)** and also on agriculture **(Geisser 1998; Onida et al. 1995; Sekhar 1998).** The various actions of the wild boar on the environment have recently been summarized by **Massei & Génov (2004)*(Figure 3)***. It should be noted that these impacts are not necessarily negative on' the environment. Indeed, the species will, for example, promote seed dispersal, and one of the consequences of altering the soil nutrient cycle is to accelerate the growth and regeneration of certain shrub species **(*Figure 3 a*)** such as American beech (*Fagus grandifolia*) or spruce (*Picea abies*). Similarly, its consumption of insect larvae has been shown to reduce the impact of certain invertebrate pests in forestry plantations **(*Figure 3 b*).**

a: Impacts of Wild Boar on Plants



b: Impacts of Wild Boar on Animals

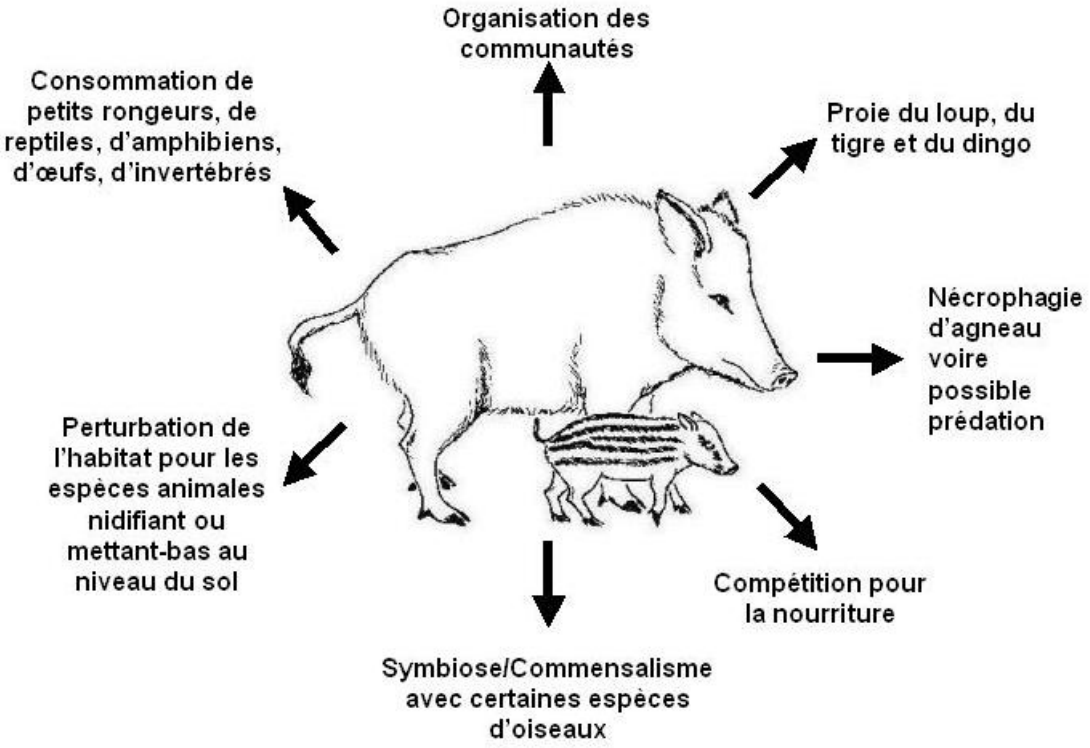


Figure 3: Impacts of wild boar on the environment with (a) the impact on plants and (b) the impact on animals. According to Massei & Génov 2004.

Wild boar is the only species whose regulation depends on hunting, with humans being the main predator of this invasive species **(Dauccourt & Gaudy, 2018),** and for good reason, as its rooting causes a number of problems or significant damage to crops and meadows **(Herrero et al., 2006; Schleyet al., 2008; Schley & Roper, 2003)**. On the other hand, wild boar behavior can conflict with conservation objectives. For example, wild boar foraging behavior can compromise the reproductive success of ground-nesting species (Ground nesting) **(Carpio et al., 2016; Oja et al., 2017**), and threaten reptiles **(Graitson et al., 2019)**. Thus, through predation, wild boar can have a direct impact on soil vertebrates and invertebrates **(Granval & Muys, 1995; Laznik & Trdan, 2014)** and a negative impact on biodiversity **(Hone, 2002)**. In addition, soil turnover and seed consumption have consequences on the seed bank and plant biodiversity **(Burrascano et al., 2015; Dovrat et al., 2014; Picard et al., 2015)**. However, many authors describe a positive effect of wild boar rooting behavior while foraging, which partially modifies ecosystem dynamics and soil composition **(Pitta-Osses et al., 2020)**, and generally affects 15 to 50 cm of the surface soil horizon **(Slawski, 2020)** and has positive effects on vegetation cover, diversity, and regeneration **(Barrios-Garci & Ballari, 2012)**. Some studies have also shown that wild boar can disperse the seeds of invasive species and therefore play a negative role in the ecosystem **(Dovrat et al., 2012)**.

6. Existing management strategies and policies

A variety of management strategies are employed to mitigate wild boar conflicts. Lethal methods, such as culling and regulated hunting, are widely used but often criticized for their limited long-term effectiveness and ethical implications **(Massei et al., 2011).** Wild boars high reproductive rate means that populations can rebound quickly after reductions. Non-lethal deterrents such as fencing, sound devices, repellents, and drones are being explored as alternatives **(Massei et al., 2011).** Some regions have also adopted policy and community engagement approaches**,** focusing on participatory management, education campaigns, and compensation schemes for

affected farmers **(Bevins et al., 2014).** Integrated strategies that combine ecological data, local knowledge, and economic planning show the most promise for sustainable conflict mitigation **(Madden, 2004; Massei et al., 2011).**

Chapter 2:

Study Area and Methodology

1. Study area description

1.1 Guelma

The city of Guelma is located in the valley of Oued Seybouse, in the heart of a large agricultural region, at 290 meters above sea level, in the northeast of Algeria, bounded by the following geographic coordinates: Latitude: 36°28'12.12"N to 36°26'9.36"N; longitude: 7°28'10.72"E to 7°23'46.44"E . Guelma is bounded to the north by Oued Seybouse, to the east by Oued el Maiz and the town of Belkheir, to the south by the mountains of Mahouna, and to the west by the plain of Ben Tabouche. ***(Figure 4)***. The climate is Mediterranean sub-humid, with rainy periods from October to April and dry periods from May to September, with annual rainfall ranging from 450 to 600 mm. The average annual temperature is approximately 18°C. The hottest months are July and August, with average temperatures around 26°C. The coldest months are December and January, with average temperatures of about 12.1°C. It covers an area of 15 km2 and has a population of 137 971 inhabitants in 2018, with a density of 9 198 inhabitants per km2. It is a transitional city in Algeria's northeast region, connected to the coastal wilayas (el Taref, Annaba, and Skikda) as well as the interior wilayas (Constantine, Souk Ahras, and Oum El Bouaghi.

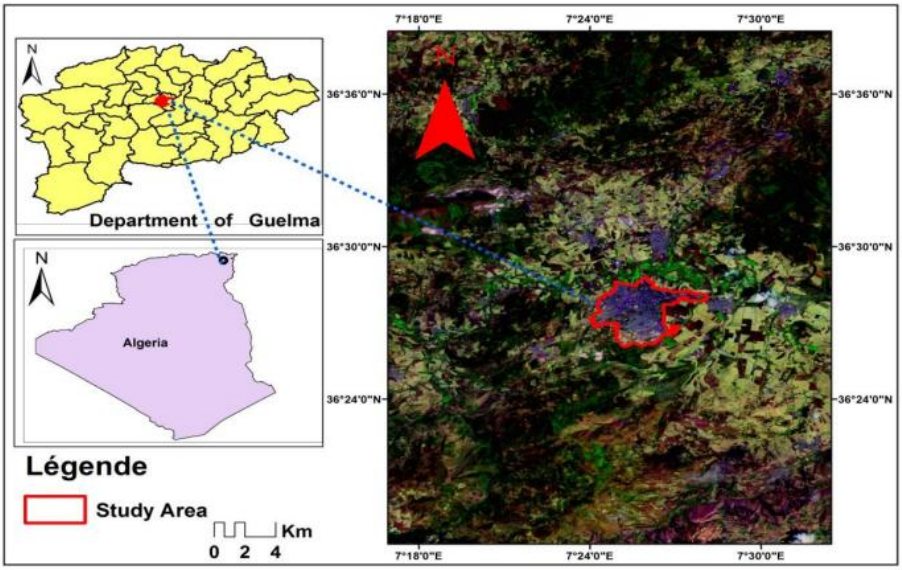


Figure 4 : Location of the study area in Guelma, Algeria.

Source: Adapted from Khallef et al. (2020, p. 453).

1.2 Annaba

The province of Annaba is situated between latitudes 36°30N and 37°30N and longitude 7°20E and 8°40E. Its area is 1411.98 km2; its population has increased recently to 650.000 inhabitants, which is in general concentrated at the level of municipalities and hamlets. It is bounded to the south by the province of Guelma, to the west by the province of Skikda, in the east by the province of El Tarf and to the north by the Mediterranean Sea ***(Figure 5)*** . The climate is typically Mediterranean with an average annual temperature of 18 °C, and an annual rainfall ranging from 650 to 1000 mm, with a winter peak and a deficit during summer. The city of Annaba is bounded to the north and the west by the Edough massif (highest altitude: 850 m), the Mediterranean Sea to the east and the Seybouse alluvial plain to the south. The Edough massif is characterized by a basement of gneiss, schist, and micaschist. Alluvial plain featured by Tertiary gravelly and sandy clayed layers at depth and arable Quaternary clay cover.

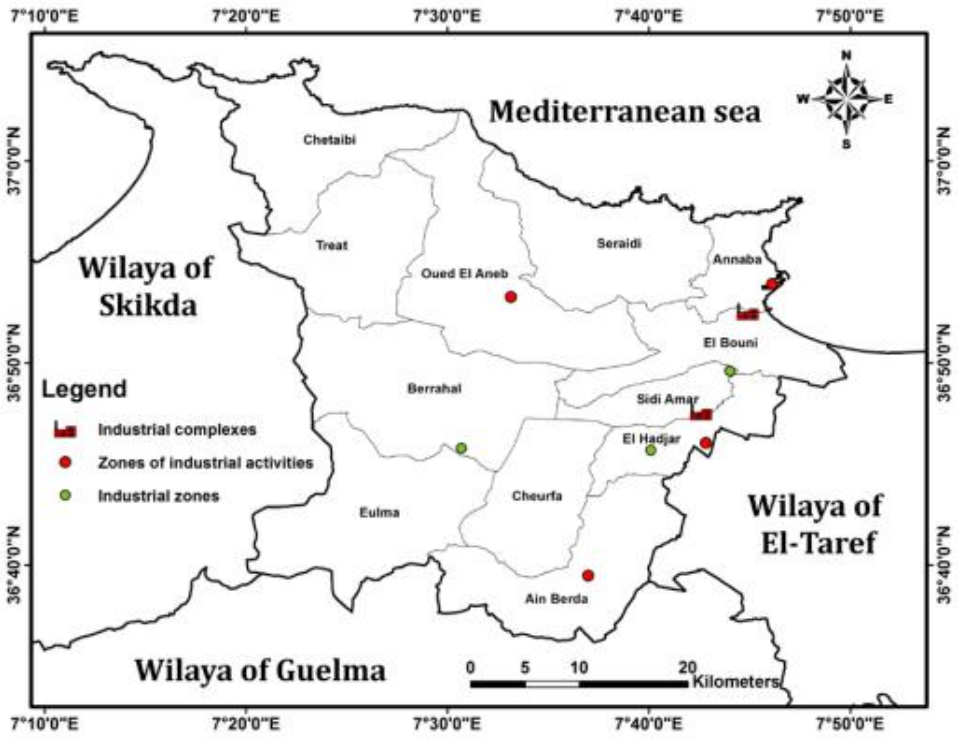


Figure 5: ***Location of the study area in Annaba, Algeria.***
Source: Adapted from Badjoudj et al. (2023, p.25).

1.3 El-Taref

El Tarf is located in the far north-east of Algeria, with an area of 2,908 square kilometers, and a population of about 427,109 in 2011. The territory of this state is determined as follows:

• east on the Algerian-Tunisian border.

• To the west, through the states of Annaba from the west and northwest, and through the Wilayat of Guelma from the west and southwest.

• In the south in the state of Souk Ahras.

• In the north on the Mediterranean Sea. It should be noted, in this connection, that the coast of this state has a great sea front facing east and west, generally straight, but locally meandering with a linear length of about 90 kilometres.**(*Figure 6*)**

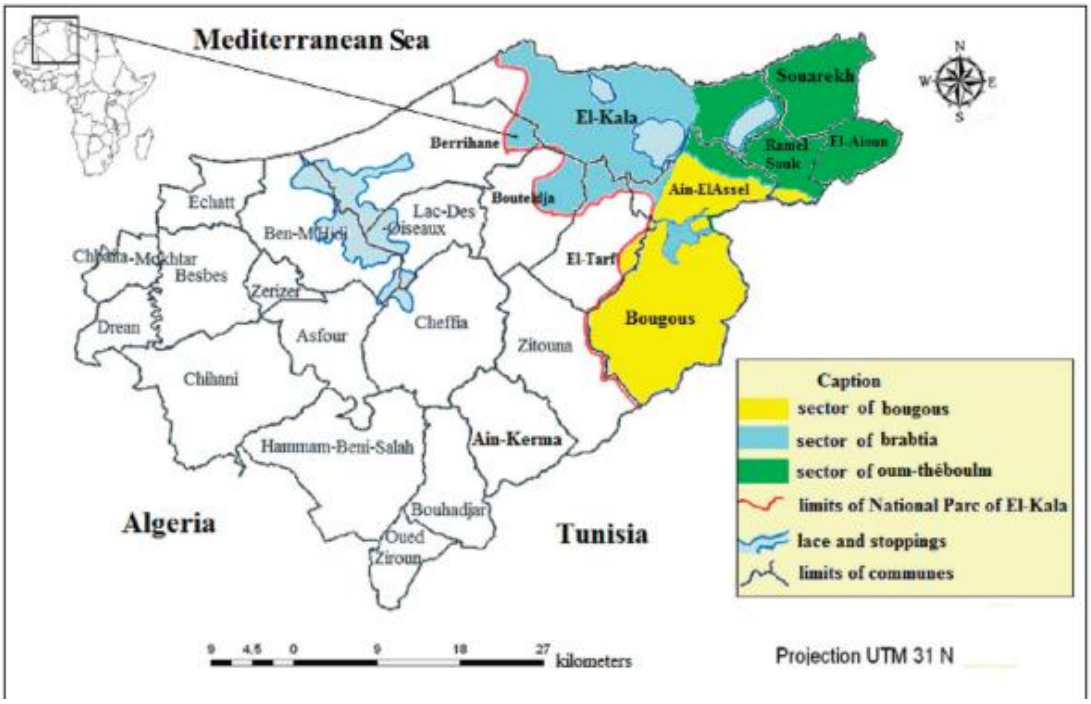


Figure 6: chart of the administrative limits of the wilaya of El-Tarf (Algeria) with the limits of the National Park of El-Kala.*(Adapted from Sarri et al., 2015)*

2. Data collection methods:

To better understand the conflict between humans and wild boars, I conducted a series of surveys using questionnaires targeting different groups involved or affected by the issue. These included local farmers, hunters, forestry officials, residents living in areas where wild boars are present, and representatives from agricultural administrations.

Each group offered valuable insights into how a wild boar affects daily life, farming activities, and forest ecosystems.

By gathering opinions and experiences from a wide range of people and regions, I aimed to build a clear, grounded picture of the situation and the strategies currently used to manage it. This approach helped ensure that the data reflects the reality on the ground from multiple points of view.

The questionnaires were conducted in four main regions, each selected for its specific context related to wild boar presence:

- In **Annaba** and **El Taref**, the surveys aimed to understand the conflict in urban areas where wild boars are increasingly entering city environments and creating disturbances.
- In **El Kala (NPK)**, the focus was on protected areas, with the goal of understanding how wild boars are affecting biodiversity and conservation zones.
- In **Guelma**, the questionnaires targeted forests and agricultural lands to assess the impact of wild boars on reforested zones and crop fields.

3. Data Analysis Techniques:

The results of our questionnaire were collected, organized in a matrix made into Microsoft®Excel 2016 and expressed simply as a percentage of the total number of respondents.

4. Limitation of the study :

While this study relies mainly on data from interviews and questionnaires, such perception-based information should not be seen solely as a limitation. In regions like Northeastern Algeria, where ecological monitoring tools (e.g., GPS tracking, camera traps) are limited, local knowledge plays a key role. These insights offer valuable, ground-level understanding of conflict patterns and help fill critical data gaps. Thus, rather than weakening the study, stakeholder perspectives complement scientific efforts to assess and manage human-wildlife conflict.

Chapter 3: Results and Discussion

❖ Results :

1. Human-wild boar conflict in urban areas: insights from Annaba and El Tarf, Algeria :

This part presents the results of a questionnaire conducted in the urban areas of Annaba and El Taref, where the presence of wild boars has become a growing concern. The survey was conducted among local residents and forestry officials to assess the frequency of encounters with wild boars, the types of disturbances caused, as well as risk perceptions and possible management strategies. This information helps us to illustrate the nature of conflicts in urban areas and underlines the need for effective intervention measures.

1.1. local residents :

a) Respondent profile:

Out of 80 people, 66% are women and 34% men **(*Figure 7*)**

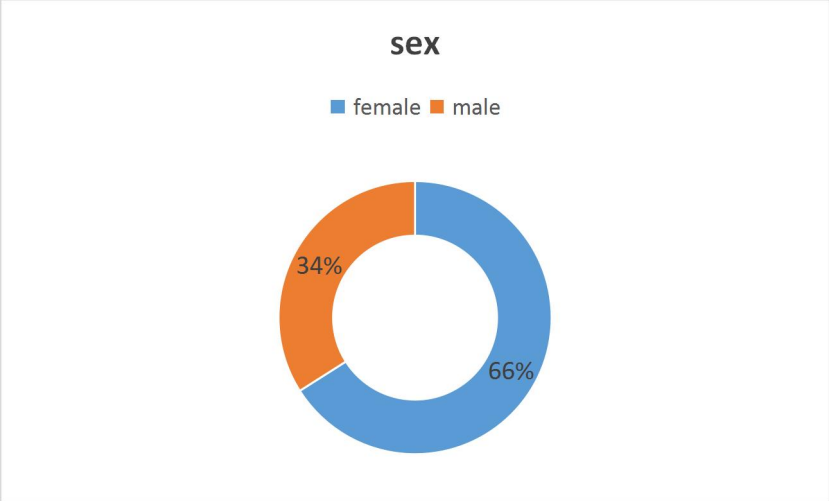


Figure 7: Female/male ration questioned.

The analysis by age group of the people questioned shows that 65% of them are between 18 and 29 years old, 20% have an age between 30 and 45 years old and those aged over 45 years correspond to 15% of the population surveyed **(*Figure 8*).**

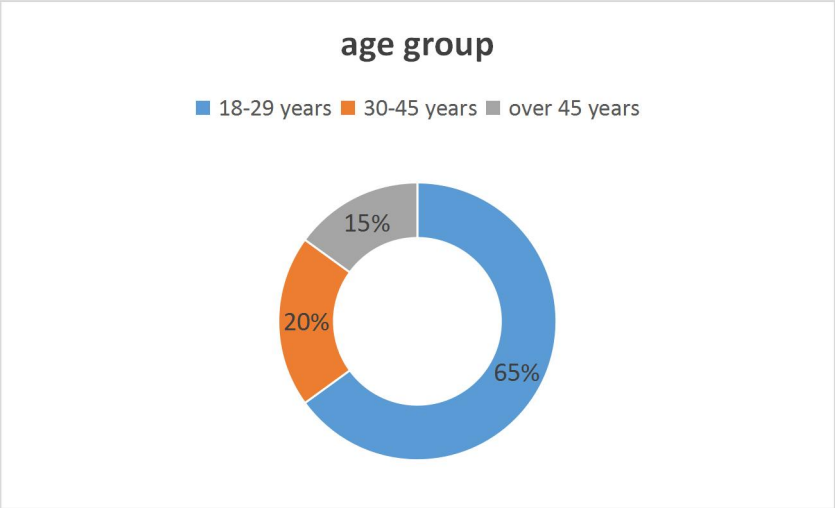


Figure 8: Proportion of people surveyed by age group

b) **Responses regarding wild boar monitoring:**

All respondents confirm the presence of wild boar in urban areas, with 79% having observed them near garbage cans, 6% in public gardens, and 15% near forests. 70% of these observations were made in the evening and 30% in the morning **(*Figure 9*).**

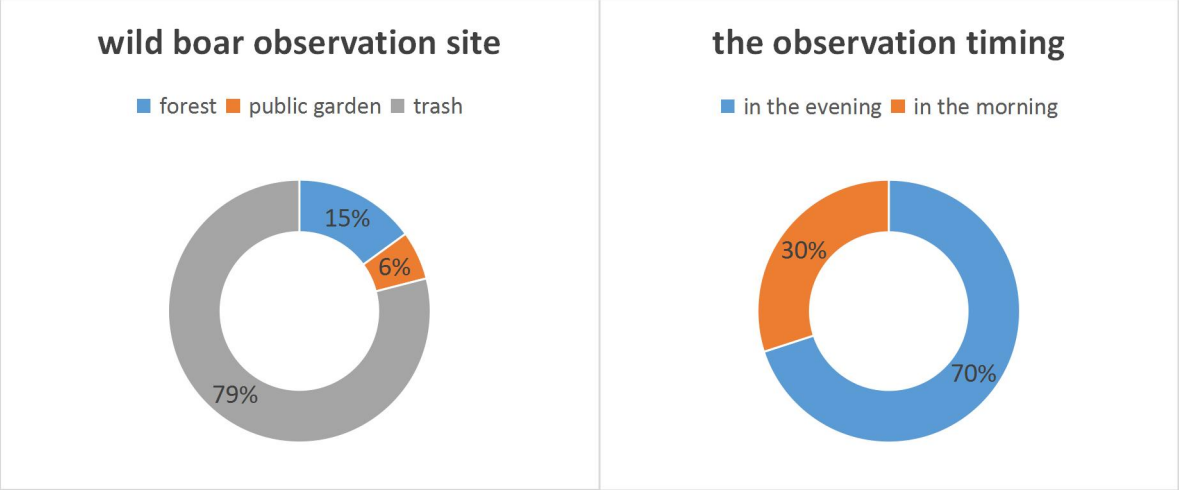


Figure 9: Location and time of sighting of the wild boar in the urban environment.

Regarding the social organization of wild boars, 50% of those surveyed observed wild boars moving in families (with piglets), not only in groups of adults (17%), but also solitary (28%) and in pairs (5%). **(*Figure 10*).**

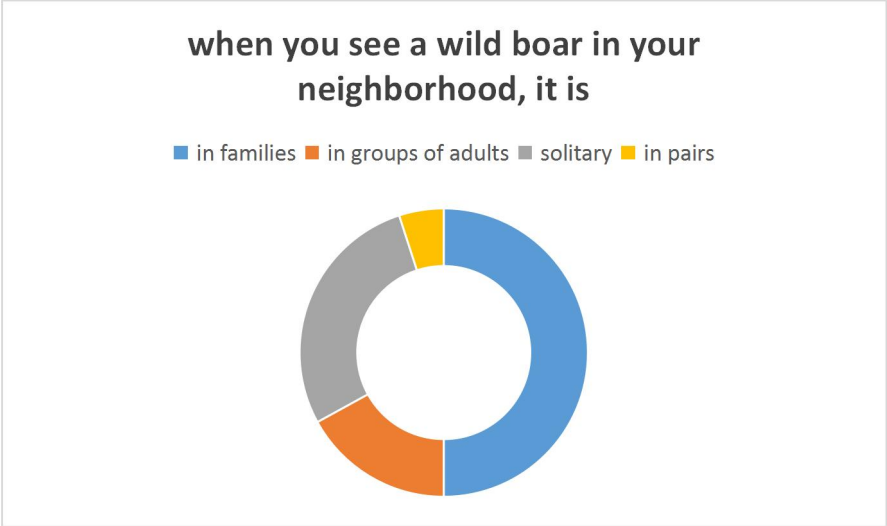


Figure 10: Social organization of wild boar in the urban environment

Among those surveyed, 44% observed wild boar in the company of cats, 35% saw it with dogs, 18% with rats, and 3% with cows. **(*Figure 11*).**

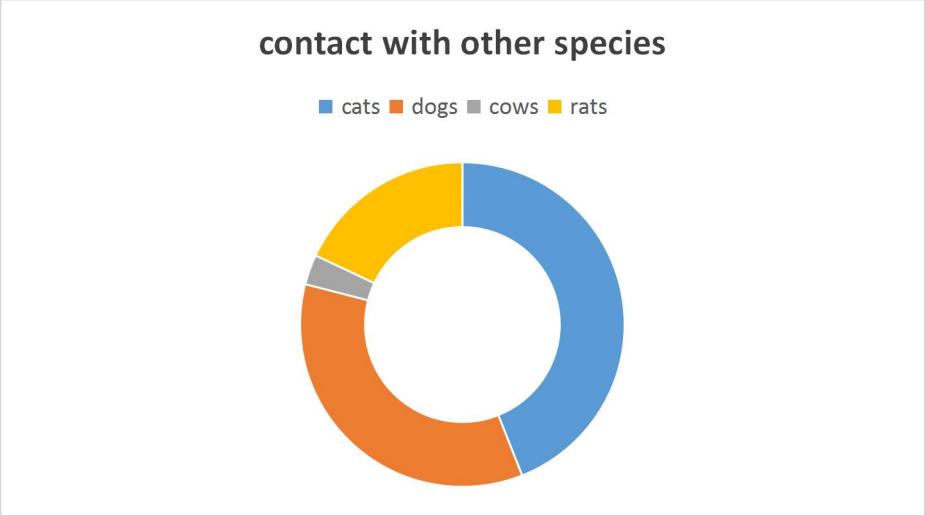


Figure 11: Contact of wild boars with other species

The evolution of the wild boar population in urban areas was the subject of a survey of residents regarding their perceptions.39% of them notices a significant increase in their population, 41% see a decrease, and 20% consider their population to be stable. **(*Figure 12*).**

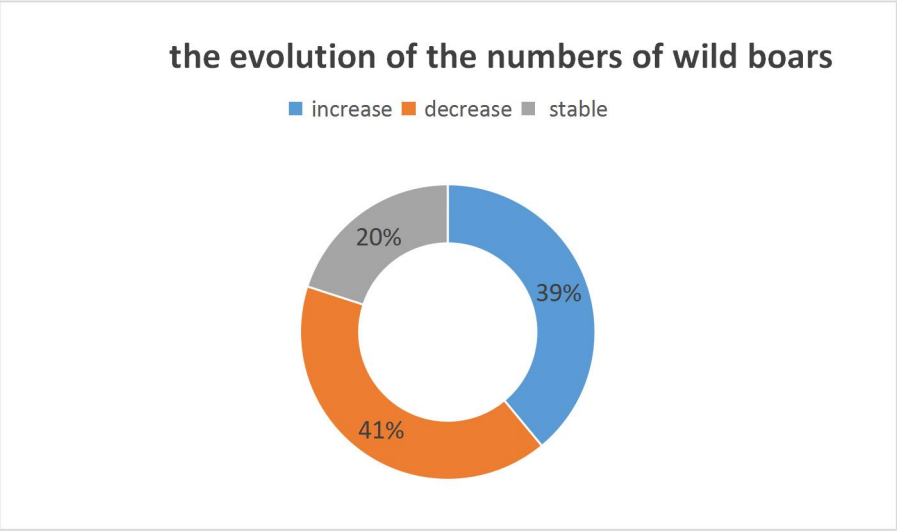


Figure 12: Perception of the citizens on the evolution of the numbers of boars.

According to this survey, wild boar is considered dangerous by 81% of respondents. 70% of respondents believe that the danger is caused by attacks on citizens and their property, while 18% point to the transmission of diseases. **(*Figure 13*).**

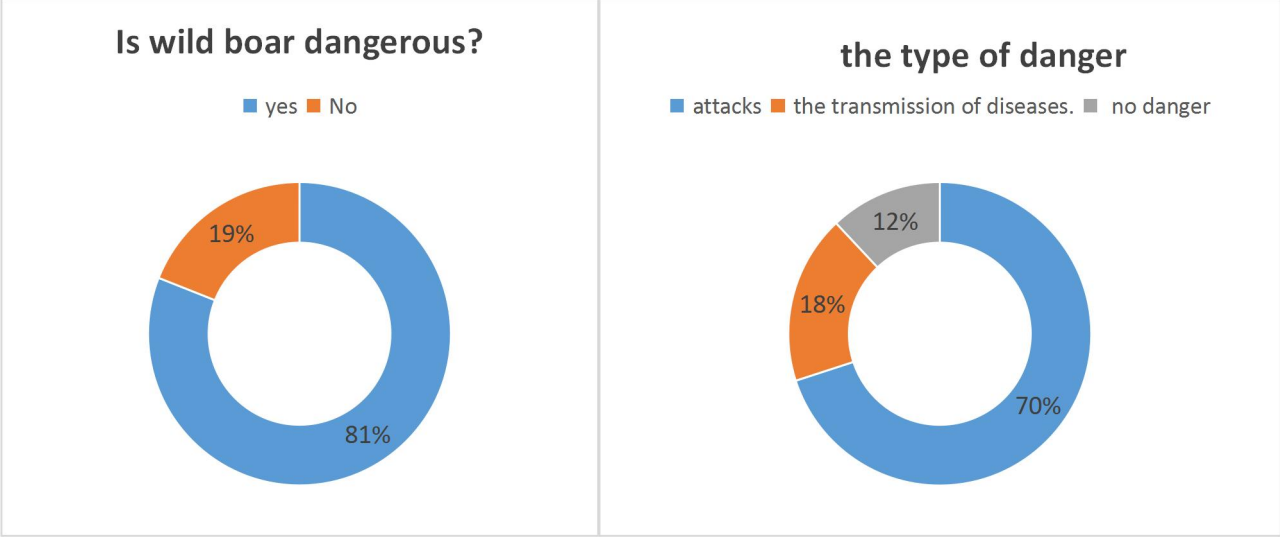


Figure 13: Perception of the danger posed by Boars in urban environment.

The results indicate that 88% of respondents view wild boar as having a negative effect on the environment, whereas 5% of citizens hold a positive opinion about their presence, and 7% of respondents perceive wild boar as having both positive and negative impacts **(*Figure 14*).**

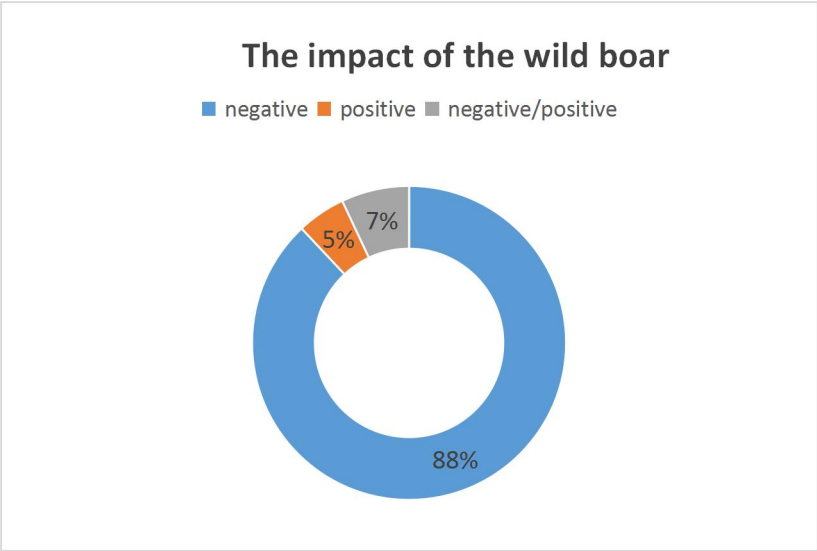


Figure 14: Perception of the impact of wild boar in the environment

1.2 Forestry officials:

a) Presence of wild boars and reported incidents:

According to responses from forestry officials ,the frequency of wild boar incidents reported over the past five years in Annaba and El Taref is frequent, indicating a persistent and significant conflict between humans and wild boars in these areas ***(Table 1).***

Table 1: Frequency of wild boar-related incident reports in Annaba and El-Taref

Frequency of reports	**Annaba**	**El-Taref**
Never	×	×
Rarely (1-2 times per year)	×	×
Occasionally (3-5 times per year)	×	×
Frequently (More than 5 times per year)	✓	✓

The most common issue in both regions is crop damage, reported consistently by respondents. In El-Taref, urban intrusion by wild boars is also a notable concern, unlike in Annaba where no such incidents were reported. Other types of conflicts,

such as damage to reforested areas, road accidents, livestock attacks, and public safety concerns, were not commonly reported in either region ***(Table 2)***.

Table 2: Types of wild boar-related conflicts reported.

Types of Reported Incidents	**Annaba**	**El-Taref**
Crop damage	✓	✓
Damage to reforested areas	×	×
Intrusion into urban areas	×	✓
Road accidents involving wild boars	×	×
Livestock attacks	×	×
Public safety concerns	×	×

As reported by forestry officials, in Annaba, wild boar conflicts have mostly affected rural areas, reflecting significant impacts on agricultural lands. In El Taref, both rural and urban areas were reported as being affected, indicating that the presence of wild boar extends beyond agricultural zones into inhabited urban spaces***(Table 3)***.

Table 3: Most affected areas by wild boar conflicts in Annaba and El Taref

Most Affected Areas	**Annaba**	**El-Taref**
Rural areas	✓	✓
Urban areas	×	✓
Protected areas/forests	×	×

Forestry officials reported that in Annaba, a significant increase in wild boar-related conflicts over the past five years, whereas in El Taref, the officials observed a slight increase. These findings suggest that the intensity and frequency of human-wild boar conflicts are escalating more rapidly in Annaba compared to El Taref. ***(Table 4).***

Table 4: Evolution of wild boar-related conflicts in Annaba and El Taref.

Evolution of the Conflict	Annaba	El-Taref
Increased significantly	✓	×
Increased slightly	×	✓
No change	×	×
Decreased slightly	×	×
Decreased significantly	×	×

b) Conflict management and response:

Hunting campaigns are the most common method, with additional strategies.However, more advanced or preventive strategies, such as the implementation of population control methods (e.g., sterilization) and the installation of fencing in high-risk areas, are notably absent in both areas In Annaba, there is a focus on educating the local population, helping communities to understand how to reduce interactions with wild boars ***(Table 5).***

Table 5: Current measures taken to manage wild boar conflicts.

Current Management Measures	Annaba	El-Taref
Organizing hunting campaigns	✓	✓
Implementing population control methods (e.g., sterilization)	×	×
Installing fencing in high-risk areas	×	×
Managing waste and food sources in urban areas	×	×
Educating and informing local populations	✓	×

Table 6 **s**ummarizes the level of coordination with various institutions in efforts to manage wild boar conflicts in Annaba and El-Taref. The data indicate that collaboration with local municipalities (APC) is the most consistent and reported in both wilayas. In contrast, cooperation with agricultural organizations and environmental agencies appears to be absent in both regions. El-Taref is the only region that reported active coordination with hunting associations. These results highlight the fragmented nature of institutional collaboration and underscore the importance of building multi-stakeholder networks for more effective and sustainable conflict mitigation.

Table 6: Collaboration with other institutions to manage wild boar conflicts.

Coordination with Other Institutions	**Annaba**	**El-Taref**
Agricultural organizations	×	×
Environmental agencies	×	×
Hunting associations	×	✓
Local municipalities(APC)	✓	✓

- **Effectiveness of Current Measures:**

In El Taref, the current strategies were considered effective, while in Annaba, they were viewed as partially effective, with a lack of funding and personnel identified as major limitations ***(Table 7).***

Table 7: Effectiveness of current strategies in reducing wild boar conflicts

The main limitations	**In Annaba**
Lack of funding	✓
Lack of personnel	✓
Ineffective regulations or enforcement	×
Lack of coordination between stakeholders	×

c) Future policies and strategies :

Current regulations and legislation on wild boar management are adequate in the provinces of Annaba and El Taref. When asked about strategies to better manage wild boar populations, participants strongly supported non-lethal control methods, such as sterilization, in both regions. In Annaba, preference is given to increasing hunting quotas and public awareness campaigns, while in El Taref, the emphasis is on increased investment in research and monitoring to improve management.

- **Government support for wild boar management in Annaba and El Taref** :

In El Taref, believe that the government provides sufficient support for wild boar management, while in Annaba, there is a general sentiment that the support is insufficient**.** This suggests differing perceptions of government involvement and resource allocation between the two regions.

2. Assessing wild boar (*Sus scrofa*) conflict in forested and agricultural zones: a case study from Guelma, Algeria:

This section presents findings from a questionnaire conducted in Guelma to assess human-wild boar conflict. The survey and interviews targeted forestry officials, representatives from the directorate of agriculture, farmers and hunters to evaluate the frequency of wild boar activity, the types of damage caused, and local perceptions of the issue.

2.1 Forestry officials and directorate of agricultural interests:

a) Presence of wild boars and reported incidents:

Both forestry officials and representatives from the Directorate of Agricultural Interests reported that wild boar-related incidents occur frequently-around five times per year and often more. This reflects a persistent and growing pattern of conflict in the region, as revealed through interviews.

Table 8: Frequency of wild boar-related incident reports in Guelma.

Frequency of reports	**forestry officials**	**The directorate of agricultural interests**
Never	×	×
Rarely (1-2 times per year)	×	×
Occasionally (3-5 times per year)	×	×
Frequently (More than 5 times per year)	✓	✓

Both forestry officials and representatives from the Directorate of Agricultural Interests identified damage to agricultural crops as the most frequently reported incident related to wild boars. According to the directorate of agricultural interests, wild boars have increasingly been observed entering urban zones, while other types of incidents, such as livestock attacks, risks to public safety, or disease transmission, were not mentioned by either group. This reflects the strong impact of wild boars on crop production in the region.

Table 9: Types of wild boar-related incidents reported by forestry officials and the Directorate of Agricultural Interests in Guelma.

Types of Reported Incidents	**forestry officials**	**The directorate of agricultural interests**
Crop damage	✓	✓
Damage to reforested areas	×	×
Intrusion into urban areas	×	✓
Road accidents involving wild boars	×	×
Livestock attacks	×	×
Public safety concerns	×	×

Both forestry officials and agricultural representatives identified rural areas as the most affected by wild boar presence. Forestry officials also highlighted significant impacts within forests and protected areas, while a small percentage reported occasional incidents in urban zones. These findings point to a strong concentration of wild boar-related conflict in rural and forested areas.

Table10: Most affected areas by wild boar activity as reported by forestry officials and the Directorate of Agricultural Interests in Guelma

Most Affected Areas	**forestry officials**	**The directorate of agricultural interests**
Rural areas	✓	✓
Urban areas	✓	×
Protected areas/forests	✓	×

- **Evolution of the Conflict:**

Both forestry officials and representatives from the Directorate of Agricultural Interests of Guelma reported "no change" in the evolution of the conflict related to wild boars. This uniform perception suggests a stable situation over time, with neither an escalation nor a reduction in conflict intensity as observed by both groups.

b) Conflict management and response:

According to ***Table 11***, both forestry officials and the Directorate of Agricultural Interests in Guelma reported coordination with hunting associations and local municipalities (APCs), reflecting a collaborative approach grounded in local stakeholder engagement. Additionally, the Directorate of Agricultural Interests reported cooperation with the forestry services, indicating some level of interdepartmental coordination. Notably, neither institution reported coordination with environmental agencies, revealing a gap in multi-sectoral engagement.

Table 11 : Institutional collaboration in wild boar management efforts in Guelma.

Coordination with Other Institutions	**forestry officials**	**The directorate of agricultural interests**
Environmental agencies	×	×
Hunting associations	✓	✓
Local municipalities(APC)	✓	✓
Forestry services	×	✓
Agricultural organizations	✓	×

- **Effectiveness of Current Measures:**

In Guelma, forestry officials view current measures as effective in managing the wild boar conflict. In contrast, representatives from the Directorate of Agricultural Interests believe the actions in place are insufficient, citing a lack of personnel as a major limiting factor. This contrast in perception reveals institutional differences and underscores the need for greater human and logistical resources to enhance conflict mitigation efforts.

c) Future policies and strategies :

Both forestry officials and representatives from the Directorate of Agricultural Interests agreed that the current laws and regulations governing wild boar management are adequate. This shared perspective suggests that stakeholders perceive the existing legal framework as appropriate for addressing the challenges posed by wild boar populations, even if practical implementation remains a concern.

- **Effectiveness of Current Measures**

This table presents the management strategies prioritized by two key stakeholder groups, forestry officials and representatives from the Directorate of Agricultural Interest, in response to wild boar-related challenges. The strategies assessed include increasing hunting quotas, implementing more lethal control methods, improving

damage compensation programs, investing in fencing, increasing funding for mitigation efforts, conducting public awareness campaigns, and suggesting other solutions. These findings underscore a shared recognition of the need for both direct control methods and broader preventive approaches to mitigate wild boar impacts effectively.

Table 12: Stakeholder prioritization of wild boar management strategies.

Priority Solutions	**forestry officials**	**The Directorate of Agricultural Interests**
Non-lethal population control (e.g., sterilization)	✓	×
Improved compensation programs for farmers	✓	✓
More investment in fencing and deterrents	×	×
Increased funding for research and monitoring	✓	✓
Public awareness campaigns	×	×
Increased hunting quotas	×	✓

- **Government Support**

Forestry officials reported receiving government support for wild boar management, whereas representatives from the Directorate of Agricultural Interest indicated a lack of such support for the agricultural sector. This contrast highlights a disparity in institutional backing, which may influence the effectiveness of coordinated management efforts.

2.2 Interviews with farmers :

This section presents the results of a questionnaire conducted with farmers in the Guelma region to explore the impact of wild boars on agricultural lands. The survey

aimed to evaluate the frequency of wild boar intrusions, the types of crop damage reported, and the methods used by farmers to mitigate these impacts. Data were collected through face-to-face interviews during field visits to five localities: **Ben Djerrah, Bordj Sabath, Dahouara, Guelaat Bousbaa, and Lakhzara *(figure 15)* .**

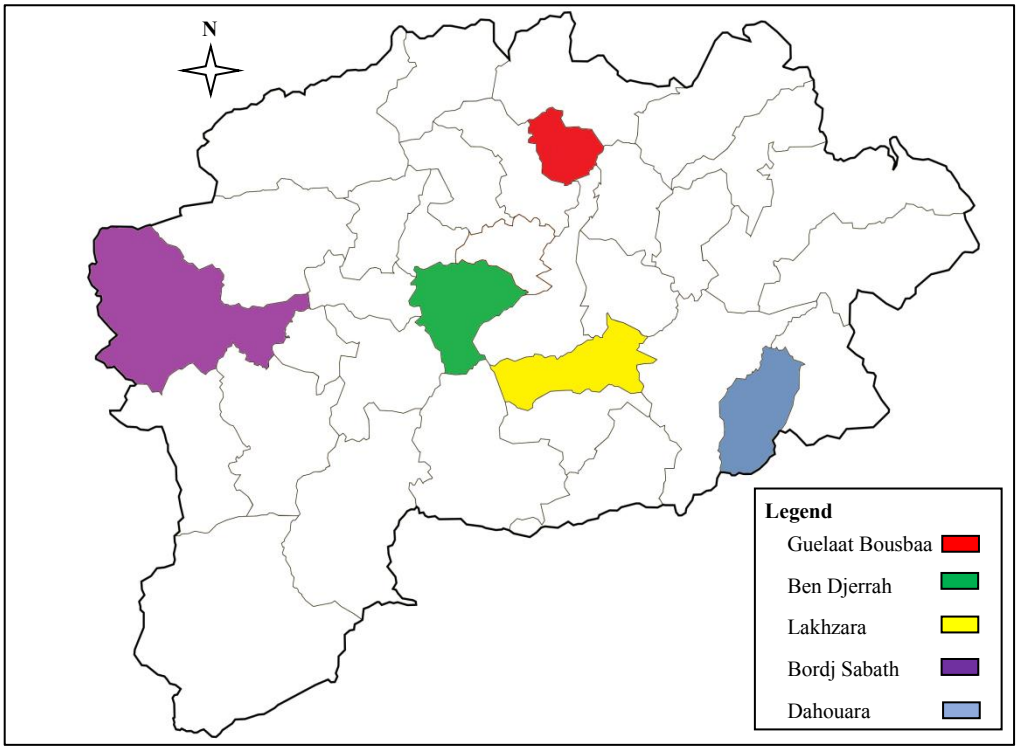


Fig 15: Map of Guelma Province, modified by the author.

source: Gifex.com

These sites were selected in coordination with the Forest Directorate to ensure coverage of the widest possible range of areas within Guelma province, capturing variation in both landscape and conflict intensity. The findings provide valuable insights into the daily challenges faced by farmers and the effectiveness of current mitigation strategies.

Table13: Number of farmers interviewed per locality in Guelma province

Locality	**Number of Respondents**
Ben Djerrah	25
Bordj Sabath	19
Dahouara	13
Guelaat Bousbaa	15
Lakhzara	10
Total	**82**

a) Evaluation of the damage caused by wild boars to crops

This chart illustrates the frequency of wild boar sightings reported across six locations in the Guelma region: Ben Djerrah, Bordj Sabath, Dahouara, Guelat Bousbaa, and Lakhzara. The data is categorized into four groups: Never, 1-2 times, 3-5 times, and More than 5 times. Notably, a high proportion of respondents in Ben Djerrah and Bordj Sabath reported seeing wild boars 3-5 times, while Guelat Bousbaa shows a significant number of sightings exceeding five times. In contrast, sightings are generally less frequent in Lakhzara and Dahouara.

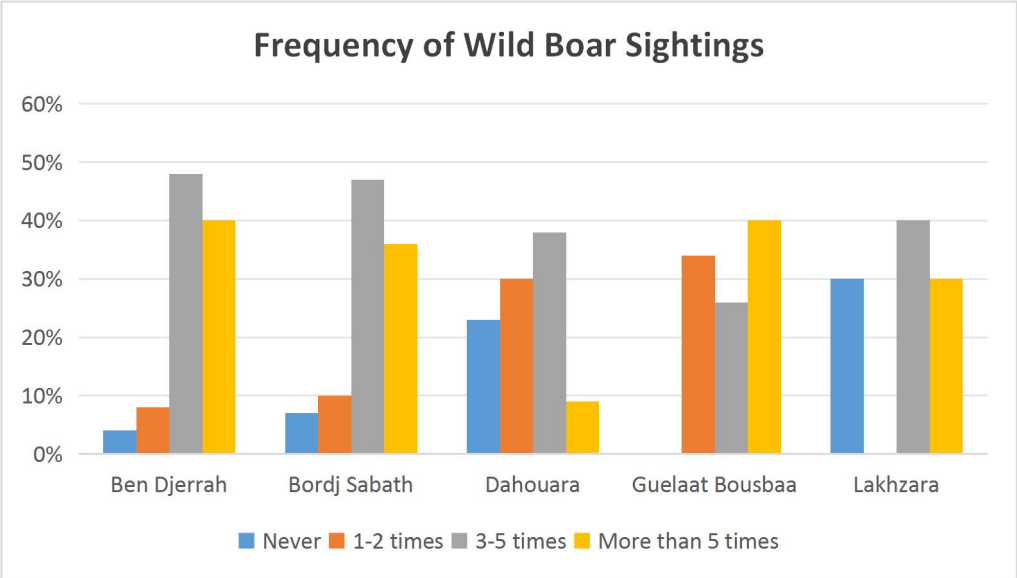


Figure 16: Distribution of wild Boar sightings across selected locations in Guelma.

This chart presents data on the extent of crop damage attributed to wild boars across five locations in Guelma: Ben Djerrah, Bordj Sabath, Dahouara, Guelat Bousbaa, and Lakhzara. The damage is categorized by area affected: less than 1 hectare, 1-3 hectares, 3-5 hectares, and more than 5 hectares. The highest percentage of severe crop damage (3-5 hectares) was reported in Ben Djerrah, followed by Dahouara and Bordj Sabath. In contrast, in Guelat Bousbaa and Lakhzara, damage tends to fall more frequently in the >5 hectares category, suggesting widespread impacts in those areas.

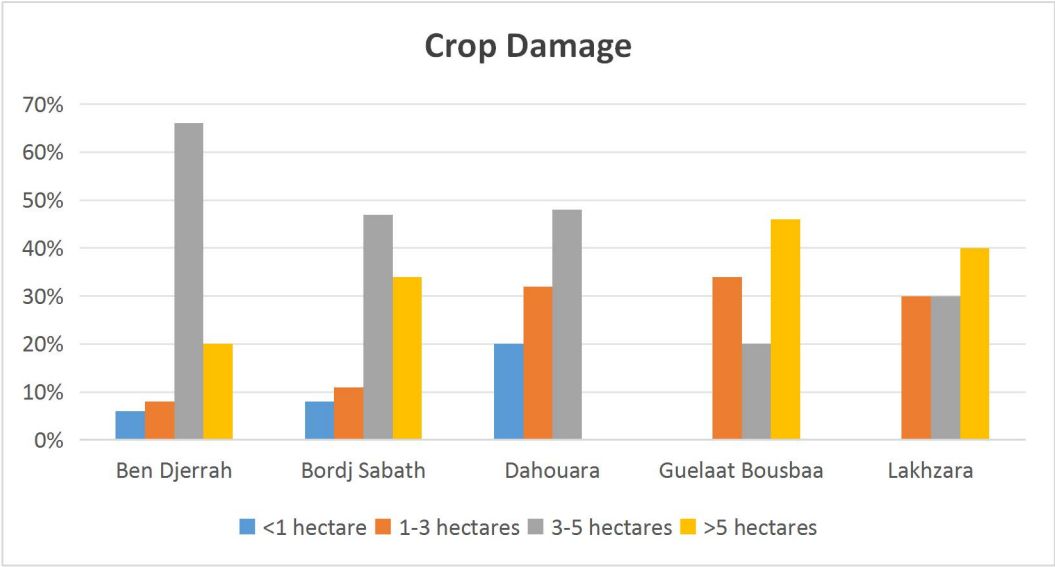


Figure 17: Extent of crop damage caused by wild boars in different locations of Guelma.

This chart displays the types of crops most affected by wild boar activity across five locations in Guelma: Ben Djerrah, Bordj Sabath, Dahouara, Guelat Bousbaa, and Lakhzara. Wheat is by far the most frequently damaged crop, with nearly or above 80% of respondents in all locations reporting losses. Other crop types such as fruit trees, vegetables, and corn show minimal damage in comparison. The results highlight wheat fields as the primary target of wild boar foraging, indicating significant economic implications for cereal production in the region.

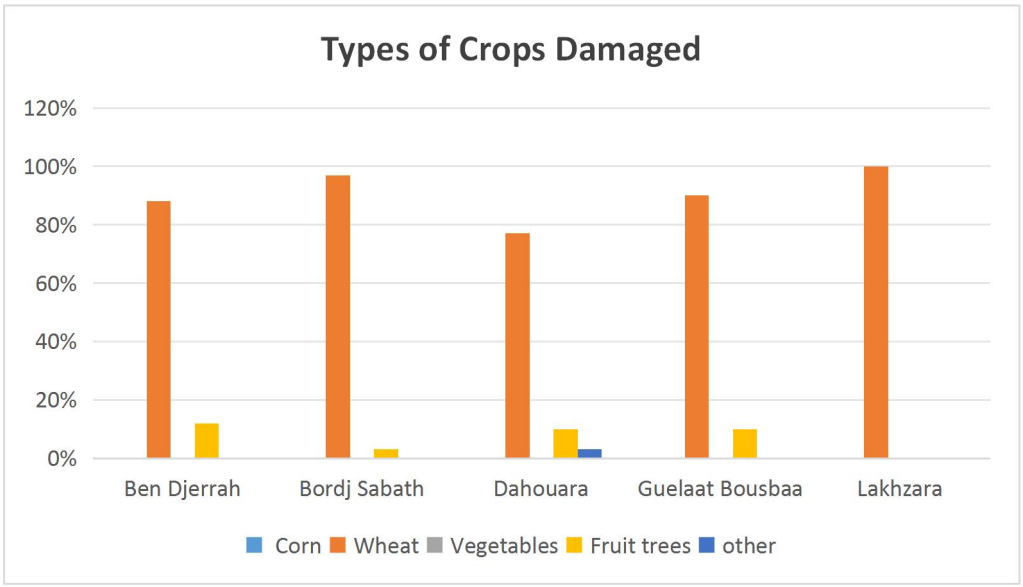


Figure 18: Types of crops damaged by wild boars in different areas of Guelma.

This figure presents data on the occurrence of wild boar hunting as reported by respondents in five regions of Guelma: Ben Djerrah, Bordj Sabath, Dahouara, Guelat Bousbaa, and Lakhzara. Guelat Bousbaa reports the highest rate of hunting activity, with approximately 70% of participants confirming its presence. In stark contrast, Bordj Sabath shows minimal hunting, with over 90% indicating no such activity. Ben Djerrah and Lakhzara show more balanced perceptions but still indicate limited hunting overall. Dahouara presents moderate activity, with about 30% confirming the practice.

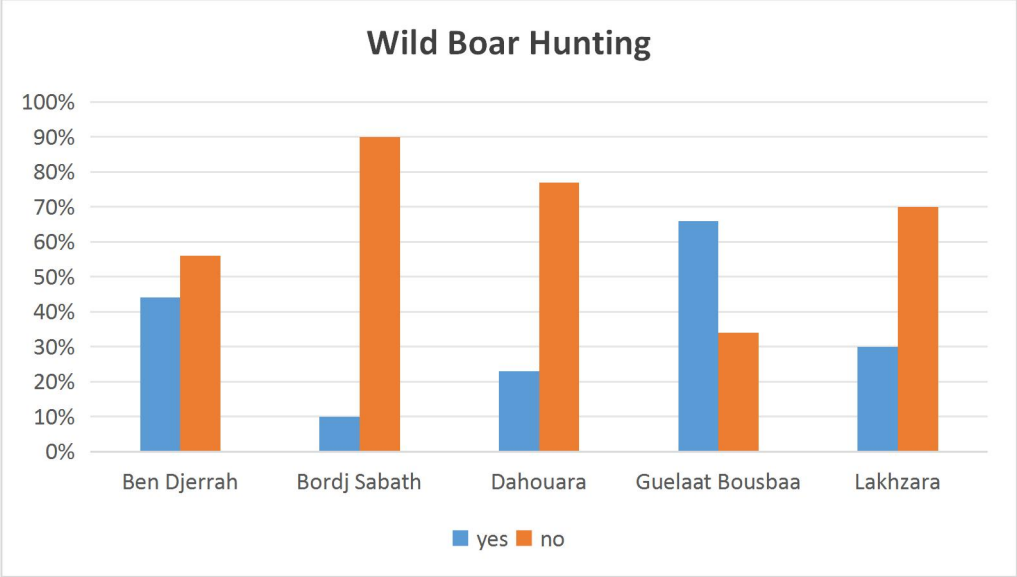


Figure19: Prevalence of wild boar hunting across selected areas in Guelma.

This figure summarizes the methods employed for wild boar hunting or control among those respondents who reported such activities. Firearms are the predominant method across all areas, with usage exceeding 80%. Night hunting is the second most utilized technique, particularly prominent in Dahouara, where it accounts for roughly 30% of responses. The use of traps and other less conventional approaches remains negligible throughout the surveyed regions.

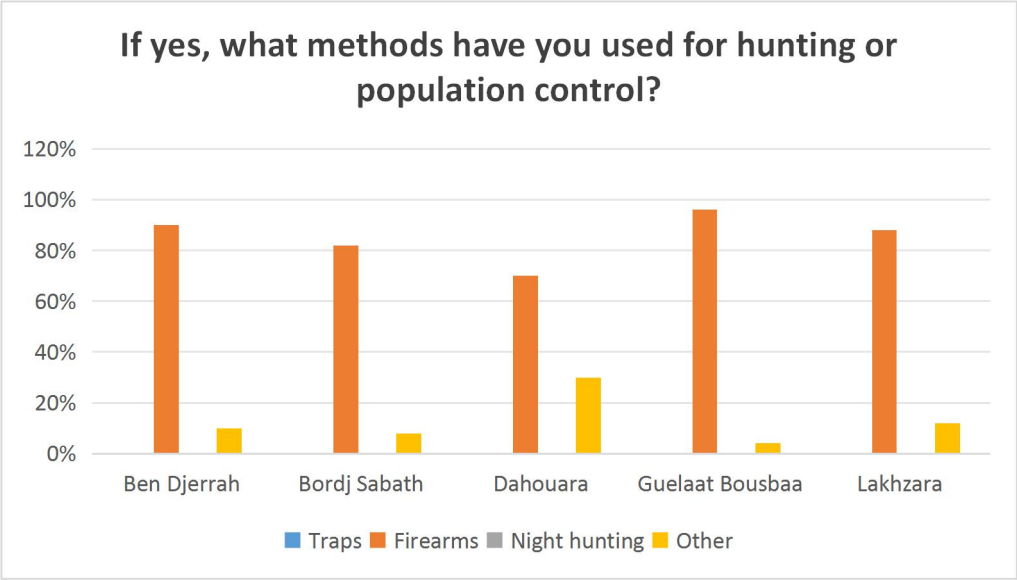


Figure 20: Methods used for wild boar hunting or population control.

This chart illustrates the distribution of wild boars hunted by respondents across five locations in Guelma: Ben Djerrah, Bordj Sabath, Dahouara, Guelat Bousbaa, and Lakhzara. The data is divided into four categories: None, 1-5 boars, 6-10 boars, and More than 10 boars. In Bordj Sabath, the majority of participants (over 70%) reported hunting between 1-5 wild boars, with minimal instances of either no hunting or higher numbers. Ben Djerrah and Dahouara exhibit more variation, with a considerable proportion indicating 6-10 boars hunted, although 1-5 remains the most frequent in Dahouara. In Guelat Bousbaa, responses are more evenly distributed, including a notable percentage hunting more than 10 boars. Lakhzara shows a similarly diverse pattern, with most respondents hunting 1-5 boars, alongside smaller but significant shares indicating higher figures.

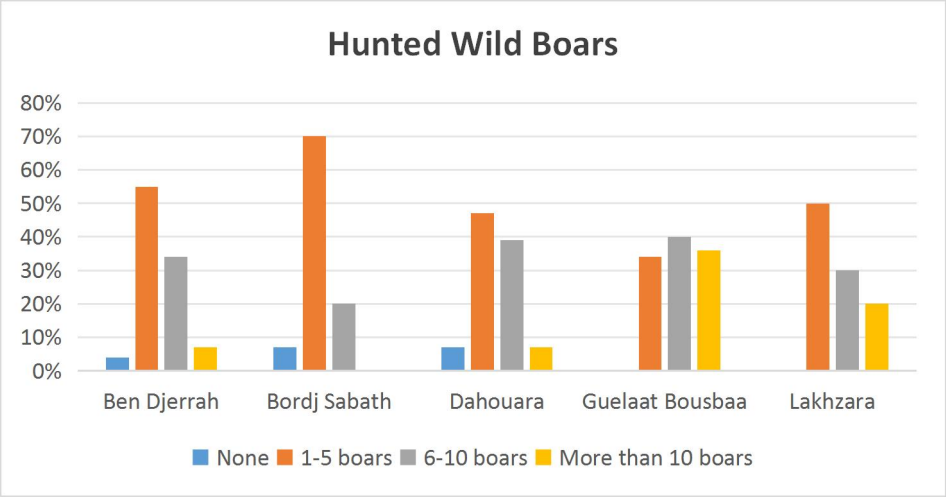


Figure 21: Number of wild boars hunted per respondent in different locations of Guelma.

2.3 Interviews to hunters in Guelma province:

Questionnaires were administreted through face-to-face interviews to hunters in Guelma Province. Each hunter was asked to his personal characteristics (age, level of education, occupation, resident area, monthly income, family condition) and his behavior towards hunting and present condition of hunting activities (number of days spent for hunting, if he hunt at night or not, reasons for selecting wild boar species, problems of hunting and perceived constraints related to declining number of days spent in hunting). Most of questions were chosen referring to previous similar studies.

Table 14: Personal characteristics of wild boar (Sus scrofa) hunters in Guelma

Personal characteristics	**items**	**n**	**(%)**
Age	30-39 years	3	10
	40-49 years	7	23.33
	50-59 years	10	33.33
	Over 60 years	10	33.33
Hunting experience (years)	0-9 years	4	13.33
	10-19 years	15	50
	20-29 years	6	20
	Over 30 years	5	16.67
Level of education	Analphabet	9	30
	Elementary school	7	23.33
	Lyceum	10	33.33
	University	4	13.33
Occupation	Public service	4	13.33
	Self employed	11	36.67
	Pensioner	15	50
Location of home	Urban area	21	70
	Rural area	7	23.33
	Mountainous area	2	6.67
Monthly income (DA)	15000-25000	12	40
	26000-50000	8	26.67
1 euro = 152 DA	Over 50000	10	33.33

Table 15: Hunting behavior of wild boar hunters in Guelma

Hunting Behavior	Items	n	(%)
Hunting frequency per month	1 time	3	10%
	2 times	12	40%
	3 times	7	23.33%
	4 times	8	26.67%
Hunting at night	Hunt	9	30%
	Don't hunt	21	70%
Hunting type if hunting at night	Individual hunt	2	22.22%
	Battues	7	77.78%

Figure 22 illustrates the primary motivations for hunting wild boar in the region of Guelma**.** The most commonly cited reason is leisure**,** accounting for approximately 50% of responses, indicating that hunting is often a recreational activity. This is closely followed by the motive to reduce agricultural damages**,** which represents around 40%**,** reflecting the significant impact of wild boar on crops and farms. A smaller proportion of respondents, about 8%, cited abundance,suggesting population control as a reason,while commerce was the least cited motive, comprising less than 2%, implying that economic gain is not a major driver of wild boar hunting in this area.

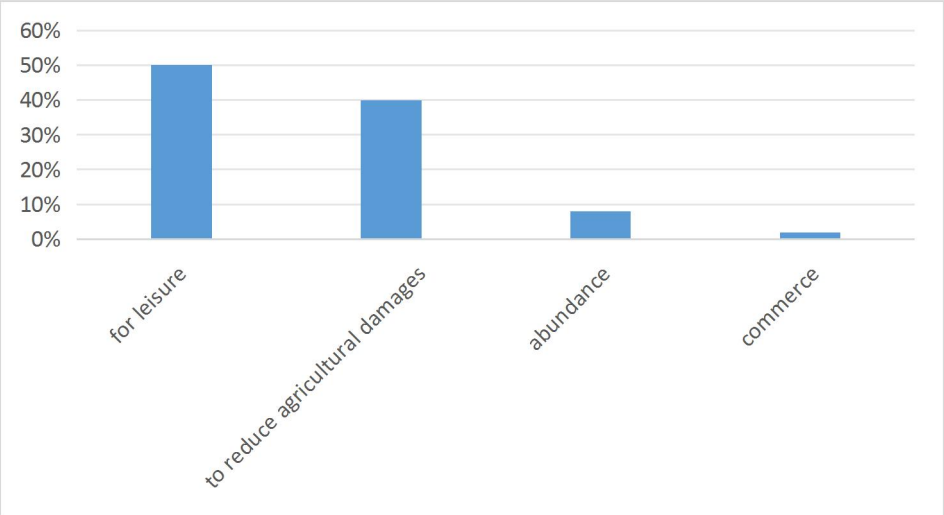


Figure 22: Reasons for hunting wild boar in Guelma

2.3.2 Hunting drives:

According to interviews conducted with members of three local hunting associations in Guelma Province, there is a clear variation in the number of organized wild boar hunting drives over recent years.The first one reported having organized 7 hunting drives**,** while another reported 5, and the third conducted only 4. These differences illustrate a disparity in hunting activity, which may be linked to factors such as resource availability, membership size, coordination with local authorities, and the level of perceived conflict in each area. The responses suggest that while hunting remains the primary method of wild boar population control, the level of engagement varies significantly between associations.

2.3.3 Wild boar harvest:

Interview data from three hunting associations in Guelma Province revealed variation in the number of wild boars harvested during recent hunting campaigns. The third association reported the highest number of wild boars culled, with 10 individuals, followed by the second association with 7, and the first with 6. These differences may reflect variations in hunting effort**,** organizational capacity, or wild boar abundance across different operational zones. The findings highlight not only the uneven distribution of hunting success but also the need for more coordinated and data-informed management approaches.

2.3.4 Population trends:

Interviews with three wild boar hunting associations in Guelma Province revealed contrasting perceptions of wild boar population trends. The first association reported an increasing population, which they attributed to factors such as reduced hunting pressure**,** land use changes**,** or favorable reproductive conditions**.** In contrast, the second association observed a declining trend, possibly linked to intensified hunting**,** habitat degradation**,** or the impact of disease**.** The third association described the population as stable, suggesting a balance between natural reproduction, mortality, and hunting activity. These differing assessments reflect the spatial variability in wild

boar dynamics across the region and emphasize the value of incorporating local knowledge into broader wildlife management and conflict mitigation strategies.

- **Some photos provided by local hunters:**

Wild boars (*Sus scrofa*) hunted by local hunters in Guelma, Algeria. These photos ***(figure 22 & 23)*** illustrate human intervention as a population control strategy and highlight the ongoing human-wildlife conflict in both mountainous and agricultural areas. Additionally***, (figure 24& 25)*** depicts a hunting scene where dogs are used to track and kill wild boars, a traditional yet controversial method that reflects cultural practices and local efforts to mitigate the ecological and agricultural impacts of wild boar overpopulation.


Figure 23 & 24: Wild boars (Sus scrofa) hunted by local hunters in Guelma using firearms. *(Source: anonymous hunter)*

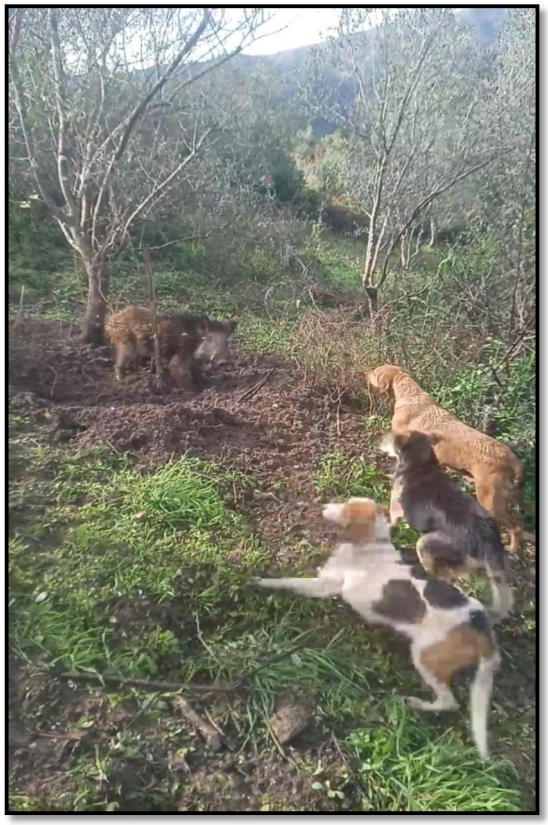



Figure 25 & 26: Wild boars (Sus scrofa) hunted by local hunters in Guelm using hunting dogs. *(Source: anonymous hunter)*

3. Assessing wild boar (*Sus scrofa*) conflict in protected natural areas: a case study from El Kala national park, Algeria:

This section presents the findings from the questionnaire administered to the administrative staff of El Kala National Park. The objective was to assess their perspectives on the occurrence, frequency, and impact of wild boar (*Sus scrofa*) within the park's boundaries, as well as their views on current management strategies and conservation priorities. Responses provided by park administrator's offer institutional insights into the challenges posed by wild boar populations in this protected area, including their effects on biodiversity and ecosystem stability. The results also underline the administrative capacity, resources, and inter-agency coordination involved in addressing this growing conflict.

a) Presence of wild boars and reported incidents:

- **Frequency of reporting:**

Over the past five years, incidents involving wild boars have been reported occasionally (3 to 5 times per year) to the park administration. This reflects a moderate but recurrent level of conflict affecting the park and surrounding areas.

- **Types of reported incidents:**

The main types of wild boar-related incidents include: Damage to agricultural crops, damage to forested or reforested areas,Intrusion into urban area,road accidents involving wild boars. Other types of conflict, such as disease transmission or livestock attacks, were not reported.

- **Most affected areas:**

The conflicts were reported most frequently in rural areas ,urban areas ,forests and protected areas.This indicates the wide-ranging impact of wild boars across different landscapes.

- **Evolution of conflict:**

According to the administration, the frequency of wild boar-related conflicts has increased slightly over the past five years. This trend suggests a gradual intensification of human-wildlife interactions in and around the park.

b) Conflict management and response:

- **Current management measures:**

In terms of actions already undertaken, the park administration reported implementing :Organization of hunting campaigns, public awareness and information initiatives.Other measures such as sterilization, fencing, waste management, or compensation for affected farmers have not been adopted by the institution at this time.

- **Coordination with other institutions**:

The administration confirmed that it collaborates with other stakeholders in managing wild boar conflicts. The entities involved include: forestry Services,local municipalities (APC) and environmental agencies.No partnerships with hunting associations, agricultural organizations, or other institutions were reported.

- **Effectiveness of current measures**:

The park administration believes that the current measures are effective in reducing conflicts with wild boars, although additional support and expanded interventions would be beneficial.

c) Future policies and strategies:

- **Legislation and regulations:**

The administration considers the current legal framework for wild boar management to be adequate No changes to existing legislation were recommended.

- **Strategies for priority management:**

To enhance wild boar control, the Government has given priority to the following measures: Non-lethal population control measures, such as sterilization ,fencing and other physical barriers, public awareness campaigns, ramping up hunting or extending compensation systems were not highlighted.

- **Governmental support:**

The present level of support by the authorities was deemed to be inadequate. The administration suggested creating scientific research as well as monitoring programs

to provide a fuller picture of how wild boar behaves in order to make more informed management choices.

d) Additional comments:

In their open-ended remarks, the park administration reiterated that current efforts are hampered by a lack of rigorous, science-based data. They called for the establishment of dedicated surveillance and research programs, specifically, long-term monitoring of wild boar movements, feeding ecology, and reproductive dynamics. According to the administration, collecting these empirical data would allow managers to quantify the true scale of the conflict and to design precisely targeted interventions, thereby moving beyond guesswork toward more effective, evidence-driven solutions.

❖ Discussion:

The wild boar (*Sus scrofa*) is among the most adaptable and widespread ungulates globally, but its increasing population density and behavioral plasticity have made it one of the most challenging species in human-wildlife conflict scenarios **(Massei et al., 2015; Barrios-García & Ballari, 2012)**. This study provides an integrated assessment of such conflict in Northeastern Algeria, namely in Guelma, Annaba, El Taref, and El Kala , by examining agricultural, urban, and protected areas.

The presence of wild boars in urban environments has been documented in numerous cities worldwide, reports had emerged from at least 44 cities or towns across 15 countries **(Cahill et al., 2012)**. Research from European and Asian cities has shown that wild boars increasingly exploit anthropogenic food sources such as garbage and food waste **(Stillfried et al., 2017; Shammer et al., 2024)**. These resources not only attract wild boars into urban areas but also elevate the risk of human-wild boar conflict **(Cahill et al., 2012; Gonzalez-Crespo et al., 2023)**. Our findings from Annaba and El Taref strongly align with these patterns. Field data indicate a notable rise in wild boar activity near garbage collection sites and peri-urban forest edges. Furthermore, public perception reinforces this concern: 81% of surveyed residents viewed wild boars as dangerous animals. This aligns with previous studies highlighting the risks of physical injury, disease transmission, and vehicle collisions associated with urban wild boar encounters **(Massei et al., 2011; Bevins et al., 2014)**.Notably, several respondents reported observing wild boars interacting with domestic animals such as cats and dogs. This behavior may increase the risk of zoonotic disease transmission, a concern that warrants further investigation **(Barrios-García & Ballari, 2012)**.

Forestry officials in both Annaba and El Taref confirmed that wild boar-related conflicts, particularly crop damage and urban intrusions, have become increasingly frequent. However, their evaluation of the institutional response diverged. In El Taref**,**

stakeholders viewed current measures, such as hunting campaigns and cooperation with municipalities and hunting associations, as effective and well-coordinated. In contrast, officials in Annaba described these strategies as only partially effective**,** citing limited funding**,** staff shortages, and lack of coordination as major obstacles. This institutional disparity aligns with broader findings that resource constraints and governance fragmentation hinder effective wildlife conflict mitigation **(Bevins et al., 2014; European Commission, 2019).**

In the rural areas of Guelma Province, particularly in regions such as Ben Djerrah, Bordj Sabath, Guelat Bousbaa, and Lakhzara, the human-wild boar conflict takes on a primarily economic dimension, especially in terms of crop losses. Farmers frequently reported significant damage to wheat fields, sometimes exceeding 5 hectares, which aligns with regional studies identifying cereals as a primary foraging target for wild boars **(Zhang et al., 2023; Apollonio et al., 2010).** Additionally, damage to reforested areas raises serious environmental concerns, as boar rooting behavior can compromise both restoration efforts and biodiversity goals **(Massei & Genov, 2004; Benotmane et al., 2022)**. A notable contrast emerged between forestry officials, who generally viewed current control measures positively, and agricultural stakeholders, who expressed frustration over the lack of support. This discrepancy reveals a lack of cross-sectoral coordination, a well-documented barrier to sustainable conflict mitigation **(Madden, 2004).**

Hunting, often promoted as a primary population control strategy, showed highly variable application across the Guelma region. While areas like Guelaat Bousbaa exhibit active hunting pressure, other localities such as Bordj Sabath report minimal engagement. Most hunting relies on firearms, with limited use of night hunting, despite wild boars being predominantly nocturnal **(Keuling et al., 2013; Quirós-Fernández et al., 2017).** This mismatch likely reduces hunting efficiency and may contribute to the persistence of conflicts in some areas. The low use of traps or fertility control options suggests a need to diversify management tools.

In El Kala National Park, the wild boar population is present and increasing, but stakeholders do not yet consider it a crisis. Nevertheless, administrators noted a slight increase in conflict over the past five years. Damage to forested areas and intrusion into urban spaces were the most commonly reported issues. The lack of scientific monitoring and reliance on organized hunting and awareness campaigns underscores the limitations of current approaches. Globally, experts recommend data-driven strategies involving spatial monitoring, ecological modelling, and stakeholder engagement to enhance adaptive management **(Vajas et al., 2020; Gaynor et al., 2024).**

Across all regions studied, a recurrent theme is the gap between existing legislation, generally seen as adequate, and its implementation, which is hampered by insufficient coordination, lack of personnel, and limited financial resources. This reflects a broader issue noted in wild boar literature: while regulatory frameworks may exist, practical management often fails without institutional integration and local community involvement **(Apollonio et al., 2017; Madden, 2004)**.

In summary, the human-wild boar conflict in Northeastern Algeria is driven by ecological expansion, agricultural vulnerability, urban encroachment, and fragmented institutional responses. Though hunting remains a cornerstone of population control, its effectiveness is limited unless complemented by preventative infrastructure (e.g., fencing), waste management, and non-lethal tools such as sterilization. Investing in long-term ecological monitoring and fostering multisectoral partnerships will be essential for sustainable conflict resolution.

To our knowledge, this is one of the first studies in Algeria to combine local stakeholder perceptions with ecological and institutional analysis on wild boar conflict.

Conclusion and Recommendations

❖ Conclusion

This research provides a comprehensive assessment of the growing human-wild boar (*sus scrofa*) conflict in Northeastern Algeria, with a particular focus on Guelma, Annaba, El Taref, and the El Kala National Park. The study reveals that this conflict is not only intensifying, but also deeply rooted in a web of ecological pressures, socio-economic vulnerabilities, and institutional limitations.

In agricultural zones such as Guelma, wild boars pose a serious threat to food security by damaging staple crops like wheat. Their destructive foraging behavior also undermines national efforts to restore degraded lands and protect biodiversity. In urban areas including Annaba and El Taref, wild boars are increasingly present in residential neighborhoods, drawn by poor waste management and unsecured garbage. This urban intrusion heightens public anxiety and introduces potential risks related to disease transmission and human safety.

Although the level of conflict in protected areas such as El Kala National Park remains relatively low, the lack of preventive measures, including population control and infrastructure like fencing, raises concerns about future escalation. The absence of proactive strategies may compromise both ecological integrity and conservation goals in the long term.

A key finding across all study sites is the disproportionate reliance on hunting as the main management tool. In the absence of complementary strategies, such as fencing, compensation programs, and public awareness campaigns, hunting alone proves insufficient to mitigate the conflict. Moreover, the study exposes serious institutional weaknesses, including fragmented responsibilities, inadequate funding, limited human resources, and weak coordination between relevant sectors.

Addressing this multifaceted issue requires a paradigm shift from reactive, short-term responses to proactive, integrated, and science-driven strategies. Effective

conflict mitigation must be grounded in strong inter-institutional collaboration, systematic ecological monitoring, sustainable land-use planning, and meaningful engagement of local communities. Only through such a holistic and inclusive approach can Algeria achieve a sustainable balance between wildlife conservation and human development in the face of this increasingly complex challenge.

❖ **Recommendations:**

The results of this study reveal that human-wild boar (*Sus scrofa*) conflict in Northeastern Algeria is widespread, multifaceted, and intensifying. Addressing this issue requires a shift from fragmented, reactive responses to integrated, evidence-based management. Based on empirical findings and supported by international research, the following key recommendations are proposed:

1. Strengthen institutional coordination:

Improving coordination between forestry departments, agricultural services, municipal authorities, and protected area managers is essential. The lack of cross-sectoral communication was identified as a key barrier to effective conflict mitigation in all surveyed areas. Establishing multi-agency working groups can improve information sharing, synchronize control measures, and enhance stakeholder trust **(Madden, 2004; Bevins et al., 2014)**.

2. Enhance monitoring and research capacity:

Wild boar management must be informed by ecological data. This includes tracking population size, distribution, seasonal behavior, and reproduction. Techniques such as GPS telemetry, camera trapping, and citizen reporting platforms can provide critical information for adaptive management **(Gaynor et al., 2024; Vajas et al., 2020).** Long-term monitoring is also crucial for evaluating the impact of hunting and non-lethal interventions.

3. Diversify conflict mitigation tools:

Relying solely on hunting is not sufficient to reduce wild boar impacts in the long term **(Massei et al., 2011; Quirós-Fernández et al., 2017).** A mixed-method approach should be adopted, combining:

- **Fencing and deterrents** to protect crops and sensitive zones **(Apollonio et al., 2017).**
- **Improved urban waste management** to reduce attractants **(Shammer et al., 2024).**
- **Experimental fertility control** (e.g., immunocontraceptives), which shows promise in non-urban areas where reproduction drives overpopulation **(Massei et al., 2011).**

4. Improve funding, human resources, and infrastructure:

Institutional stakeholders in Annaba and Guelma cited severe limitations in personnel, equipment, and funding. Adequate investment is required to implement fencing, patrols, and response systems **(Bevins et al., 2014)**. Financial resources should also support damage compensation programs for farmers, an approach used in several European contexts to maintain social tolerance **(Apollonio et al., 2017).**

5. Promote public education and community participation:

Public engagement is important, especially in urban areas where inhabitants often directly interact with wild boars. Also, educational campaigns can encourage safe behaviour, discourage feeding, and increase public support for management efforts **(Madden, 2004; Barrios-García & Ballari, 2012)**. On the other hand, local hunting groups should also be trained and integrated into regional management plans, putting their efforts towards conservation objectives.

To support future research and practical data collection on the human-wild boar conflict, several template tables were developed as part of the recommendations section of this study. These tables are designed for use by stakeholders such as forestry officials, agricultural services and urban authorities to systematically record conflict-related data in the field.

The complete set of editable tables is available in the Excel file accessible at the

following link: ..\Click here to access the Excel data table.xlsx

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https://indo-germanbiodiversity.com

https://www.hwctf.org/policies

Appendices

1. Supplementary Material (Excel Tables)

The file contains editable templates for data recording by forestry, agriculture, and municipal services.

→ ..\Download here.xlsx

2. Questionnaire Samples

A. Questionnaire for Administrative Authorities on the Human-Wild Boar Conflict in the city:

1. General Information

1.1 Respondent Information

- Name (optional): _____
- Function :

  ☐ Local authority (APC, CET)

  ☐ Forest Service Agent

  ☐ Representative of an environmental agency

  ☐ Other (please specify): _____

- Institution/Department: _____
- Municipality/Province: _____

2. Presence of Wild Boars and Reported Incidents

2.1 Frequency of Reporting

Over the past five years, how often have incidents involving wild boar been reported to your institution?

☐ Never

☐ Rarely (1 to 2 times per year)

☐ Occasionally (3 to 5 times per year

☐ Frequently (more than 5 times a year)

2.2 Types of Reported Incidents

What types of wild boar conflicts have been reported to your institution? (Check all that apply)

☐ Damage to agricultural crops

☐ Damage to forested or reforested areas

☐ Intrusion in an urban environment

☐ Road accidents involving wild boars

☐ Attacks on livestock

☐ Risks to public safety

☐ Disease transmission (e.g. swine fever)

☐ Other (please specify): _____

2.3 Most Affected Areas

Which areas of Guelma are most affected by conflicts with wild boars? Please specify:

Rural areas **:** _____

Urban areas **:** _____

Forests / Protected areas **:** _____

Other (please specify) **:** _____

2.4 Evolution of the Conflict

How has the frequency of conflicts with wild boars evolved over the last five years?

☐ Increased sharply

☐ Slightly increased

☐ No change

☐ Slightly decreased

☐ Decreased sharply

3. Conflict Management and Response

3.1 Current Management Measures

What actions have been implemented by your institution to manage the conflict with wild boars? (Check all that apply)

☐ Organization of hunting campaigns

☐ Implementation of population control methods (e.g. sterilization)

☐ Installation of fences in risk areas

☐ Management of waste and food sources in urban areas

☐ Public awareness and information

☐ Compensation for affected farmers

☐ No specific measures ☐ Other (please specify): _____

3.2 Coordination with Other Institutions

Does your institution collaborate with other actors to manage the conflict with wild boars?

☐ Yes

☐ No

If yes, which entities do you work with? (Check all that apply)

☐ Forestry services

☐ Local municipalities (APC)

☐ Hunting associations

☐ Environmental agencies

☐ Agricultural organizations

☐ Other (please specify): _____

3.3 Effectiveness of Current Measures

Do you think that the measures implemented are effective in reducing conflict with wild boars?

☐ Yes

☐ No

☐ Partially

If no or partially, what are the main limitations? (Check all that apply)

☐ Lack of funding

☐ Lack of staff

☐ Ineffective or poorly enforced regulations

☐ Lack of coordination between the actors involved

☐ Other (please specify): _____

4. Future Policies and Strategies

4.1 Regulation and Policy

Do you think that current laws and regulations on wild boar management are adequate?

☐ Yes

☐ No

☐ Don't know

If not, what changes do you suggest?

4.2 Priority Solutions

In your opinion, what strategies should be implemented to better manage wild boar populations in the city ? (Check all that apply)

☐ Increase hunting quotas

☐ Implement non-lethal population control methods (e.g. sterilization)

☐ Improve compensation programs for affected farmers

☐ Invest more in fencing and deterrents

☐ Increase funding for research and population monitoring

☐ Implement public awareness campaigns

☐ Other (please specify): _____

4.3 Government Support

Do you think the government provides sufficient support for wild boar management?

☐ Yes

☐ No

☐ Don't know

What types of additional support would be needed?

5. Additional Comments

Please share any other comments or suggestions on managing the conflict with wild boars in the city

B. Questionnaire for Farmers: evaluation of the damage caused by wild boars to crops

1. **Where is your farmland located?**
2. **Frequency of Wild Boar Sightings**
   In the past five years, how many times have you noticed signs of wild boar activity (e.g., tracks, rooting, damaged crops) in your fields?

   ☐ Never

   ☐ 1-2 times

   ☐ 3-5 times

   ☐ More than 5 times

3. **Crop Damage**
   In the past five years, how many hectares of crops do you estimate have been damaged or lost due to wild boars?

   ☐ <1 hectare

   ☐ 1-3 hectares

   ☐ 3-5 hectares

   ☐ >5 hectares

4. **Types of Crops Damaged**
   Which types of crops have been most affected by wild boars? Please estimate the affected area in hectares for each:

- Corn: _____ hectares
- Wheat: _____ hectares
- Vegetables: _____ hectares
- Fruit trees: _____ hectares
- Other: _____ hectares

5. **Wild Boar Hunting**

Have you attempted to hunt or control the wild boar population on your land?

☐ Yes

☐ No

If yes, what methods have you used for hunting or population control? (Select all that apply)

☐ Traps

☐ Firearms

☐ Night hunting

☐ Other (please specify): _____

6. **Hunted Wild Boars**

In the past five years, how many wild boars have you hunted on your property?

☐ None

☐ 1-5 boars

☐ 6-10 boars

☐ More than 10 boars

C. Resident Wild-Boar Sighting & Perception Survey

1. Gender

☐ Male

☐ Female

2. Age

☐ 18–30

☐ 31–45

☐ Over 46

3. **Have you ever seen wild boars in your neighbourhood?**

☐ Yes

☐ No

4.When you see wild boars, do you usually observe them:

☐ Alone

☐ In pairs

☐ In groups of adults

☐with their young

5. Where do you most often see wild boars?

☐ trash

☐ public garden

☐ near to forests

6. At what time of day do you most often see them?

☐ Morning

☐ Afternoon

☐ Evening

7. Have you seen wild boars accompanied by any of these animals?

☐ Cats

☐ Dogs

☐ Cows

☐ Rats

8. In your observation over the past year, the number of wild boars in your area is:

☐ Increasing

☐ Decreasing

☐ Stable

10. in your opinion, are wild boars dangerous?

☐ Yes

☐ No

11. Overall, how would you describe their impact in your neighbourhood?

☐ Negative

☐ Positive

☐ both

D. Questionnaire for Hunting NGOs

1. Personal characteristics :

1) Age :

☐ 30-39 years

☐ 40-49 years

☐ 50-59 years

☐ Over 60 years

2) Hunting experience (years):

☐ 0-9 years

☐ 10-19 years

☐ 20-29 years

☐ Over 30 years

3) Level of education:

☐Analphabet

☐ Elementary school

☐ Lyceum

☐ University

4) Occupation:

☐ Public service

☐ Self employed

☐ Pensioner

5) Location of home :

☐ Urban area

☐ Rural area

☐ Mountainous area

6) Monthly income (DA) :

☐ 15000-25000

☐ 26000-50000

☐ Over 50000

2. Hunting Behavior :

1) Hunting frequency per month :

☐ 1 time

☐ 2 times

☐ 3 times

☐ 4 times

2) Hunting at night :

☐ Hunt

☐ Don't hunt

3) Hunting type if hunting at night:

☐ Individual hunt

☐ Battues

3. Reasons for hunting wild boar in Guelma:

☐For leisure

☐To reduce agricultural damages

☐Abundance

☐Commerce

4. To your knowledge, how many wild boars were hunted by your associations over the past five years?

☐ None

☐1–5 drives

☐6–10 drives

☐ More than 10 drives

☐I don't know

5. To your knowledge, how many wild boars were hunted by your associations over the past five years?

☐None

□1–5 boars

□6–10 boars

□More than 10 boars

☐ I don’t know