INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH AND INNOVATIVE STUDIES
ISSN: 2820-7157
www.ijsrisjournal.com

April 2026 Volume 5 Number 2 286-297

Received Date: 22 February 2026 Accepted Date: 14 March 2026 Published Date: 2 April 2026

Perceptions of Climate Change Among Market Gardeners in N'djili Brasserie, Mikondo Neighbourhood, in the City-Province of Kinshasa, D.R. Congo

Kwatenge Nsele Jonathan [1], Buluku Palamoke Grace [1], Ntantay Judicael [1], Luvezo Tshimpangila Divine [3], Mosete Bungalasa Corneille [2], Ruzindana Joseph Idriss [(4,5)], Kakule Kasereka Roland [(1,2)]

1. Centre for Geological and Mining Research (CRGM), Kinshasa, jonathankwatenge@gmail.com
2. National Pedagogical University (UPN), Faculty of Science and Technology, Kinshasa
3. Centre for Research in the Humanities, Kinshasa
4. National Centre for Remote Sensing (CNT), Kinshasa
5. Higher Pedagogical Institute (ISP), Department of Geography, Tshikapa

Abstract

The Mikondo district was a village under the authority of traditional chiefs. From 1926 onwards, it was home to Kinshasa's first brewery, formerly known as the 'Brasserie de Léopoldville', which earned it the nickname 'N'djili-Brasserie'.

In 1968, a presidential decree issued by President Mobutu officially incorporated Mikondo as a district of the commune of N'Sele, transferring its administration from the traditional authorities to state bodies, located south of the city-province of Kinshasa (DRC), an agricultural experiment that enables them to observe and interpret climate change with precision. The results show that the perception of climate change is widely shared: market gardeners note a shift in the seasons and frequent flooding.

Keywords: climate change, perception, market gardener, R software, Mikondo

1. Introduction

Climate change represents a major challenge for agriculture worldwide. Its impacts are particularly felt in developing countries, where agricultural systems often remain vulnerable to climatic variations. The Mikondo neighbourhood, commonly known as N'djili Brasserie, located in the commune of N'sele in the city-province of Kinshasa, capital of the Democratic Republic of the Congo, perfectly illustrates this reality. Market gardeners in this area, who are heavily dependent on weather conditions for successful harvests, face a range of challenges linked to rainfall variability, rising temperatures and the increased frequency of extreme weather events.

Farmers' perceptions of climate change play a decisive role in their ability to adapt and implement effective strategies to improve their productivity. Indeed, the way market gardeners interpret the signs of climate change influences their technical choices, their resource management and their resilience to climate hazards. In this context, it is essential to understand

how these farmers perceive the risks associated with climate change to their production.

This study aims to examine the perception of climate change among market gardeners in N'djili Brasserie and to analyse the strategies they implement to improve their agricultural productivity. Through field surveys and interviews with local stakeholders, this study aims to identify the specific challenges these farmers face, as well as the solutions they are considering or already implementing to adapt to new climatic realities. The findings of this research will not only provide a better understanding of the local dynamics of climate change, but also enable the formulation of concrete recommendations to support market gardeners in their pursuit of sustainable and resilient agriculture.

- How do market gardeners in N'djili Brasserie perceive climate change and its potential effects on their agricultural production?

This research is based on the hypothesis that market gardeners in N'djili Brasserie perceive climate change as a growing threat to their production, characterised by unpredictable rainfall, high temperatures and crop losses.

2. Materials and Methods

This section of the research describes the spatial scope of the study as well as the technical and methodological approaches employed. It begins by presenting the study area, situating the Mikondo neighbourhood within its geographical context. It then outlines the materials and methods used, specifying the nature of the data collected, the analytical tool (GIS); the field survey form; and the R software, as well as the main stages of data processing and interpretation that led to the production of the results.

2.1. Study Area

The Mikondo neighbourhood is situated on terrain characterised by plateaus and small hills, with sandy, slightly undulating soil and subsoil.

Covering an area of 18 km², Mikondo is crossed by three main rivers—the N'djili, Bansimba and Nsingu-Ndumba—which provide a favourable environment for the development of local agriculture thanks to the abundance of water and the fertility of the land.

Before 1968, the Mikondo district was a village under the authority of traditional chiefs. From 1926 onwards, it was home to Kinshasa's first brewery, formerly known as the 'Brasserie de Léopoldville', which earned it the nickname 'N'djili-Brasserie'.

In 1968, a presidential decree issued by President Mobutu officially incorporated Mikondo as a district of the commune of N'Sele, transferring its administration from the traditional authorities to the state authorities.

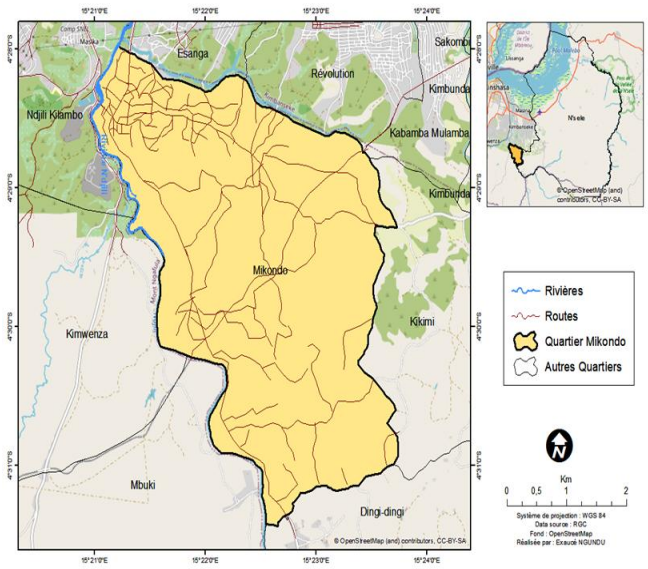

Figure 1: Overview of the Mikondo district

The Mikondo district is bounded as follows:

- To the north: by the Bansimba River, which separates it from the municipality of Kimbanseke;
- To the south: by the Nsingu-Ndumba River, which separates it from the Dingi-Dingi district;
- To the east: by Edo-Mafuku Avenue, which separates it from the Kikimi district;
- To the west: by the N'djili River, which separates it from the municipality of Mont-Ngafula.

2.2. Materials and methods

This research was conducted using a range of proven methods and tools, widely employed in similar geographical and environmental studies. These approaches enabled a rigorous and integrated analysis of the study area, involving field observation, processing of data collected in the field, and a systemic interpretation of market gardeners' perceptions of climate change.

- The descriptive method: This was useful in describing our study area, the Mikondo

neighbourhood—commonly known as N'djili Brasserie—located in the commune of N'sele, as well as all market gardening activities in the said neighbourhood.

- The analytical method was used to characterise the Mikondo neighbourhood through our survey data and observations; this method enabled us to analyse the information received in greater detail in order to draw conclusions that would allow us to determine and evaluate market gardeners' different perceptions of climate change, with a view to proposing sustainable strategies for green agriculture.

- The systemic method This method is commonly used in geographical and environmental science research, urban planning and spatial planning, etc. It enables us to understand the consequences of climate change on agricultural production.

- The systemic method has been useful to us in understanding the relationship between climate change and market gardening, the reciprocal relationship that influences our study area.

- The cartographic method will enable us to produce administrative maps of the neighbourhood and the municipality

- Documentary technique

According to Gacha (1971), in his general sociology textbook, the documentary technique involves the study and analysis of documents in order to identify the events or phenomena covered by the documentation, which leads to evidence.

Document review is one of the basic techniques in scientific research in general, and in Geography and Environmental Sciences in particular.

It involves reading scientific papers and works related to the subject of study.

This technique has helped us gain an overview and a clear direction for the development of our research and an understanding of our research field.

- Survey methodology

A survey is a primary data collection method based on a questionnaire administered to a sample drawn from a target population.

It can take various forms, such as a poll, an interview, a cross-sectional study, etc.

We used this technique in the field, along with our research letter, to distribute a survey questionnaire to the target population.

- Interview technique

The interview is an excellent data collection technique used to fill in gaps in the information during our investigations.

Furthermore, or in other words, certain technical questions require more detailed explanations to enable some respondents to answer our survey questionnaire.

This technique enabled us to familiarise ourselves with the study environment whilst getting to know the residents of the site under study, including the head of the local council department, the head of the neighbourhood in question, and the target population.

- The R software

R is a programming language and statistical software designed to perform complex statistical analyses, manipulate databases, produce professional graphs and automate calculations or reports. It is widely used in environmental sciences, social sciences, agriculture, geography, etc. In the context of this study, R was useful to us for:

- Analysing the results of our survey (frequencies, averages, correlations, etc.);

- Create clear graphs to visualise perceptions and the perceived effects of the climate;

- Process observational data (weather, soil, etc.);

- Perform statistical tests to validate hypotheses.

Table 1: Summary of the equipment and methods used

Category	Materials / Methods	Objective / Contribution
Descriptive method	Direct field observation	To describe the physical and human environment of Mikondo
Analytical method	Analysis of survey and field data	Market gardeners' perceptions of climate change
Systemic approach	Integrated analysis of pressure factors	Understanding ecological and social interrelationships
Cartographic method	ArcGIS 10.8	Map production
Literature review	Books, articles, technical reports	Strengthening the theoretical and scientific basis
Field surveys	Questionnaires for market gardeners and economic operators	Collecting socio-environmental data
Analysis of results	R software	Analysing the results; Creating graphs

3. Results

The main results from the survey of 80 market gardeners in N'djili Brasserie. The results are organised into four areas: (i) the socio-demographic profile and characteristics of the farms, (ii) perceptions of climate change, (iii) the impacts on market gardening, and (iv) access to information.

3.1.1. Level of education

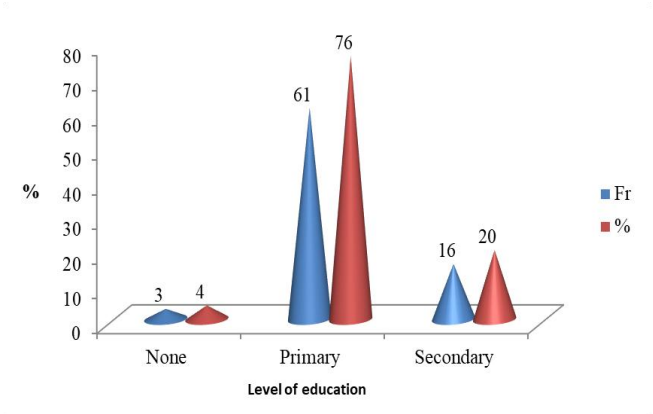

Figure 2: Distribution of market gardeners by educational attainment

Figure 2 shows the educational attainment of the market gardeners surveyed. The majority (76%) have completed primary education, 20% secondary education, whilst 4% report having no formal education. None of the respondents have completed higher education.

This low level of schooling may limit access to certain written technical information (guides, agro-meteorological bulletins, input leaflets, etc.) and increase dependence on informal channels (neighbours, cooperatives) for acquiring knowledge. The Spearman correlation between educational attainment (dependent variable) and the perceived intensity of the impact nevertheless shows a positive relationship, suggesting that producers with a higher level of education better understand and identify the challenges associated with climate change.

3.1.2. Experience in market gardening

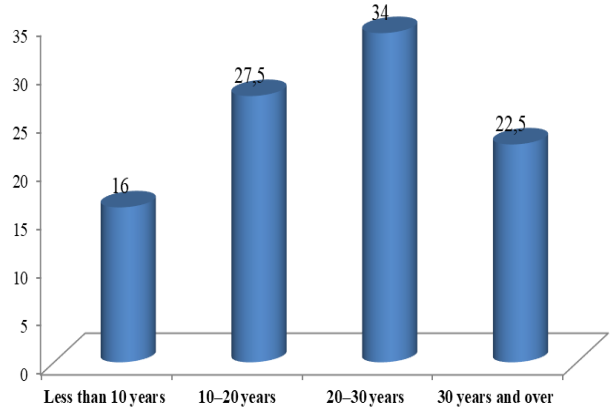

Figure 3: Distribution of market gardeners by years of experience

The years of experience of market gardeners are summarised in **Figure 3**. The results show that 16% of producers have less than 10 years' experience, 27.5% between 10 and 20 years, 34% between 20 and 30 years, and 22.5% have 30 years' experience or more.

Thus, a large majority of respondents have more than 10 years' experience, and over half have more than 20 years. Market gardening therefore appears to be a long-established activity, which often constitutes the main source of income and livelihood.

The Spearman correlation between experience (dependent variable) and the perceived intensity of climate impact shows a strong and significant relationship: the longer the experience, the more market gardeners consider that climate change has a significant impact on their work. This

observation can be explained by the fact that experienced producers compare changes in seasons, yields and climatic hazards over a longer period.

3.1.3. Land tenure and plot size

Information on land tenure is summarised in **Figure 4**. The results reveal that 42.5% of market gardeners own their plots, whilst 57.5% are tenants.

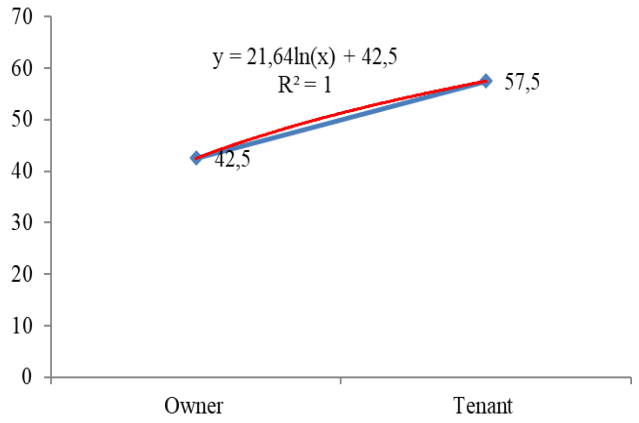

Figure 4: Distribution of market gardeners by land tenure

The size of cultivated plots is shown in Figure 5. Almost all producers (95%) farm areas of less than 1 ha, compared with only 5% who have 1 ha or more.

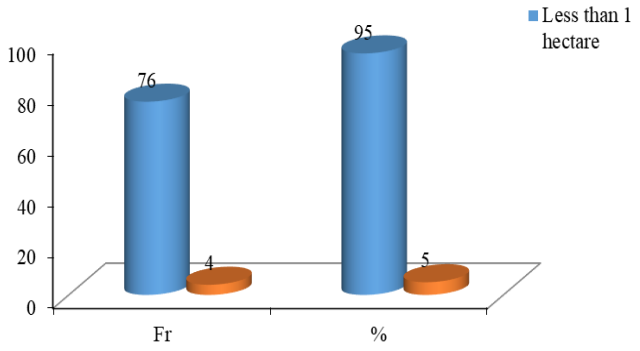

Figure 5: Distribution of market gardeners by size of cultivated plots

These results confirm the nature of small-scale urban and peri-urban agriculture, characterised by limited but intensively cultivated areas. The predominance of tenants may hinder long-term investment (irrigation systems, drainage infrastructure, hedgerows) due to fears of land tenure insecurity. A χ^2 independence test between land tenure status and yield trend (see Section 4.6, Table 25 and Figure 25) allows us to examine whether land tenure security is associated with better yield prospects.

3.1.4. Main water source

The main water source used for irrigation is shown in Figure 6.

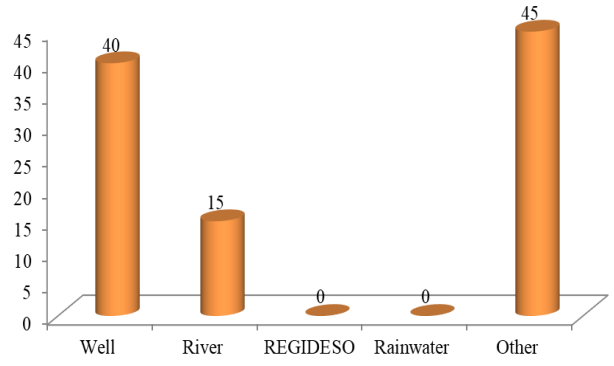

Figure 6: Main water source

The results indicate that 40% of market gardeners obtain their water from wells, 15% from rivers, and 45% from other sources (often runoff, ditches, or water reservoirs). No respondent reported using exclusively REGIDESO water or rainwater as their main source.

Market gardening therefore relies heavily on **informal and vulnerable** water sources, which are susceptible to being affected by variations in groundwater levels, fluctuations in river flow or flooding. Some of these sources may also pose health risks, particularly where wastewater or polluted water is involved.

3.2. Perception of climate change

3.2.1. Perception of the existence of climate change

Perceptions of the existence of climate change over the last ten years are illustrated in **Figure 7**. An overwhelming majority (95%) of market gardeners report having noticed changes in the climate, compared with only 5% who have not observed any.

This near-unanimity shows that climate change is not perceived as an abstract phenomenon, but as a concrete reality directly affecting production conditions. It provides an important basis for the acceptance of adaptation measures, insofar as producers recognise the existence of the problem.

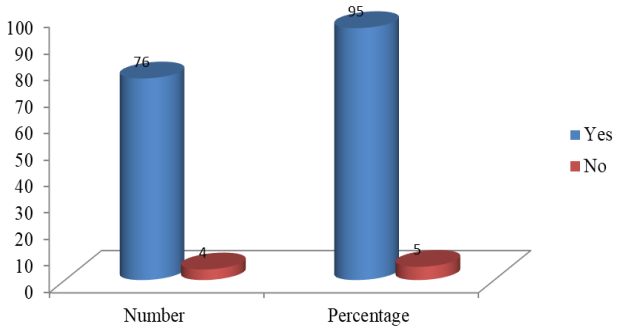

Figure 7: Perception of the existence of climate change

3.2.2. Types of changes observed

The types of climate changes observed are summarised in **Table 2**. Three combinations of observations stand out: Heavier rainfall, warmer temperatures and an unpredictable season: 45%; Heavier rainfall, warmer temperatures, an unpredictable season and flooding: 20%; Heavier rainfall, warmer temperatures and a shifted ‘ ’ season: 35%. The responses as a whole highlight two recurring factors: **heavier rainfall**, causing runoff, localised flooding or soil saturation; and **warmer temperatures**, exacerbating water stress and creating conditions favourable to pests.

The elements of an ‘unpredictable’ or ‘shifted’ season indicate that the traditional sowing calendar is becoming less reliable, complicating the planning of crop management strategies.

Table 1 : Types of changes observed

Types of changes observed	Fr	%
Heavier rainfall, warmer temperatures and an unpredictable season	36	45
Heavier rainfall, warmer temperatures, an unpredictable season and flooding	16	20
Heavier rainfall, warmer temperatures and a shifted season	28	35
Total	**80**	**100**

Source: Field survey, 2026

3.2.3. Severity of the impact on market gardening

The intensity of the impact of climate change on market gardening is shown in **Figure 8**.

The results show that 59% of respondents consider this impact to be ‘strong’ and 41% ‘very strong’. No responses fell into the ‘not at all’, ‘slight’ or ‘moderate’ categories.

The perceived impact is therefore unanimously high, reflecting a significant sense of vulnerability: increased production difficulties, more frequent hazards, risks of flooding or water stress, etc. This perception is particularly pronounced among the oldest and most experienced producers, as indicated by Spearman’s correlations.

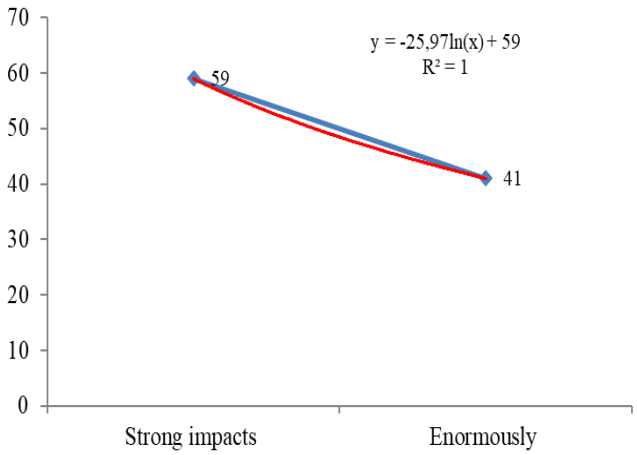

Figure 8: Severity of the impact on market gardening

3.2.4. Perceived causes of climate change

The perceived causes of climate change are shown in **Figure 9**.

It appears that 16% of market gardeners attribute these changes to human activities, 29% to natural causes, whilst 55% state that they do not know.

These results reveal a limited understanding of the root causes of climate change among the surveyed population. Despite a strong perception of the effects, more than half of the producers are unable to identify the responsible factors, which may limit support for mitigation measures (emissions reduction, conservation of natural resources) and the adoption of truly climate-smart practices.

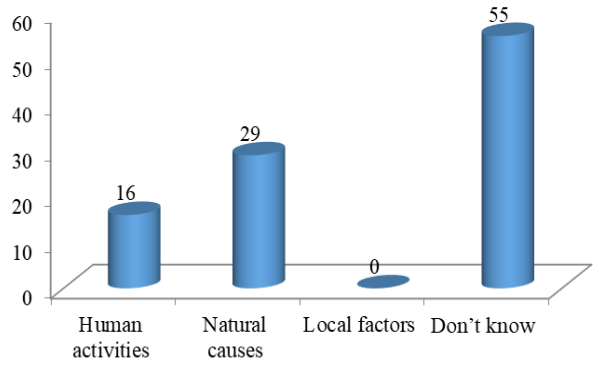

Figure 9: Perceived causes of climate change

3.3. Impacts of climate change on market gardening

3.3.1. Yield trends

The trend in market garden yields is shown in Figure 10. The results show that 39% of respondents report an increase in their yields, whilst 61% indicate that yields have remained stable. No decrease was reported in the responses.

These reports can be explained by an intensification of farming practices (increased use of fertilisers, pesticides and, in some cases, irrigation), which helps to offset the negative effects of climatic hazards. However, this apparent stability or increase in yields must be analysed in conjunction with changes in production costs.

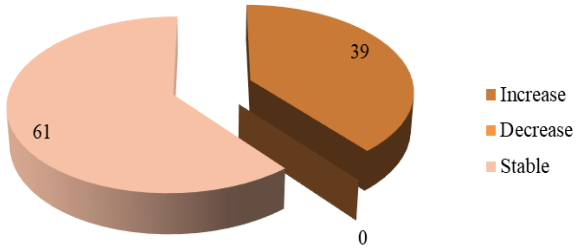

Figure 10: Yield trends

3.3.2. Relationship between age and the perceived impact of climate change

The relationship between age groups and the intensity of the perceived impact is illustrated in Figure 25. The results show that the older age groups have a higher proportion of 'enormously' responses compared to the younger age groups.

The chi-square test indicates a statistically significant association between age and perceived impact ($p < 0.05$), and Cramer's V suggests a strong association. The Spearman correlation between age (dependent) and impact (dependent) is strong and positive, confirming that older producers view climate change as more disruptive to their business.

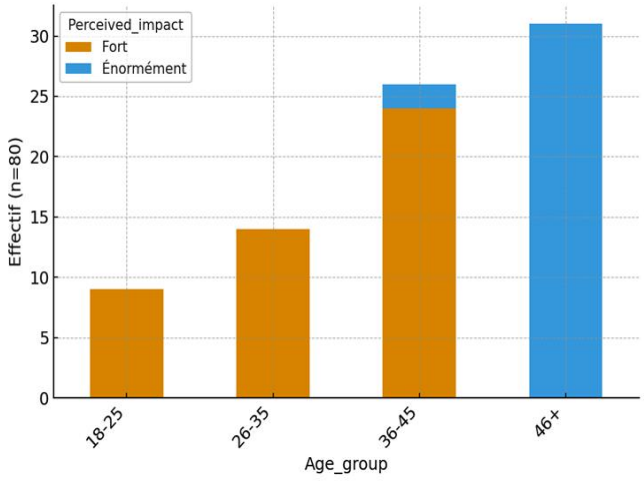

Figure 1 : Relationship between age and perceived impact of climate change

3.3.3. Trends in production costs

The trend in production costs is summarised in Figure 12. The results show that 39% of market gardeners report an increase in production costs, whilst 61% report stable costs. No respondent reported a decrease.

It is thus observed that, in order to maintain or improve their yields in an unfavourable climate context, producers are making greater use of inputs and irrigation, which increases costs. Even when yields remain stable, profit margins may shrink due to rising costs. This situation exacerbates the economic vulnerability of market gardening households.

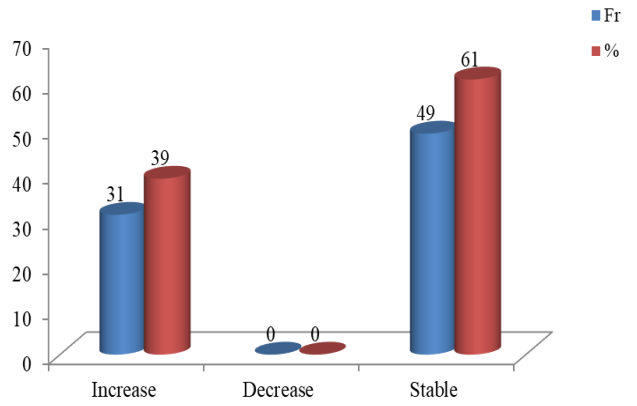

Figure 12: Yield trends

3.3.4. Technical problems encountered

The main problems faced by market gardeners are set out in Table 3. Three dominant combinations are reported: Flooding, diseases/pests and seed destruction: 35%; Diseases/pests and seed destruction: 54%; and diseases/pests, seed loss and difficulty accessing water: 11%. Diseases and pests appear to be a recurring problem, associated with the destruction or loss of seeds. Flooding is also frequent on some plots, whilst others suffer from difficulties accessing water. These results illustrate a dual pressure on production systems: a **water-related** pressure, ranging from excess (flooding) to a lack of access to water; and a **biotic** pressure, through the resurgence of pests and diseases favoured by changing climatic conditions.

Table 2 : Technical problems encountered

Problems	Fr	%
Flooding, disease/pests and seed destruction	28	35
Disease/pest and seed destruction	43	54
Disease/pest, seed loss and difficulty accessing water	9	11
Total	**80**	**100**

Source: Field survey, 2026

3.3.5. Frequency of crop losses

The frequency of crop losses is shown in Figure 13. No respondent reported never suffering losses or suffering them often. However, 66% stated that they experience losses 'rarely', and 34% 'sometimes' Although 'frequent' recurring losses were not reported, the existence of 'rare' or 'occasional' losses among all producers indicates a constant vulnerability to climatic hazards. These losses, even when moderate, can have a significant impact on food security and incomes when they recur over the course of the seasons.

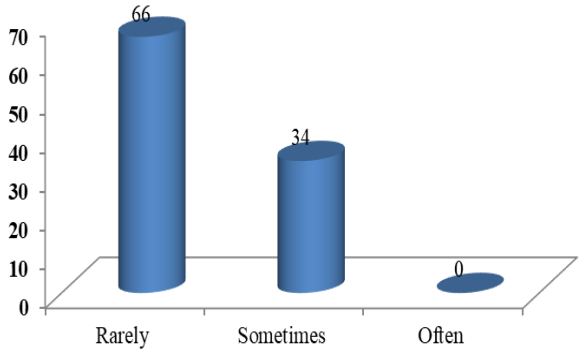

Figure 12: Frequency of crop losses

3.4. Access to information and support needs

3.4.1. Sources of information

The sources of information for market gardeners are shown in Figure 14.

The vast majority (86%) obtain information from neighbours and cooperatives, 9% via schools or training courses, and 5% through NGOs or projects. None of the respondents cited radio/TV, telephone/WhatsApp or technical services as their main source. This heavy reliance on informal networks has a twofold effect: it facilitates the rapid dissemination of information and practices; however, it does not guarantee the scientific quality or relevance of the advice, which can lead to inappropriate or risky practices (incorrect application rates of inputs, inappropriate timing, etc.).

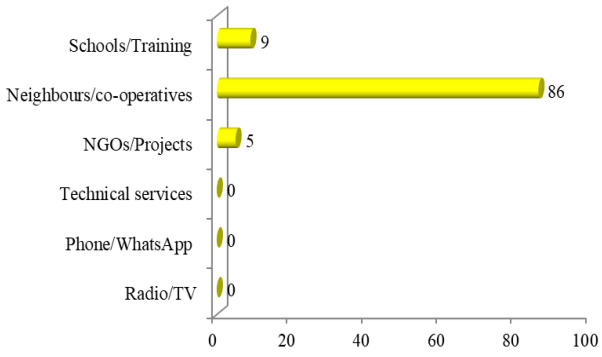

Figure 14: Sources of information

3.4.2. Quality of information received

The perceived quality of the information received is illustrated in Figure 15. Market gardeners rate this quality as 'good' (29%), 'very good' (40%) or 'excellent' (31%). No responses mention poor or average quality. This generally positive assessment reflects strong confidence in the available sources of information, particularly local networks (neighbours, cooperatives). However, this favourable opinion does not imply that this information complies with agronomic or climatic recommendations derived from scientific research.

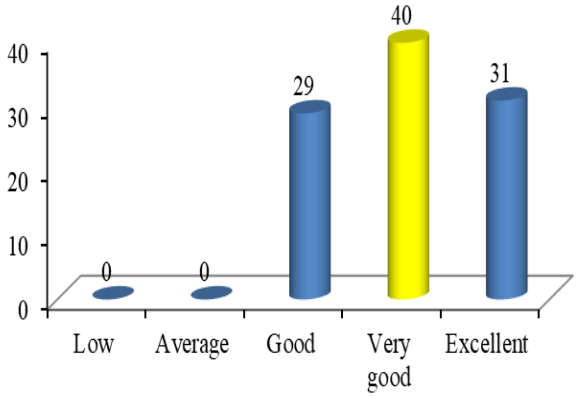

Figure 15: Quality of information received

4. Discussion

4.1. Level of Education

The **level of education** is generally low: 76% of respondents have only primary education, 20% have secondary education, and 4% have no formal education. No market gardener reported a higher level of education. This situation is consistent with numerous studies showing that small-scale urban and peri-urban producers rarely have a high level of education, which can limit their access to technical information, innovation and formal financing schemes (FAO, 2012). A low level of schooling can also hinder understanding of global climate issues and complex technical recommendations (Gbetibouo, 2009).

4.2. Experience, land tenure and farm structure

The results indicate that **the majority of market gardeners have extensive experience**: 27.5% have between 10- and 20-years' experience, 34% between 20 and 30 years, and 22.5% more than 30 years. This pattern of seniority suggests that market gardening is a **long-standing feature** of the respondents' career paths. This is consistent with observations made in other African cities, where peri-urban agriculture constitutes a survival strategy that has become established over time (Rakodi, 1997; Lee-Smith, 2010).

The Spearman correlation between years of experience and **the perceived intensity of the impact of climate change** is positive and significant: the more experience a market gardener has, the more strongly they report feeling the effects of climate change on their work. This may be explained by the fact that the most experienced producers have a longer climate memory and are able to compare current conditions (rainfall, temperatures, seasonal patterns) with those observed 10, 20 or 30 years ago. These results are consistent with those of Mertz et al. (2009) in the Sahel, which shows that experienced farmers are often the most sensitive to seasonal changes and climate extremes

In terms of land tenure, **57.5% of market gardeners are tenants** and 42.5% are owners. This predominance of tenancy reflects significant **land tenure insecurity**, typical of urban and peri-urban market gardening areas where land is sought after for urbanisation, infrastructure or other uses (FAO, 2012; Mbiba, 2001). Land tenure insecurity can limit long-term investments (sustainable irrigation systems, planting hedges, drainage, flood protection structures) and increase vulnerability to climate shocks. Tests of independence between land tenure status and changes in yields, or other variables, allow for a better analysis of whether secure land tenure constitutes a factor of resilience.

The size of the plots confirms the **small-scale** nature of **the farming**: 95% of market gardeners farm less than 1 ha. These results are consistent with the literature on urban market gardening, which generally reports very limited but intensively cultivated areas, often with heavy use of inputs (Drechsel et al., 2006). Such small areas make producers particularly vulnerable to hazards: a flood or a disease can affect the entire plot and thus their entire income.

4.3. Access to water and water vulnerability

The main **sources of water** used are wells (40%), rivers (15%) and 'other sources' (45%), which may include runoff, drains, water reservoirs or wastewater. No market gardener mentions REGIDESO or rainwater as a main source. This heavy reliance on informal, and sometimes unregulated, sources expose market gardeners to a dual vulnerability:

1. **Quantitative vulnerability**, as river flow, groundwater depth or the availability of runoff are highly sensitive to variations in rainfall and extreme events (droughts, floods) (IPCC, 2014);

2. **Qualitative vulnerability**, as these waters may be contaminated (domestic and industrial pollution, urban discharges), posing a health risk to producers and consumers, as highlighted in several studies on urban agriculture irrigated with wastewater (Drechsel et al., 2010).

Thus, climate change, which alters the frequency and intensity of rainfall, has a direct impact on the water security of farms.

4.4. Perception of climate change and understanding of its causes

An **overwhelming majority (95%)** of market gardeners report having noticed climate change over the last ten years. The types of changes cited – **heavier rainfall, higher temperatures, unpredictable or shifted seasons, and flooding** – are consistent with the trends described for the Central and West African region in IPCC reports (IPCC, 2014, 2021), which mention an increase in the frequency of extreme rainfall, rising average temperatures and disruption to agricultural seasons.

The severity of the impact is perceived as **high or very high** by all respondents (59% 'high', 41% 'very high'). No responses fell into the 'not at all', 'slightly' or 'moderately' categories. This consensus on the severity of the impact clearly reflects the vulnerability of market gardening, which is heavily dependent on rainfall patterns, temperature and extreme events (Mertz et al., 2009; Morton, 2007).

However, when examining the **perceived causes of climate change**, 55% of market gardeners state that they do not know, 29% attribute it to natural causes and only 16% to human activities. This limited understanding of anthropogenic causes is consistent with similar observations in several rural African contexts, where farmers perceive climate change but do not always identify greenhouse gas emissions, deforestation or urbanisation as the causes (Gbetibouo, 2009). This disconnects between the **perception of effects** (very strong) and the **understanding of causes** (weak) may act as a barrier to the adoption of mitigation practices (reforestation, reducing deforestation, sustainable land management).

4.5. Access to information, training and support needs

The main **sources of information** used by market gardeners are **neighbours and cooperatives (86%)**, followed by schools or training courses (9%) and NGOs/projects (5%). None of the respondents cited radio/TV, the telephone/WhatsApp or technical services as their main source. This confirms the importance of **informal networks** in the dissemination of knowledge in urban agricultural settings (Lee-Smith, 2010). Whilst these networks may be effective for the rapid dissemination of practices, they do not always guarantee the scientific quality of the advice, which can lead to inappropriate practices (overuse of inputs, poor pesticide management, etc.).

However, the **quality of the information received** is rated as 'good' (29%), 'very good' (40%) or 'excellent' (31%) by market gardeners. This high level of trust in informal sources highlights a possible disconnect between the perceived quality of the information and its **compliance with technical recommendations** derived from research. This discrepancy has been reported in other contexts, where farmers rely heavily on peers, even when the practices disseminated are not sustainable (Gockowski et al., 2011).

Conclusion

This study has enabled an in-depth examination of the information gathered from the 80 market gardeners surveyed in N'djili Brasserie. The analyses reveal that producers operate within a socio-economic context characterised by low levels of education, but with extensive agricultural experience that enables them to observe and accurately interpret climate change. The results show that the perception of climate change is widely shared: market gardeners note changes in the seasons, frequent flooding, as well as losses of seeds and crops.

Statistical analysis highlights a significant relationship between market gardeners' experience and their perceived sensitivity to climatic effects, underscoring the importance of environmental memory in assessing these changes.

Thus, this study highlights a real vulnerability among market gardeners to climate hazards, which is still limited by technical problems and a lack of reliable information.

Acknowledgements

The authors would like to extend their warmest thanks to the National Pedagogical University (UPN) and the Centre for Geological and Mining Research (CRGM) for their logistical and scientific support during data collection and processing. We would also like to express our gratitude to the local authorities of the commune of Nsele and the market gardeners of Mikondo for their time and the information they provided during the field surveys. Finally, thank you to the field assistants.

Funding

This research did not receive any external funding.

Conflict of Interest

We declare that we have no financial or non-financial conflicts of interest in relation to the content of this article.

Ethical considerations

Field surveys were conducted in accordance with current ethical principles. Respondents gave their informed consent prior to participation and personal data were processed anonymously and confidentially.

Authors' contributions

- K.N.J.: study design, scientific supervision, data analysis, corresponding author (jonathankwatenge@gmail.com), approval of the final version.
- B.P.G.: field data collection, initial data processing.
- N.J.: participation in data collection and field verification.
- L.T.D.: GIS processing and mapping, participation in the interpretation of results.
- M.B.C.: literature review and formatting of references.
- R.J.I: conducting socio-environmental surveys, critical review.
- K.K.R.: contributions to mapping and final validation of maps.

All authors have read and approved the final version of the manuscript.

Bibliographical References

- ANONYMOUS (2012), *Larousse Dictionary*, Larousse, Paris.
- BONNES, M. & SECCHIAROLI, G., (1996), *Environmental psychology: a psycho-social introduction*, Sage Publications, London;
- DESJEUX, D., (2004), *Consumption: the social construction of the market*, ed. Armand Colin, Paris;
- MUNKUAMO, J.R., (2019), *Concepts of the Environment*, lecture notes, UPN-Kinshasa.
- SARR, M., (2005), *Perception and management of the environment in the Sahel: a socio-anthropological approach*, published by Harmattan, Paris;
- ELLIS, F., (2000), *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press, London;
- ZERBO, I., (2016), *Market gardening practices and natural resource management in urban and peri-urban areas of Ouagadougou*, published by Harmattan, Paris;
- WALKER, B., & SALT, D., (2006), *Resilience thinking: Sustaining ecosystems and people in a changing world*, Island Press, Washington;
- HOLLING, C.S., (2002), *Panarchy: Understanding transformations in human and natural systems, published by Island Press*, Washington.
- *RI*BOT, J., (2006), 'Climate variability, vulnerability and natural disaster: a social science view', *Adaptation to Climate Change*, London, pp. 44–74;
- NDUENGISA, R., & KIFUKIETO, C., (2022), 'The contribution of market gardening to household income in the N'djili Valley in Kinshasa', *IJIAS Journal*, Vol. 37, No. 4;
- MWABILA, A. & al., (2021), "Perception of and adaptation to climate change in the DRC: the case of

farmers in Maluku, Kinshasa", *Afrique Science journal, Kinshasa*;

- ROBINEAU, O., (2015), "Policy support for urban agriculture in West Africa: taking informal arrangements into account", *CIRAD Journal*;

- BONGONGO, M.G., (2023), "Climate hazards and crop vulnerability in the N'djili River valley", *Canadian Journal of Tropical Geography*, Vol. 9, pp. 14–22;

- SMIT, B., & WANDEL, J., (2006), 'Adaptation, adaptive capacity and vulnerability', *Global Environmental Change*, pp. 281–289;

- F*OL*KE, C., (2006), 'Resilience: The emergence of a perspective for social-ecological systems analyses', *Global Environmental Change*, pp. 253–267

- IPCC, (2007), *Synthesis Report: Contribution of Working Groups I, II and III, Art. 4*, Geneva;

- IPCC, (2021), *Report of Working Group I – The Physical Science Basis of Climate Change, Art. 6*, Geneva;

- IPCC, (2014), *Climate Change: Impacts, Adaptation and Vulnerability*, Geneva;

- FAO, (2012), *Urban and peri-urban horticultural production: a strategy for urban food security*, Rome;

- INS, (2020), *Statistical Yearbook of the DRC*, Kinshasa;

- UN-Habitat, (2008), *Urban Agriculture and Food Security in Cities*, Nairobi.