Environmental Perceptions about the link between Climate Change and the School Garden

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Abstract: Perceptions related to the environment and climate change are of crucial importance in any educational community due to they are fundamental elements to foster a conscious, capable and committed citizenry of with environmental challenges. In the Ibero-American and Latin American context, various studies have approached this topic using methodologies such as social cartography and Participatory Action Research, evincing their potential to generate meaningful changes in pedagogical and community practices. This research was done with 24 ninth grade students from *La Aurora IED*. The study was focused on exploring their perceptions regarding the connection between School Gardens and Climate Change. Data were collected through an expert-validated survey instrument, ensuring robust results. The findings were organized and analysed around three main variables: environmental awareness, food sovereignty, and the human food cycle linked to Climate Change and School Gardens. These categories not only helped to organise students' perceptions but also to identify key areas for implementing educational strategies that promote sustainability and climate change mitigation through school gardens.

Keywords: School Gardens; Climate Change; Environmental Perceptions; Environmental Awareness; Food Sovereignty.

Percepciones Ambientales sobre el vínculo entre el Cambio Climático y la Huerta Escolar

Resumen: Las percepciones relacionadas con el ambiente y el cambio climático tienen una importancia crucial en cualquier comunidad educativa, debido a que son elementos fundamentales para fomentar una ciudadanía consciente y comprometida con los desafíos medioambientales. En el contexto ibero y latinoamericano, diversos estudios han abordado esta temática utilizando metodologías como la cartografía social y la investigación-acción participativa, evidenciando su potencial para generar cambios significativos en las prácticas pedagógicas y comunitarias. En este trabajo, se presentan los resultados de una investigación realizada con 24 estudiantes de grado noveno del *Colegio La Aurora IED*. Este estudio se centró en explorar sus percepciones sobre el vínculo entre las Huertas Escolares y el Cambio Climático. La información fue recolectada a través de un instrumento encuesta validado por expertos asegurando resultados robustos. Los resultados fueron organizados y analizados en torno a tres variables principales: concienciación ambiental, soberanía alimentaria y el ciclo alimentario humano vinculado al Cambio Climático y las Huertas Escolares. Estas categorías no solo permitieron estructurar las percepciones estudiantiles, sino también identificar áreas clave para implementar estrategias educativas que promuevan la sostenibilidad y la mitigación del cambio climático a través de las huertas escolares.

Palabras Clave: Huertas Escolares; Cambio Climático; Percepciones Ambientales; Concienciación Ambiental; Soberanía Alimentaria.

Percepções Ambientais sobre a ligação entre as Mudanças Climáticas e a Horta Escolar

Resumo: As percepções relacionadas ao meio ambiente e às mudanças climáticas têm uma importância crucial em qualquer comunidade educativa, pois são elementos fundamentais para promover uma cidadania consciente e comprometida com os desafios ambientais. No contexto ibero e latino-americano, diversos estudos abordaram esse tema utilizando metodologias como a cartografia social e a pesquisa-ação participativa, demonstrando seu potencial para gerar mudanças significativas nas práticas pedagógicas e

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comunitárias. Neste trabalho, apresentamos os resultados de uma pesquisa realizada com 24 estudantes do nono ano do *Colégio La Aurora IED*. Este estudo concentrou-se em explorar suas percepções sobre a ligação entre as Hortas Escolares e as Mudanças Climáticas. As informações foram coletadas por meio de um instrumento questionário validado por expertos assegurando resultados robustos. Os resultados foram organizados e analisados em torno de três variáveis principais: consciência ambiental, soberania alimentar e o ciclo alimentar humano vinculado às Mudanças Climáticas e às Hortas Escolares. Essas categorias não apenas permitiram estruturar as percepções dos estudantes, mas também identificaram áreas-chave para a implementação de estratégias educativas que promovam a sustentabilidade e a mitigação das mudanças climáticas por meio das hortas escolares.

Palavras Chave: Hortas Escolares; Mudanças Climáticas; Percepções Ambientais; Consciência Ambiental; Soberania Alimentar.

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Introduction

The exponential growth of the global population, coupled with rapid socio-economic advancements, have placed an unprecedented demand on natural resources. Fossil fuels, despite their widespread use, are unsustainable and contribute to severe environmental and public health challenges (Curtin *et al*., 2019; Yang *et al*., 2021). The combustion of fossil fuels releases significant quantities of greenhouse gases (GHGs), including methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O), which exacerbate atmospheric pollution and climatic instability.

Projections indicate that GHG emissions will continue to escalate due to accelerated industrialization and urban development, intensifying the risks associated with climate change, including global temperature rise, sea-level elevation, ecological disruptions, and adverse health effects (Olabi *et al*., 2022).

Simultaneously, agricultural land is under increasing pressure due to urban expansion (Jiang *et al*., 2013; Mishra, 2002), as well as land abandonment and forced displacement (Reddy & Reddy, 2007). The encroachment of urbanization onto arable land threatens food security and underscores the urgent need for alternative agricultural production systems capable of sustaining the growing global demand for food (Mok *et al.*, 2014).

By 2050, the global population is projected to reach 9.7 billion (Nation United, 2019), with approximately 70% of individuals residing in urban areas. This demographic shift is anticipated to drive a 171% increase in the global urban footprint compared to 2015 levels (Huang *et al*., 2019; Nation United, 2018). Consequently, urban agriculture emerges as a viable and sustainable solution to address the escalating concerns surrounding food security in rapidly urbanizing environments.

Urban agriculture can be effectively integrated into small-scale garden systems within public schools in Bogotá, leveraging their potential for both productive and non-productive benefits. Beyond its role in food production, urban agriculture contributes to nutrient cycling, biodiversity enhancement, and the preservation of ancestral agricultural practices, while also fostering social equity and food justice (Alaimo *et al*., 2008; Draper & Freedman, 2010; Harrison & Winfree, 2015; Kulak *et al*., 2013; Meenar & Hoover, 2012).

Additionally, the environmental advantages of urban agriculture are well-documented, including its role in mitigating urban heat island effects (Ackerman *et al*., 2014; Lin *et al*.,

2015; Lovell, 2010), and reducing energy consumption and greenhouse gas (GHG) emissions associated with food production and distribution (Ackerman *et al*., 2014; Lovell, 2010; Peters *et al*., 2009). These factors underscore the potential of urban agriculture as a multifaceted strategy for promoting environmental sustainability and resilience in urban ecosystems.

The environment is increasingly acknowledged as a legal entity with inherent rights, particularly in the context of its vulnerability to climate change (CC). Within this framework, school gardens (SGs) function as effective pedagogical tools for cultivating socio-environmental awareness among students. Through active participation in SG-related activities, students gain a comprehensive understanding of the dynamic relationship between individual and collective actions in both mitigating CC and adapting to its effects. Additionally, SGs contribute significantly to the promotion of sustainable agricultural practices, the reinforcement of food sovereignty, and the enhancement of resilience to environmental challenges, positioning them as a fundamental component of education for sustainability (Novo, 2009; Ángel *et al*., 2024).

Moreover, SGs play a crucial role in urban CC adaptation and mitigation strategies, providing localized solutions to broader environmental issues. This study examines environmental perceptions regarding the relationship between CC and SGs among ninth-grade students at *La Aurora Public School*. Data were collected using a survey instrument, which remains unspecified, to assess students' awareness of CC and its potential implications for the educational community. The findings suggest that higher awareness levels are closely linked to students' recognition of the broader socio-environmental impacts of SGs in the context of climate change.

Methodology

The methodology of this research project was guided based on a descriptive type of research, in which everyday situations are detailed and characterized by their impact on the lives of the selected population. Thus, it considers not only data collection but also variable relationships (Figure 1), such as the characterization of Awareness, that allows for the grouping of data based on different criteria.

This study focused on exploring the perceptions of 24 ninth grade students at *La Aurora Public School* about the link between School Gardens and Climate Change. The information was collected through an instrument (survey) validated by experts in the field.

A survey was designed to address questions related to each research variable, forming the basis for the qualitative methodological approach adopted in this study. The research was conducted in sequential phases, as outlined in Figure 2. Ensuring rigor, a validation instrument was developed and reviewed by experts, including two specialist professors in Exact Sciences. After incorporating their feedback, the instrument was refined and finalized for use in the study (Sampieri, *et al*., 2014).

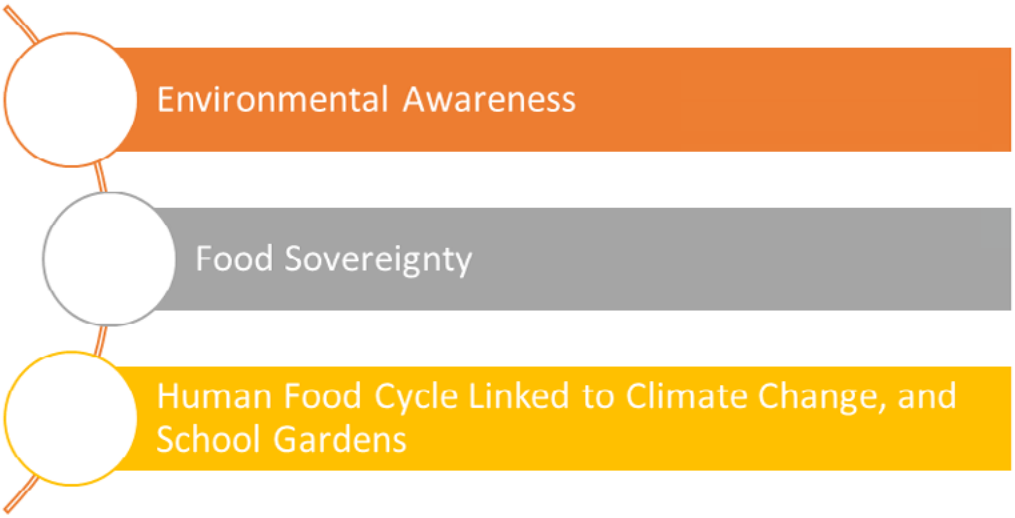

Figure 1. Research Variables. Source: Authors

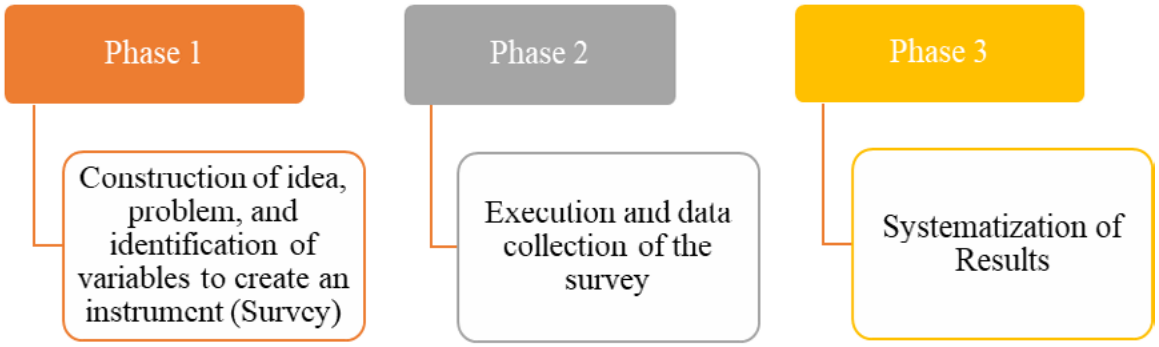

Figure 2. Research Phases. Source: Authors

In Phase 1 of the research, various topics were identified for each research variable, which guided the development of the survey questions. These topics and their corresponding survey questions are detailed in Figure 3.

A descriptive type of research, in which everyday situations are detailed and characterized. The results are presented through multiple graphs, each depicts all the associated questions with a specific variable, which were subsequently analysed in greater detail.

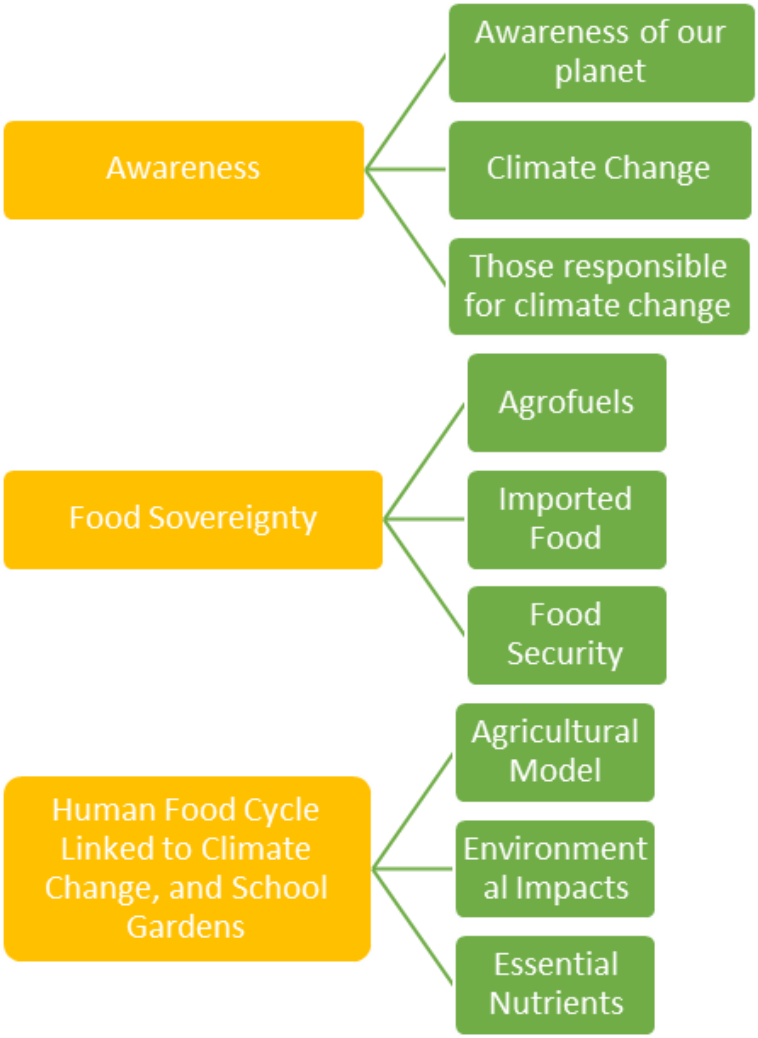

Figure 3. Development of the survey questions. Source: Authors

3. Results and Discussion

The results of the instruments are detailed as follows:

For Section 1 (Variable Awareness): 83.3% of respondents selected option A for the first question (20 students), indicating that the moment when we went from improving our planet to be on the verge of destroying it occurred with the onset of industrial development, as it led to the rise of large factories and diverse machinery.

The 62.5% of respondents selected option B for the second question (15 students), indicating that CC is a reality that is accelerating due to human intervention, increasing CO2 emissions.

The 62.5% of respondents selected option B for the third question (15 students), indicating that the responsible sectors for CC with the highest percentages correspond to the energy sector (electricity, transportation, industry, and construction. Each question and its answers from Section 1 are represented in the Figure 4.

Research conducted in Valladolid, Spain, by Diago (2022) highlights a didactic proposal aimed at fostering environmental awareness among students at the *CEIP Miguel Delibes School*. This proposal integrates water conservation, the school garden, and the Sustain-

able Development Goals (SDGs), demonstrating the interconnectedness of these elements in environmental education.

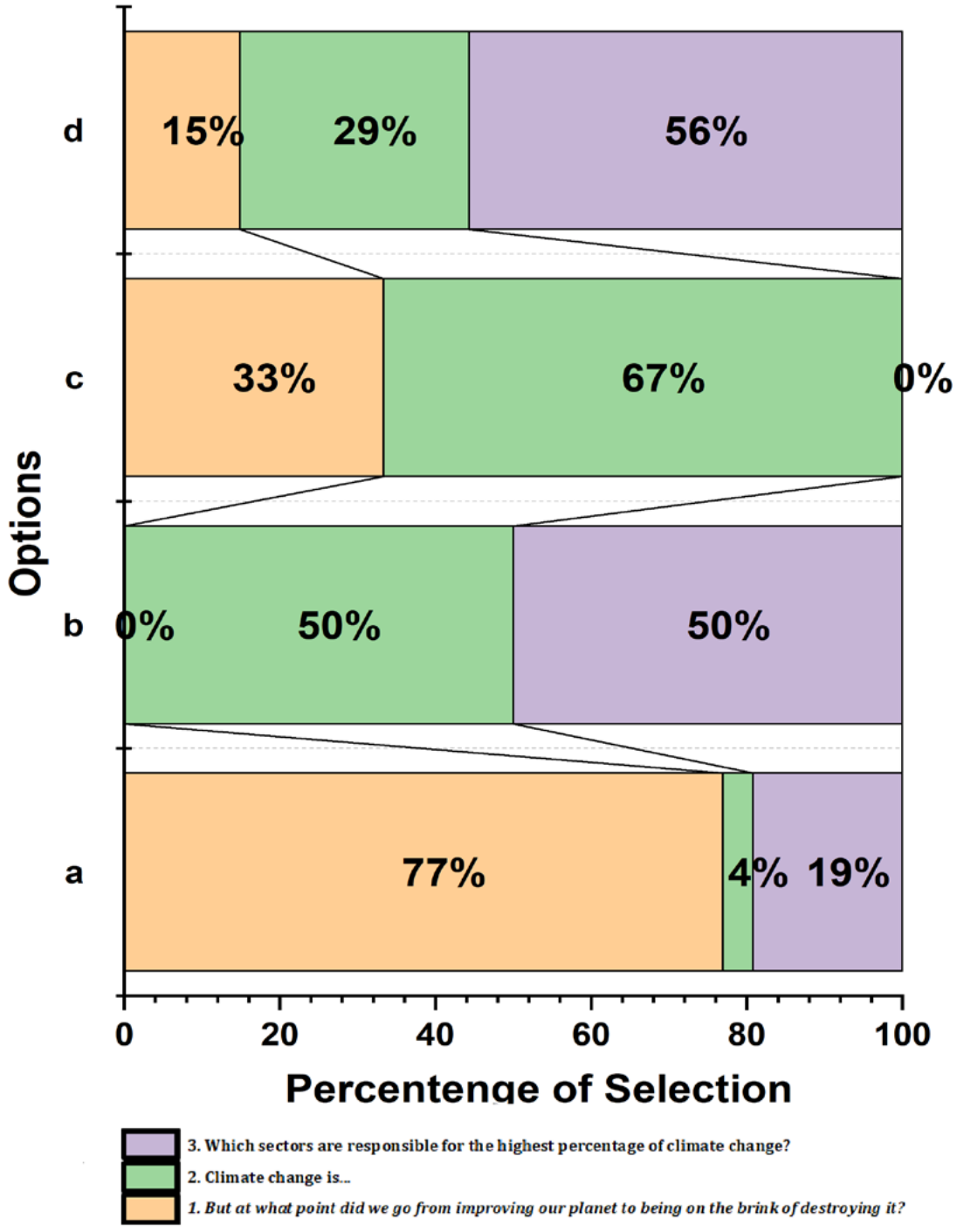

Figure 4. Section 1: Variable Environmental Awareness. Each question and its answers from this Section are represented by option, colour and percentage. Source: Authors

Similarly, studies carried out in Colombia, such as Ángel *et al*. (2024) and Romero *et al*. (2023) worked and emphasized in promoting socio-environmental awareness through centred activities on the school garden. These activities engaged the community of the

San Pedro Bajo Rural School, fostering a collective sense of environmental responsibility. Another notable example is the "Ecopensadores" project developed at the *José Celestino Mutis I.E.D. Rural School*. This initiative underscores the importance of cultivating reflective and empathetic individuals who are considerate of others, themselves, and the environment.

The research led by Noratto (2021) aimed to strengthen environmental awareness and cultural appreciation by recovering ancestral knowledge about medicinal and aromatic plants among eighth-grade students at the *Academic College in Buga. Through* this initiative, environmental awareness was fostered, highlighting the importance of preserving ancestral practices as a means to mitigate CC.

In contrast to these studies, the current research focuses on linking environmental awareness creation with actions and phenomena while identifying environmental perceptions regarding the responsibility for CC. This approach seeks to provide a broader understanding of how environmental consciousness can be nurtured through practical and reflective methodologies.

For Section 2 (Variable Food Sovereignty): 50% of respondents selected option A for the first question (12 students), indicating that the monocultures of biofuels (AGC) produced in Colombia involving large tracts of land and investments that bring not only environmental degradation due to soil degradation and resource contamination but also it means: The export of AGC implies exporting resources such as water, which is generally not included in the compensation payment costs, where the concept of virtual water (water used for the production of goods and services) is fundamental to evaluate the gross water impact of a product on the environment.

The 50% of respondents selected option A for the second question (12 students), indicating that the country has stopped producing fundamental foods for the diet, such as wheat, barley and corn, which has led to dependence on food from other regions. In the 1990s, 95% of the corn consumed nationally was produced domestically, but in 2011, the country imported 85% of the corn it consumed (FAO 2013; Superintendencia de Industria y Comercio, 2012). Although the country has capacity to produce food, the economic development model has prioritized: legislation and market regulation, as there is an exemption from VAT, a surcharge on gasoline, the global tax, and the mandatory consumption, etc.

The 58.3% of respondents selected option C for the third question (14 students), indicating that the evaluation regarding food security in the world, in a country, in a region, in a locality, in a community, or for an individual, requires an integral vision that considers the economic, political, social, cultural, technical, and environmental aspects that influence each of the stated features (quantity, variability, and quality) Each question and its answers from Section 2 are represented in Figura 5.

In research conducted in Spain by Sáenz (2022), the Ecoinnova project emphasized the value of the school garden as a pedagogical resource. This initiative incorporated activities that reframed the garden's role from a food sovereignty perspective, highlighting its potential in fostering sustainable practices.

Similarly, studies in Colombia have explored various dimensions of food security and sovereignty through innovative educational approaches. For instance, Rodríguez Rojas (2023) researched at IED Alexander Fleming School, he promoted food security by

implementing pilot projects of home vertical gardens, addressing challenges related to health, climate, and political emergencies through a "blended learning" model.

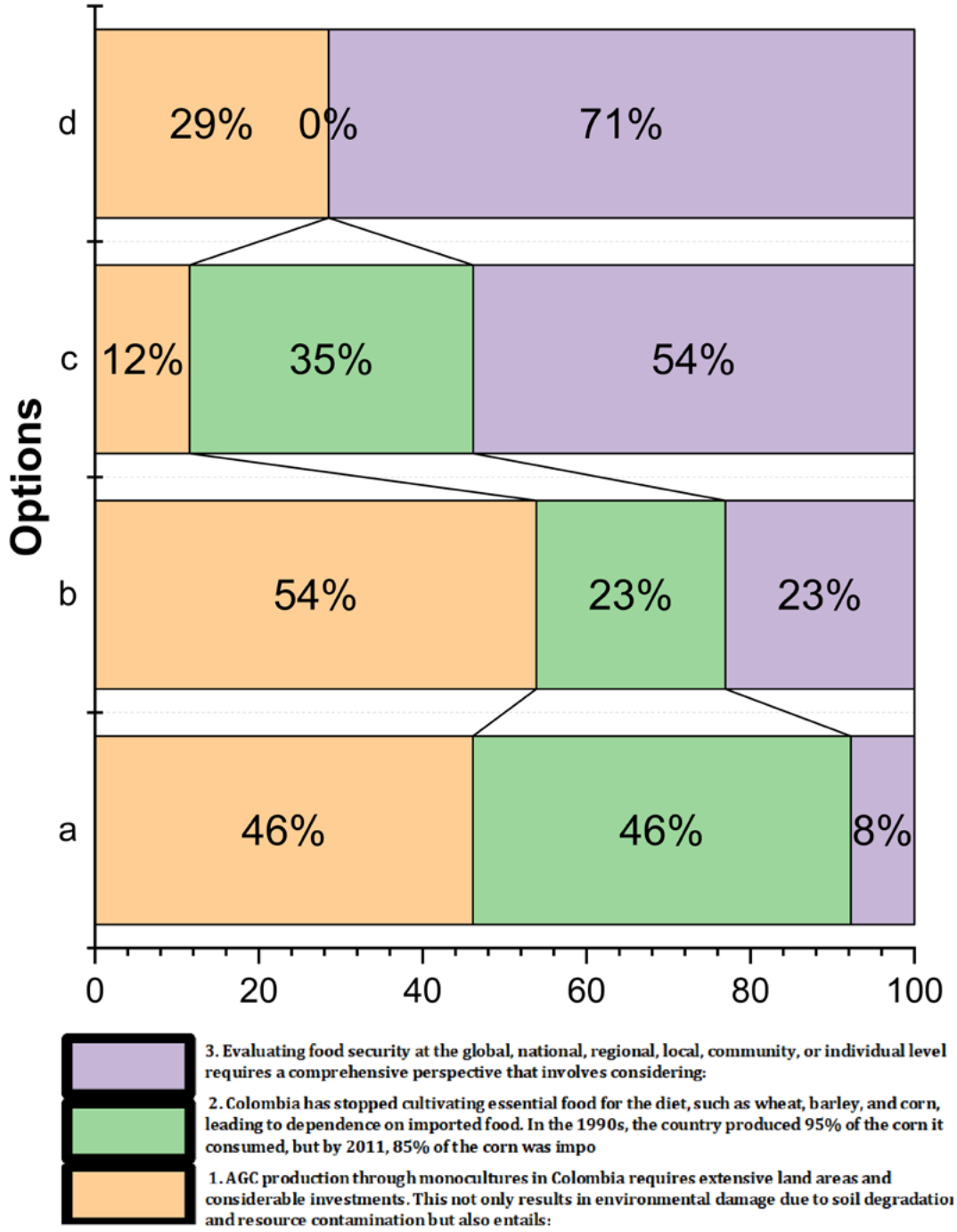

Figure 5. Section 2: Food Sovereignty. Each question and its answers from this Section are represented by option, colour and percentage. Source: Authors

Additionally, Rivera Cardona (2021) presented a curricular proposal on agroecology and food sovereignty at the Marco Tobón Mejía Educational Institution in Santa Rosa de Osos, Antioquia. This proposal focused on fostering good agricultural and food practices among sixth-grade students and their families. Furthermore, Bravo Sarmiento (2023) developed a school garden at the Quiba Alta IED Rural School, transforming it into a pedagogical space to address food and water security issues. The initiative involved design-

ing and implementing educational materials to support various stakeholders responsible for ensuring the right to food.

In contrast to these studies, the present research centres on the short-, medium-, and long-term impacts of the excessive reliance on monocultures and agrochemical inputs (AGCs). It examines how these practices sustained over extended periods; they directly threaten the food sovereignty of the Colombian population.

Thus, for Section 3 (Variable Human Food Cycle Linked to CC and School Gardens): 45.8% of respondents selected option A for the first question (11 students), indicating that recognizing the need to advocate for an agricultural model that adopts strategies based on low use and maximum utilization of natural resources through a production model that fits within the planet's biophysical limits, it is important stems from yields crops that align with the natural rhythms of nature, without intervening in them and maximizing their use.

The 45.8% of respondents selected option A for the second question (11 students), indicating that the Food and Agriculture Organization of the United Nations (FAO) warns that agricultural and livestock activities are capable of generating 20% of greenhouse gas emissions, and these will increase in the coming decades. Its impact is only surpassed by the energy sector (47% of emissions), so a change in the agricultural model could have a meaningful impact.

The 45.8% (11 students) of respondents selected option A for the third question, indicating that high levels of CO2 significantly reduce the essential nutrients of foodstuff for human consumption such as wheat, rice, corn, or soybeans. In this context, it is possible that global warming alters the development and reproductive cycle of plants, advancing flowering and harvest times and decreasing crop yields. Each question and its answers from Section 3 are represented in Figure 6.

Gozzer (2019) reported on BBC News World that South America is already experiencing four observable effects of CC: more frequent floods, more severe droughts, destructive hurricanes, and rising sea levels.

These phenomena demonstrate how rising temperatures and their associated impacts—droughts, floods, and other derived effects—pose significant threats to food production and disproportionately affect the livelihoods of subsistence farmers.

This vulnerability is exacerbated by the weak state supporting for agricultural communities, despite some initiatives like those proposed by the Agrarian Bank to assist small-scale farmers.

CC profoundly affects natural and anthropogenic ecosystems, with agriculture being particularly vulnerable. In Colombia, subsistence agriculture is the most affected due to its reliance on consistent environmental conditions and limited resources. According to the Colombia's Ministry of Agriculture (2016) 83.5% of the food consumed by Colombians is produced by local farmers, emphasizing the critical need for effective adaptation measures to safeguard food production and agricultural livelihoods.

Many adaptation techniques currently in use are rooted in pre-Hispanic practices, as CC has been a recurring challenge throughout Andean history. Evidence of these traditional strategies is widespread in Colombia. For example, farmers traditionally bury weeds across cultivated fields during weeding to create organic fertilizer, and water conserva-

tion systems include networks of canals adjusted to the land's slope. These canals prevent soil erosion during irrigation and enhance crop resilience (Córdova-Aguilar, 2022).

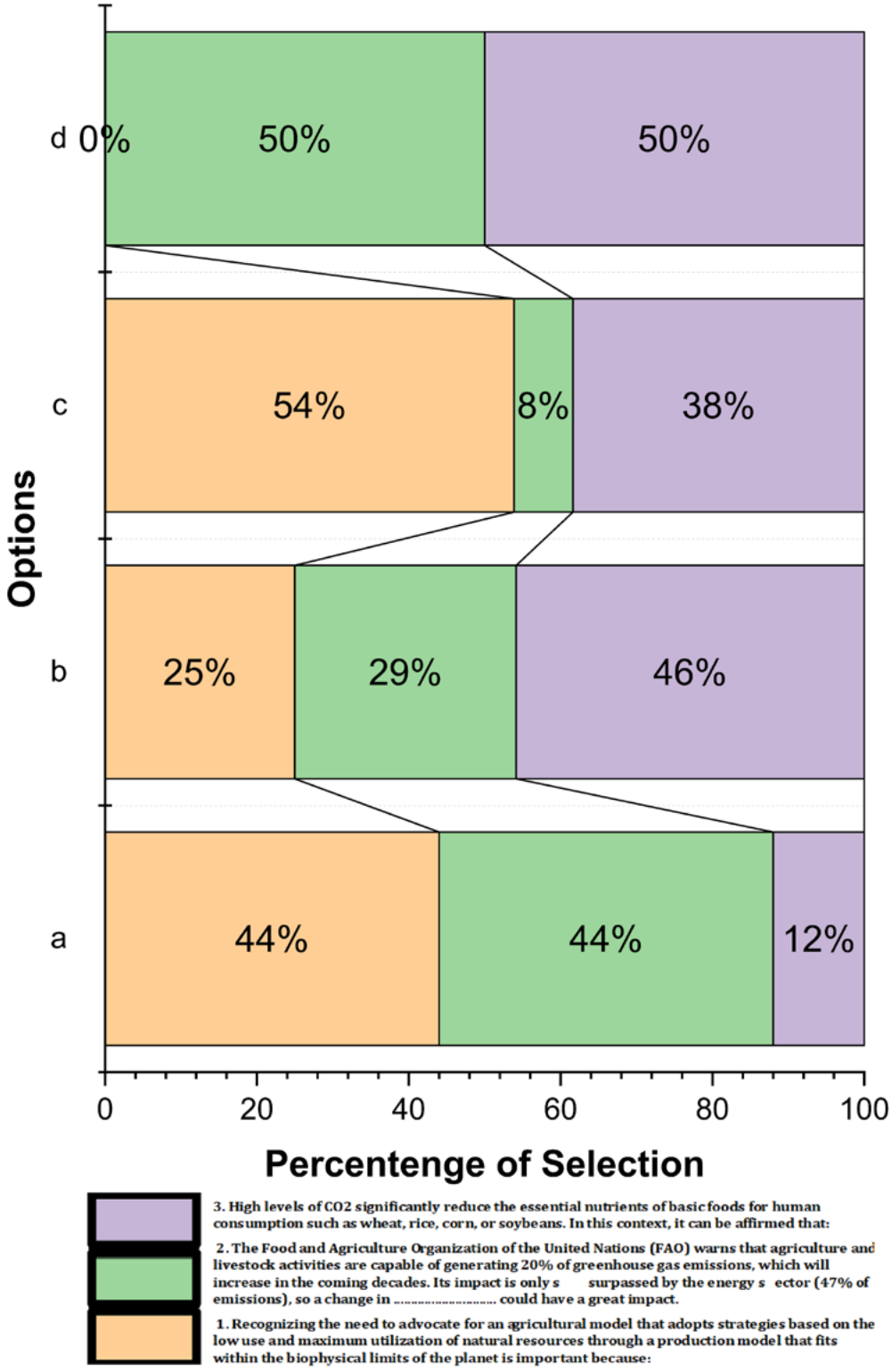

Figure 6. Section 3: Human Food Cycle Linked to Climate Change and School Gardens Each question and its answers from this Section are represented by option, colour and percentage. Source: Authors.

However, Colombian peasant communities lack the economic resources to implement large-scale adaptation measures. To address this, local governments must take proactive steps to build community capacity through scientific research, the development of evidence-based policies, institutional strengthening, community organization, and intercultural education. Dissemination of these efforts can further empower communities to adapt to the climate crisis effectively.

One innovative approach is reflected in research conducted by Ozuna (2024) in Tuxtla Gutiérrez, Chiapas, Mexico, where participatory action research promoted family and community urban gardens as a means of achieving food sovereignty and understanding the human food cycle. Another proposal of Peña Laureano, Gómez Pineda, Martínez Yáñez, & Paredes Figueroa (2022) focused on designing adaptation and resilience strategies for Mexico's most vulnerable regions, considering climatic and socioeconomic vulnerabilities.

In Colombia, the human food cycle is similarly impacted, as agriculture remains central to the country's economy and food security. However, climate inequality persists across certain regions, highlighting the need for governments to prioritize the development of projects and public policies that address climate adaptation.

Thus, this research underscores the critical relationship between the human food cycle, climate change, and school gardens. These gardens should be strategically designed to foster environmental awareness within the educational community, equipping all stakeholders to understand and address the pressing environmental challenges of our time.

Currently, there are studies focused on the perceptions of teachers regarding the use of SGs. For instance, Márquez Herranz, Bermejo San Frutos, Gálvez Esteban, & Mora-Urda (2023) explored the potential benefits of SGs in educational centres in Madrid and their connection to food education. Similarly, a study conducted by Ceballos, M; Escobar, T.; Vílchez (2014) examined the perceptions of trainee teachers regarding the school garden as a teaching tool, as well as the evaluation of its utility in addressing various topics with primary school students.

A recent study in Colombia by Valencia López, Yury Viviana; Delgado Cardona (2022) analysed the environmental perceptions of eleventh-grade students at the Villas de Progreso District Educational Institution. This study used the school garden as a central tool, concluding that students initially viewed the environment predominantly through a naturalistic lens, focusing on ecological elements such as water, plants, and soil. However, after engaging with the garden, their understanding broadened to include social, cultural, and emotional dimensions. Notably, this research utilized a mixed-methods approach, incorporating social cartography and semi-structured interviews. In contrast, the present study made use of a survey divided into three variables: environmental awareness, food sovereignty, and the Human Food Cycle Linked to Climate Change and School Gardens.

The research presented in this article is innovative, as most prior studies have focused on teacher perceptions, with limited attention to students. This study addresses environmental perceptions among secondary school students and examines the impact on their thinking and actions. Furthermore, the findings contribute to develop new strategies for addressing CC through SGs, providing a valuable framework for training future Science educators.

Finally, the relationship between environmental perception and environmental awareness has become increasingly significant in recent years, especially as global environmental challenges intensify. Therefore, it is highlighted that environmental perception, which encompasses how individuals and communities view and interpret environmental conditions and changes, it directly influences their level of environmental awareness.

Final Considerations

This study was conducted in accordance with the established methodological framework for quantitative descriptive research, ensuring a structured and systematic approach to data collection and analysis:

The first key variable, Environmental Awareness, examines the extent to which younger generations develop cognitive reasoning regarding contemporary and future environmental challenges affecting both themselves and their families. This awareness encompasses an understanding of the root causes of environmental degradation and the necessity of addressing unsustainable practices that have exacerbated climate change (CC).

To enhance environmental consciousness, educational strategies should prioritize experiential learning methodologies within formal curricula. Integrating practical, hands-on initiatives—such as the development and maintenance of school gardens (SGs), implementation of recycling programs, and local biodiversity assessments—can provide students with direct engagement in sustainability efforts. These initiatives not only promote active learning and environmental stewardship but also cultivate a deeper personal and collective responsibility toward ecological preservation.

The second variable, Food Sovereignty, underscores students' recognition of the limitations and vulnerabilities associated with monoculture-based agricultural systems. Findings indicate a growing awareness of the necessity to restructure food production models by reinforcing local and community-based economies. This approach advocates for localized food production systems to reduce dependency on external supply chains, mitigate the environmental impact of industrialized agriculture, and enhance resilience to climate change-induced disruptions.

The third and final variable, the Human Food Cycle in relation to Climate Change (CC) and SGs, highlights students' recognition of SGs as effective tools for CC mitigation. Students acknowledge their potential to promote sustainable agricultural methods, particularly when supported by educational institutions and organizations that provide guidance for implementing diverse agroecological projects. This approach not only contributes to ecological stability but also plays a role in reducing greenhouse gas (GHG) emissions associated with conventional agricultural systems.

To deepen students' comprehension of these concepts, SGs should be systematically integrated into science and environmental studies curricula. These gardens function as living laboratories, enabling students to investigate the Human Food Cycle, sustainable farming techniques, and the direct impact of agricultural practices on CC.

Beyond their academic applications, SGs serve as catalysts for broader community engagement, fostering collaboration between students, educators, and local stakeholders in sustainability initiatives. Expanding these programs to address food security challenges could provide students with a holistic understanding of plant biology, nutrition, food sovereignty, and waste reduction. Moreover, incorporating modern agricultural techno-

logies—such as hydroponic systems, composting techniques, and water conservation strategies—would allow students to develop innovative, real-world solutions to contemporary environmental challenges.

The novelty of this research lies in its examination of students' environmental perceptions, integrating key dimensions such as environmental awareness, food sovereignty, the human food cycle, and the role of school gardens (SGs). The findings underscore how these factors collectively contribute to enhancing environmental consciousness and reassessing human practices that can be effectively implemented within SG frameworks.

One notable limitation of this study is the absence of ancestral knowledge as a research variable. While the study comprehensively explored the three primary dimensions, incorporating traditional ecological knowledge could provide valuable insights by establishing connections with indigenous agricultural and environmental practices. This integration would allow for the adaptation of ancestral methodologies to contemporary strategies for climate change (CC) mitigation, fostering a more holistic and culturally inclusive approach.

Ultimately, this research contributes to the advancement of SG initiatives within public schools in Bogotá, laying the groundwork for strengthening sustainable agricultural practices in educational settings. Additionally, it promotes greater awareness of the role of SGs in CC mitigation, with particular emphasis on their impact at *La Aurora Public School*.

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Annex1

Perceptions about the link between Climate Change and the School Garden

Dear:

You are invited to participate in our survey on climate change and its relationship with urban gardens. This survey is being conducted with approximately forty students, each being asked to select a single option for each of the statements provided. Your participation in this study is necessary. There are no foreseeable risks. It is very important for us to know your opinion. Your survey responses will be strictly confidential, and the data from this research will be reported only in aggregate. This information will be analysed and shared. Thank you very much for your time and support.

Section 1: Awareness

Global warming is a challenge that requires the active participation of all members of society. As an international reference in the fight against climate change, various institutions or entities carry out various awareness initiatives as part of their social awareness plan on climate change.

The fight against climate change and all that it entails—the reduction of greenhouse gas (GHG) emissions, the energy transition towards a decarbonized economy, the efficient use of energy, changes in consumption habits, etc.—requires greater awareness and a greater willingness to act by all members of society.

In line with our environmental commitment, it is essential to include the implementation of awareness programs on climate change as an additional component of our climate actions. We have been carrying out various initiatives aimed at different audiences as part of our ongoing efforts in this area.

Earth is our home, the planet where we were born, grow, and work for our dreams. A paradise of 4.5 billion years where different species share the same stage, and where humans, from parents to children, from generation to generation, take turns to build a better world.

1. **But at what point did we go from improving our planet to being on the brink of destroying it?**
   a) Since the industrial development, which led to the start-up of large factories and various machines.
   b) When the temperature increased due to the French Revolution
   c) When wood emerged as an energy resource.
   d) When humans discovered fire.

2. **Climate change is...**
   a) There is no evidence of such a phenomenon
   b) A reality that is accelerating due to human intervention increasing CO_2 emissions.
   c) An evident reality, taking into account the irreversible alterations of the current environment.
   d) A normal change of our planet.

3. Which sectors are responsible for the highest percentage of climate change?

a) Agriculture and land use
b) Energy (electricity, transportation, industry, and construction)
c) Renewable energy consumption
d) Fossil fuels

Section 2: Food Sovereignty

The variability and climate change make it necessary to develop comprehensive and coherent policies, which should be aimed at adapting various productive sectors of the country. The benefits and drawbacks of using agrofuels (AGC) in Colombia include environmental, social, and economic impacts.

The fiscal benefits that the State obtains from AGC do not compensate for the opportunity costs associated with social investment and environmental degradation for society as a whole. Ultimately, promoting crop diversification is suggested as a measure to ensure the country's food sovereignty and improve the quality of life of the rural population, which faces high levels of poverty and indigence.

AGCs are generally produced from sugarcane, oil palm, soybean, corn, cassava, and rapeseed. The competition between AGCs and food will become increasingly severe in terms of availability and prices, because the planet has limited available agricultural land and land displacement to produce them is increasing price hikes. Although AGC production plays a crucial role in price increases, there are other factors to consider, such as the increase in transportation and freight costs due to rising oil prices, population growth, and speculation in the major markets that dominate world food trade, among other elements.

Land use should be prioritized for food production, especially when more than 1 billion people suffer from hunger, according to the Food and Agriculture Organization of the United Nations (FAO). This is even more important because it creates a competition in which the most vulnerable sectors in rural areas face increasing difficulties in producing inputs and food, aggravating and deepening exclusion models. Currently, it is recognized that in terms of food security, food availability is not a problem in most developing countries. However, the lack of access to these foods is, due to the increase in their prices and high poverty rates.

Taken from: Ávila-Díaz, Á. J. & Carvajal-Escobar, Y. (2015). Agrofuels and food sovereignty in Colombia. *Cuadernos de Geografía: Revista Colombiana de Geografía, 24*(1), 43–60. https://doi.org/10.15446/rcdg.v24n1.37699

FAO (Food and Agriculture Organization of the United Nations), IFAD (International Fund for Agricultural Development), and WFP (World Food Program). 2012. The state of food insecurity in the world 2012: Economic growth is necessary but not sufficient to accelerate the reduction of hunger and malnutrition. Rome: FAO, IFAD.

1. AGC production through monocultures in Colombia requires extensive land areas and considerable investments. This not only results in environmental damage due to soil degradation and resource contamination but also entails:

a) Exporting AGC also means exporting resources like water, an element that is rarely accounted for in compensation calculations. In this context, the concept of

'virtual water', i.e., water used to produce goods and services, becomes a fundamental aspect to evaluate the total water impact of a product on the environment.

b) Prioritizing economic capital growth over addressing territorial transformations negatively affecting food sovereignty.

c) Decreased quality of life, increased poverty in rural areas, the urbanization process, and the loss of cultural heritage linked to traditional agricultural practices.

d) Forced community relocation and land abandonment have enabled oil palm companies to occupy areas belonging to Afro-Colombian communities, such as in Chocó and Tumaco, where numerous incidents of illegal occupation have been recorded.

2. Colombia has stopped cultivating essential food for the diet, such as wheat, barley, and corn, leading to dependence on imported food. In the 1990s, the country produced 95% of the corn it consumed, but by 2011, 85% of the corn was imported (according to FAO 2013 and the Superintendence of Industry and Commerce 2012). Despite having the capacity to produce food, the economic model's focus has prioritized:

a) Market laws and regulations, including VAT exemptions, gasoline surcharges, global taxes, and mandatory consumption requirements, among other aspects.

b) State incentives aimed at making these investments feasible.

c) Preference for industrial agriculture over small farmers' production, thus favouring economic capital growth.

d) Obtaining cheaper products through product importation

3. Evaluating food security at the global, national, regional, local, community, or individual level requires a comprehensive perspective that involves considering:

a) The high frequency of agricultural pesticide use, which deteriorates food quality.

b) Regarding the reduction in the amount of protein in the current diet.

c) Economic, political, social, cultural, technical, and environmental factors impacting each of the mentioned attributes (quantity, diversity, and quality).

d) The ability to obtain and have essential foods for a healthy and active life, considering both the quantity, diversity, and quality of these foods.

Section 3: Human Food Cycle Linked to Climate Change and School Gardens

Greenhouse gas emissions from the agricultural and forestry sectors currently account for more than 30% of annual emissions (deforestation and forest degradation 17.4%, agriculture 13.5%). Agriculture, however, can contribute to reducing greenhouse gas emissions and their impact by managing ecosystem services, reducing land use changes and deforestation linked to it, using more efficient crop varieties, better control of accidental fires, improved nutrition for ruminant livestock, more effective livestock waste management, organic soil management, conservation agriculture, and agroforestry systems.

In addition to reducing greenhouse gas emissions, well-managed pasture and cropland can sequester significant amounts of carbon. Forty percent of land biomass, and thus biological carbon, is directly or indirectly managed by farmers or herders. It is in their interest to adopt management systems that combine mitigation and adaptation, thus improving both local and global food security by implementing urban or home gardens.

The current ecosocial crisis situation and the problem of climate change demand that citizens be prepared, from an educational perspective, with resilience and adaptation strategies to changes and to an inevitable new reality of decline. We consider the educational garden as an indispensable resource to face this challenge.

1. **Recognizing the need to advocate for an agricultural model that adopts strategies based on the low use and maximum utilization of natural resources through a production model that fits within the biophysical limits of the planet is important because:**
   a) Crops that align with the natural rhythms of nature are obtained, without intervening in them and maximizing their use.
   b) Notions related to the recognition of the existing limits in many resources used in food production and cultivation emerge.
   c) It is recognized that maintaining current consumption is unviable and there is a commitment to rethink food and promote local and/or ecologically sourced consumption, going beyond reflecting on food from a healthy perspective.
   d) To the reduction of negative impacts on nature as products from the field with a reduced carbon footprint.

2. **The Food and Agriculture Organization of the United Nations (FAO) warns that agriculture and livestock activities are capable of generating 20% of greenhouse gas emissions, which will increase in the coming decades. Its impact is only surpassed by the energy sector (47% of emissions), so a change in ..... could have a great impact.**
   a) agricultural model
   b) eating habits
   c) food groups consumed
   d) environmental policies

3. **High levels of CO2 significantly reduce the essential nutrients of basic foods for human consumption such as wheat, rice, corn, or soybeans. In this context, it can be affirmed that:**
   a) climate change will affect the varieties of crops we could plant.
   b) global warming alters the development and reproductive cycle of plants, advancing the flowering and harvesting seasons and reducing crop yields.
   c) climate change brings with it the rise in food prices, so the sectors with the highest purchasing power are those that have access to them.
   d) if in an average diet we reduce the amount of red and processed meat and double the consumption of fruits and vegetables, we can reduce greenhouse gas emissions by 17%, and nearly 40% of water consumption.

Based in: https://revistascientificas.us.es/index.php/IE/article/view/15495/13956

Annex 2

Evaluation Format and Validation Instrument

Objective of the Evaluation Instrument: Evaluate the content of a survey associated with perceptions about the link between Climate Change and the School Garden

Research Objective: Perceptions about the link between Climate Change and the School Garden of the students of a ninth grade course at the *La Aurora Public School*

Complete the following form by marking an X in the **Yes** or **No options**. Feel free to write in the open sections of this format. We appreciate your kind collaboration

	Section 1						Section 2						Section 3					
	1		2		3		1		2		3		1		2		3	
Item	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Consistency in Writing		X	X		X		X		X			X	X		X		X	
Partiality or Prejudice		X		X		X	X		X		X			X		X		X
Responses could be influenced by the desire to conform to social expectations.		X		X		X	X		X			X						
Coherence	X		X		X		X		X		X		X		X		X	
Does the language used align with the characteristics and demographics of the study participants?	X		X		X		X				X		X		X		X	
Does it contribute to the objectives and goals of the research?	X		X		X		X		X		X		X		X		X	
For each item, review them and determine if they need to be removed or adjusted. Kindly provide details.	SEE DOCUMENT IN THE ANNEX FILE																	

General factors to take into account	Yes	No
The guidelines provided allow you to complete the survey completely.	X	
The arrangement of the statements in the survey follows a logical and progressive order	X	
The number of sections and statements is appropriate	X	
The statements will contribute to achieving the purposes or objectives of the research.	X	

Final Considerations (Please add any other items that should be considered in this format)

1. It would be convenient to include 4 items for each sentence and leave items with approximately the same length.

2. I would correct the statements and particularly the text of the second section, which seems very biased and also very poorly written.

Instrument Validated by: JAIME A. CASAS M.	**Signature**
Phone number: +57 300 364 3371	**JAIME A. CASAS M.**
E-mail: jcasas@pedagogica.edu.co	

Source: Self made