Revista de CIENCIAS AGRÍCOLAS

e-ISSN Online 2256-2273

Received: October 10 2024 Accepted: April 01 2025 Published: April 30 2025

Research article: Agriculture

Development of an agroecological strategy with rural women based on a food consumption score

Desarrollo de una estrategia agroecológica con mujeres rurales basada en una puntuación del consumo de alimentos

David Álvarez-Sánchez[1]; Pedro Pablo Bacca-Acosta[2]; Lizeth Tatiana Luna-Mancilla[3]; Roberto Argoti-Eraso[4]; Marcela Riascos-Delgado[5]; Jhon James Borja-Tintinago[6]; Jeisson Rodriguez-Valenzuela[7]

1. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, dalvarez@agrosavia.co, https://orcid.org/0000-0003-3563-2529. (correspondence)
2. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, pbacca@agrosavia.co, https://orcid.org/0000-0002-0590-0396.
3. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, lluna@agrosavia.co. https://orcid.org/0000-0002-1181-0506
4. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, rargoti@agrosavia.co. https://orcid.org/0000-0003-2248-2285
5. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, meriascos@agrosavia.co, https://orcid.org/0000-0003-0573-2748
6. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, jborja@agrosavia.co, https://orcid.org/0000-0002-5576-0280
7. Corporación Colombiana de Investigación Agropecuaria - AGROSAVIA, Pasto, Colombia, jrodriguezv@agrosavia.co, https://orcid.org/0000-0003-2186-8805

Cite: Álvarez-Sanchez, D.; Bacca-Acosta, P.P.; Luna-Mancilla, T.; Argoti-Eraso, A.; Riascos-Delgado, M.; Borja-Tintinago, J.J.; Rodriguez-Valenzuela, J. (2024). Development of an agroecological strategy with rural women based on a food consumption score. *Revista de Ciencias Agrícolas*. 42(1): e1258. http://doi.org/10.22267/rcia.20254201.258

ABSTRACT

In rural Colombia, female-headed households represent a vulnerable group regarding food insecurity, highlighting the need for strategies to improve the diversity and volume of cultivated food. This study aimed to develop an agroecological strategy using the Food Consumption Score (FCS) as an indicator. To achieve this, we worked with 38 participants from the Obonuco district in the department of Nariño, conducting an initial characterization through a semi-structured survey and applying the FCS methodology to identify at-risk food groups that could be managed. This information served as the foundation for the participatory design of two gardens based on agroecological principles, and over a year, the contribution of these gardens to the prioritized food groups was evaluated. The results revealed that age, education level, and land access increase vulnerability in this population. Based on the FCS results, the gardens were designed to positively impact five food groups by integrating 15 plant species and two animal protein sources (guinea pigs and eggs). The project enhanced food security among rural women heads of households through participatory strategies, the FCS indicator, and agroecological production processes, creating a methodological framework that can be replicated in similar initiatives.

Keywords: food rights; food security; home gardens; participatory development; traditional knowledge; vegetables

RESUMEN

En la zona rural de Colombia, las familias con jefatura femenina constituyen un grupo poblacional vulnerable a la inseguridad alimentaria, lo que exige nuevas formas de intervención para mejorar la diversidad y el volumen de alimentos cultivados. Por tanto, este estudio tuvo como objetivo desarrollar una estrategia agroecológica, utilizando el indicador de Puntaje de Consumo de Alimentos (PCA). Para esto, se trabajó con 38 participantes del corregimiento de Obonuco en el departamento de Nariño. Se realizó una caracterización inicial mediante encuesta semiestructurada

y se aplicó la metodología PCA para identificar grupos alimenticios en riesgo y con la posibilidad de gestión; esta información se usó como base para diseñar participativamente dos huertos fundamentados en principios agroecológicos, y durante un año, se evaluó la contribución de estos a los grupos priorizados. Los resultados permitieron identificar que la edad, el nivel educativo y el acceso a la tierra son factores que incrementan la vulnerabilidad en esta población. A partir del PCA, se concertó el diseño de los huertos con el propósito de impactar positivamente en cinco grupos alimenticios mediante la integración de 15 especies vegetales y dos fuentes de proteína animal (cuyes y huevos). Con el uso de estrategias participativas, el indicador PCA y procesos de producción agroecológica, se contribuyó al incremento de la seguridad alimentaria de las mujeres rurales cabeza de familia, configurando un proceso metodológico que puede ser replicado en procesos similares.

Palabras clave: conocimientos tradicionales; derecho a la alimentación; desarrollo participativo; huertos; hortalizas; seguridad alimentaria

INTRODUCTION

In Colombia, around 5.9 million women live in rural areas and lead households in 31.6% of cases (Departamento Administrativo Nacional de Estadística [DANE], 2022). In this context, the female role in the countryside is closely linked to the production, provision, care, and management of food for the family (Sanchez *et al.*, 2022; Silva *et al.*, 2022).

It is noteworthy that this group faces a higher degree of vulnerability, associated with unequal remuneration for work, lack of access to education, and restrictions imposed by gender roles (Álvarez *et al.*, 2019; Sinclair *et al.*, 2022). This reality has led to the indication that, in the country, when a rural woman assumes leadership of the household, the proportion of food insecurity increases by 39.5% compared to households headed by a man (Sanchez *et al.*, 2022).

This raises a deep reflection on the gender gap in access to food, especially in a context where food security is part of the Sustainable Development Goals (SDGs). Therefore, a collaborative approach among various actors is required to develop strategies that effectively address fluctuations and high food prices, as well as income availability, access to land, and productive sustainability in the countryside (Ministerio de Salud y Protección Social [MSPS] *et al.*, 2019; Pinheiro *et al.*, 2022; World Food Program [WFP], 2024).

In this context, the present study was carried out in Nariño, the third department in Colombia, with the highest proportion of rural women (DANE, 2022). Specifically, in the district of Obonuco, which is located in a peri-urban area characterized by subsistence agricultural production and a high supply of informal labor (Rivera *et al.*, 2020).

The Food Consumption Score (FCS) was used, which is an indirect measure involving dietary diversity, energy value, and nutrient content consumed by a family based on the frequency of consumption of eight food groups during seven days, according to the dietary recall method proposed by the World Food Program (WFP, 2009).

This indicator has proven to be a valuable tool for both public policy formulation and the nutritional characterization of populations on a large scale. For instance, Herrera-Cuenca *et al.* (2022) used it to identify nutritional differences between rural and urban areas in Venezuela; Fite *et al.* (2022) and Markos *et al.* (2024) employed it as a criterion for prioritizing public aid interventions in Ethiopia; while Shiratori *et al.* (2023) applied it to compare nutritional indicators across different geographical regions of Burkina Faso, among other examples.

However, during the literature review, no examples of the use of the FCS as a tool to support the development of local strategies were found. Therefore, this study suggests that the assessment of nutritional status could be used as a baseline to guide the development of agroecological processes, which, according to Mahecha-Groot & Leichenko (2024), are characterized by promoting product diversification to take advantage of the broad spectrum of nutritional benefits while seeking social acceptance and promoting environmentally friendly forms of production.

In this sense, the strategy of agroecological gardens was adopted, which has proven in different contexts to be a space of resistance against the processes of food homogenization, since it allows people to produce food in a sustainable, socially equitable, and economically viable way, directly contributing to the objective of eating consciously (Guzmán, *et al*., 2022; Mahecha-Groot & Leichenko, 2024).

Therefore, this study sought to design a methodological framework to address the nutritional dynamics of a group of female heads of households in the Obonuco district and to generate strategies based on agroecological principles to advance the challenges of local food security and sovereignty.

MATERIAL AND METHODS

Characterization of the participants

This study employed a non-probability sampling approach, as the objective of the research was to identify female-headed farming households in the Obonuco district. Participant selection was conducted using the snowball sampling technique, which enabled the identification and recruitment of women meeting this profile.

The sample included 38 participants, of whom 21 reside on the Playa Alta sidewalk with geographic coordinates of 1°11´18.3´´ N and -77°18´57.6´´ W, and 17 in the San Felipe sidewalk, with coordinates of 1°11´57.6´´ N and -77°18´41.5´´ W.

Data collection was carried out in person using the semi-structured survey technique, as described by Álvarez *et al.* (2019). For this, a questionnaire was designed with 14 primary variables, grouped into three components: i) social, ii) economic, and iii) agro-productive strategies. The collected data were tabulated and analyzed using descriptive statistics.

Food Consumption Score Estimation (FCS)

The methodology proposed by the United Nations World Food Programme was followed (WFP, 2009). This estimate was made at the beginning of the project on two occasions, with an interval of 30 days, generating an average for each participant.

The instrument collected information on household consumption of food products during the previous week, grouping them into eight categories. The list of foods was drawn up based on consultations with key informants living in the study area. The final version of the instrument was shared and discussed in socialization meetings between the participating women and the research team.

Each food was given a score from 0 to 7 according to the frequency of weekly consumption, and then an average value was calculated for each group, which was multiplied by a coefficient determined in the methodology that is associated with the variety and nutritional importance of the group. Food consumption

was considered acceptable when the average of the indicator was higher than 35 points, limited consumption when a value between 21 and 35 points was presented, and poor consumption with a value lower than 21 points.

Planning and installation of community agroecological gardens

After sharing the FCS results with the participants, the critical points derived from the indicator were identified. This step led to the preparation of a list of agricultural and livestock products that had to meet the following criteria: i) adapt to the agro-environmental offer, ii) be part of local gastronomy and uses, and iii) not require intensive production and be feasible to cultivate using agroecological practices.

Subsequently, work groups were formed to plan the spatial arrangement of the gardens. Each product was assigned a color and a representative figure. During knowledge-sharing sessions, the proposals were socialized, and through consensus, a final design was generated that was installed in an area of approximately 5000 m2 in the Playa Alta and San Felipe sidewalks.

The production process was complemented with workshops on the preparation of organic fertilizer and bio-inputs, agroecological management of the garden, preparation of nutritional blocks for minor species, and post-harvest strategies.

Contribution of the community agroecological garden

The study was conducted using a quasi-experimental design. Over one year, data were collected from each component of the agroecological garden. Records included crop yields (expressed in post-harvest kilograms), the number and average weight of slaughtered guinea pigs (Cavia porcellus), and the number of eggs produced by laying hens.

This information allowed for the characterization of productive performance under real-world smallholder management conditions. Based on these data, the contribution of the agroecological garden to the categories of the FCS indicator was estimated, expressed in kilograms and units.

RESULTS AND DISCUSSION

Characterization of the participants

The participants ranged in age from 30 to 87 years, with 34.2% of women being over 60 years old, considered senior citizens according to Colombian regulations (Table 1). This age trend reflected a strong connection to agricultural work while also highlighting the aging process affecting the rural sector. This aspect poses a significant socioeconomic challenge for this population in the short and medium term (Silva *et al.*, 2022).

All women completed primary school, and 42% completed secondary education (Table 1). The reason given for not continuing with a higher level of education strongly coincides with a study carried out at the national level, according to which dedication to household chores or work, lack of economic resources, and pregnancy were identified as determining factors (DANE, 2022).

Less schooling is often linked to lower socioeconomic levels, which has significant implications in several aspects. For example, several authors have demonstrated a direct relationship between lower nutritional levels, difficulty accessing land, and employment, information that contributes to interpreting the local panorama (Silva *et al.*, 2022; Pinheiro *et al.*, 2022; Markos *et al.*, 2024).

Table 1. *Results of characterization of the production system (n=38)*

Comp.	Variable	Category	*f* absolute	*f* relative
Social	Age	30 to 45 years	9	0.24
		45 to 60 years	16	0.42
		60 to 75 years	9	0.24
		> 75 years	4	0.11
	Educational level	Primary	22	0.58
		Secondary	16	0.42
	It is part of an association	Yes	17	0.45
		No	21	0.55
	People make up the home	1 to 2	8	0.21
		3 to 4	22	0.58
		>5	8	0.21
Economic	Main economic activity	Agriculture	25	0.66
		Independent	11	0.29
		Employee	2	0.05
	Destination harvest	Market district	5	0,13
		Neighbors	3	0.08
		Self-consumption	30	0.79
	Generate some product with added value	Yes	9	0.24
		No	29	0.76
Agro-productive	Production area (m^2)	It doesn't count	4	0.11
		50 to 1000	21	0.55
		1000 to 2000	1	0.03
		2000 to 3000	3	0.08
		3000 to 4000	1	0.03
		4000 to 5000	1	0.03
		> 5000	7	0.18
	Production area ownership	Lease	5	0.13
		Own	32	0.84
		Sharecropper	1	0.03
	Type of labor	Familiar	28	0.73
		Mixed	6	0.16
		Payment per day	4	0,11
	Main product	Potato	22	0.58
		Vegetables	11	0.29
		Legume (pea, broad bean, kidney bean)	3	0.08
		Corn	2	0.05
	Presence of livestock component (minor species)	Guinea pigs	15	0.39
		Hens	6	0.16
		Rabbits	4	0.11
		Does not present	13	0.34
	Perform composting processes	Yes	15	0.39
		No	23	0.60
	Make some kind of bioinput	Yes	6	0.15
		No	32	0.85

It was relevant to note that 17 women resort to associations and cooperatives as strategies that allow them to access training processes, resources, and mark*et al*ternatives (Table 1). According to them, as a group, they have been able to take courses and workshops offered by different institutions, apply for productive projects related to their agricultural work, and participate in farmers' fairs.

This aligns with community building, a resilience strategy that allows addressing the challenges that arise from the daily work of agriculture and that has been determined as a driving factor of agroecological processes (Silva *et al.*, 2022; Mahecha-Groot & Leichenko, 2024).

The results obtained in the social component confirm the statistics reported by DANE (2024), regarding the number of household members in the rural area of Nariño, identifying in this study the prevalence of 3 to 4 people (Table 1). A particular case occurred in households with more than five members, where two situations were identified: the first associated with the support of other family members to share household obligations and a second scenario that implies that the mother, who is the head of the household, has several people in her care, which was commented on as a situation of greater vulnerability.

The above was also noted by Herrera-Cuenca *et al.* (2022) and Pinheiro *et al.* (2022), who observed that food security was inversely associated with the number of household members, specifically the larger the family, the higher the level of food insecurity, and, conversely, households with three or fewer members had higher food security.

On the other hand, it was possible to confirm what was indicated by Silva *et al.* (2022), when they reported that rural women are forced to balance their responsibilities between productive work and domestic care, which generates a continuous workload. The main economic activity reported in Table 1 corresponds to the agricultural sector with 66% of the participants, followed by non-formal activities with 29% that can be associated, according to Rivera *et al.* (2020), with domestic service, sales in marketplaces, and manufacturing in small businesses in the city of Pasto.

Agricultural production is essential for women, as it allows 79% of them to be self-sufficient in food, while 18% sell or exchange their production, generating additional income. In addition, nine participants add value to their products by making homemade food and dairy products, which diversifies household income (Table 1). These activities allow the integration of the participants into the economy of the village.

On the other hand, when analyzing the agro-productive component, it was evident that the model adopted is of a family nature, given the distribution of work, the tendency of a collective patrimony, and the orientation of production towards household income (Álvarez *et al.*, 2019; Rivera *et al.*, 2020). In most cases, women have their own area for the establishment of crops and the care of minor species, while only 16% have a productive unit for rent or share a plot with a partner (Table 1).

In this sense, a challenge related to access to land was made visible, as demonstrated by the fact that in 55% of the cases, the productive area

was less than 1,000 m², which forces women to offer their labor, generally in productive units of relatives or neighbors (Table 1). This scenario in rural areas has been documented by different authors, who attribute it to the fragmentation of properties due to hereditary succession from parents to children (Álvarez *et al.*, 2019; Rivera *et al.*, 2020), but in addition, in Obonuco there is an urbanization process due to the proximity to the city, modifying the agricultural vocation of the land to country houses and the establishment of small industries.

In the specific context of Obonuco, women have identified crops that fit the characteristics of the area they own, prioritizing those that require less physical effort, have low investment, and have a constant demand in the market. Therefore, they choose to establish diversified horticultural gardens and, to a small extent, resort to composting and the use of bio-inputs as part of their productive strategy, as detailed in Table 1.

It is worth noting that 66% of the participants included the livestock component with species whose diet can be supplemented with internal resources, such as guinea pigs and rabbits (Table 1). This allowed families to obtain an additional source of protein for their diet, as well as generate quick economic income, through the sale of products and the use of organic waste for empirical fertilizer production, which is a recurring characteristic in Nariño (Álvarez *et al.*, 2019; Sinclair *et al.*, 2022).

This characterization as a starting point not only provided a vision of the socioeconomic and productive situation of this group of single mothers but also provided an understanding of the context in which the nutritional assessment and implementation of the agroecological strategy would be carried out. In this way, it allowed for the necessary methodological adjustments to be made to promote the inclusion and participation of women, with alternatives that required low physical effort, the organization of days of exchange of didactic knowledge, and provided the freedom for participants to attend the activities carried out with family members.

Food Consumption Score Estimation (FCS)

The results obtained revealed a high sensitivity of the PCA indicator to the variation in food consumption by participants in the Obonuco district, where a range between 21.9 and 59.4 points was determined (Table 2). In this sense, it was established that 29 women presented an acceptable consumption status, 9 women obtained a borderline score, and no participant obtained a poor score.

Table 2. *Consolidated evaluation of participants to the FCS indicator and associated categories*

Food group	Associated local products	Food consumption (days)		
		Minimum	Maximum	Average
1. Cereals and tubers	Corn, rice, pasta or noodles, bread, flour, oats, wheat	2.0	6.0	5.14
	Potato, yucca, ulluco, arracacia, yam	2.0	7.0	6.28

Food group	Associated local products	Food consumption (days)		
		Minimum	Maximum	Average
2. Legumes, nuts and seeds	Beans, peas, broad beans, lentils, chickpeas, peanuts	1.0	4.0	3.53
3. Vegetables	Lettuce, spinach, onion, tomato, carrot, celery, radish, broccoli, cauliflower, beet, cabbage, chard	1.0	3.0	2.28
4. Fruits	Apple, orange, lemon, mango, papaya, melon, strawberries, golden berry, plantains, bananas	0.0	4.0	2.83
5. Meats, fish and eggs	Chicken, beef, pork, rabbit, guinea pig	0.0	4.0	2.33
	Fresh fish, dried fish, tuna, sardines	0.0	1.0	0.08
	Hens egg	1.0	4.0	3.39
6. Dairy products	Milk, cheese, yogurt, quesillo, curd	0.0	3.0	1.94
7. Sugars	Sugar, sweets, honey, pastries, biscuits, soft drinks	3.0	5.0	3.19
8. Oils, fats or butter	Oil from different sources, animal fats, margarine, butter	1.0	6.0	3.58
Food Consumption Score (FCS)*		21.9	59.4	44.60

*FCS < 21 points: Poor consumption; FCS 21 to 35 points: Limited consumption; FCS > 35 points: Acceptable consumption. Source: this research

The higher the FCS score, the more likely it is that the diet is varied and that a household covers an adequate amount of nutrients (WFP, 2009; Markos *et al.*, 2024). Therefore, those participants who were classified as having a limited diet may present restricted levels of consumption of some foods, and it is suggested that actions be established to diversify or increase intake (WFP, 2024).

The groups with the lowest consumption in this study were Group 4, associated with fruits; Group 5, which includes meat, fish, and eggs; and Group 6, associated with dairy products (Table 2). These findings are consistent with the reports of the Food Security Assessment for the Colombian Population-2024, where the drop in the frequency of consumption of these groups was identified for two consecutive years in this region, which shows that, although the population achieves an acceptable consumption, the diet is not balanced and lacks foods that are a source of essential nutrients such as vitamins, proteins, and iron (WFP, 2024).

Likewise, the National Survey of the Nutritional Situation (NSNS) for the rural area of Nariño confirms the above and suggests that this deficiency is strongly associated with the lowest wealth quartile and when the sex of the head of household is female (MSPS [Ministerio de Salud y Protección Social] *et al.*, 2019). This corroborates the hypothesis of greater vulnerability in this population group and, therefore, underlines the need to build a food production strategy in a participatory manner that increases both the volume and variety of products.

The results underline the strong influence of socioeconomic determinants on food insecurity, as argued by Pinheiro *et al.* (2022), aggravated by the high costs of healthy foods (Fite *et al.*, 2022; WFP, 2024). Consequently, in households with limited resources, heads of household tend to implement adaptive strategies that prioritize the acquisition of foods of lower nutritional quality as their income increases (Herrera-Cuenca *et al.*, 2022; Sanchez *et al.*, 2022).

This trend is reflected in the Obonuco District, where the average consumption of cereals and tubers of Group 1 reaches an average of 5.31 days, together with the consumption of Group 2, composed mainly of legumes, which reaches 3.53 days (Table 2). The participants indicated in this regard that these options provide a lower-cost source of protein with legumes and the feeling of satiety with products such as rice, potatoes, noodles, or bread, even though they recognize that these are not nutritious foods, a result similar to that reported by Sinclair *et al.* (2022).

It was also significant to establish that, on average, only 2.28 days have substantial portions of vegetables consumed, as recorded in Table 2. This is attributed to the preference to sell the harvest to obtain income for household expenses. This behavior was similar to that indicated in the NSNS, with an average of 2.8 days, where at the national level, a greater consumption of vegetables is reported in the municipal capitals compared to rural and peri-urban areas, which is paradoxical (MSPS *et al.*, 2019).

Finally, it was confirmed that the consumption of foods from Group 7, which includes sugars, and Group 8, composed of oils, fats, or butter, was high in the evaluated group (Table 2). In a similar context in Venezuela, Herrera-Cuenca *et al.* (2022) identified that more than 83% of the rural population consumes these products for more than three days a week, while in Colombia they are classified as two of the five most used products, with an average per person of 23.5g and 13 g per day, respectively (MSPS *et al.*, 2019). Findings that underline the need to address this habit through public health policies.

Based on the above information and the characterization phase, it was possible to identify the relationship between the species produced and the type of food consumed by the participating women. Greater availability of agricultural and livestock products on the farm contributes to improving nutritional diversity, which in turn helps reduce food insecurity (Ramírez, 2022; Shiratori *et al.*, 2023).

In this way, the food groups of the FCS indicator provided the basic elements for the participatory design of the agroecological garden, considering in plenary that the greatest emphasis should be placed on Groups 1, 2, 3, and 5, due to their contribution to the diet and the potential for diversification that they offer in the territory. Group 4, despite being prioritized, was determined to be integrated into a second stage of the organization of the garden due to the production time of the fruit trees.

Planning and installation of an agroecological garden

Due to the difficulty of getting around in rural areas, especially for single mothers who expressed the need not to be away from home for long periods, the implementation of two vegetable gardens was decided. This initiative facilitated the participation of women in the San Felipe and Playa Alta sidewalks and promoted the integration of the community in the programmed activities.

By consensus, 14 plant species were selected and grouped into seven botanical families. These were arranged in strips with a maximum area of 15 m2 of the same species to ensure spatial diversity within the lot, and the rotation strategy was based on switching from vegetables to legumes and from grasses to tubers in two production cycles of approximately six months (Figure 1a-d and Table 3).

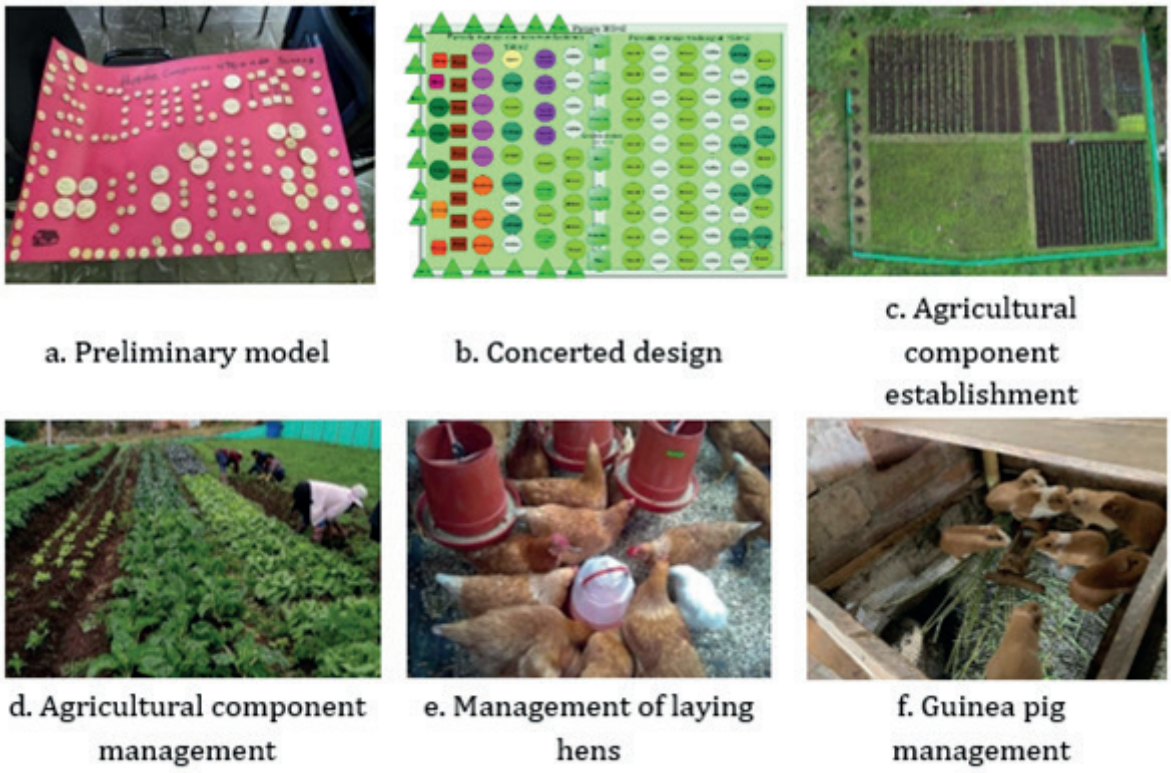

Figure 1. *Planning and installation process of an agroecological garden.*

At the planning stage, the proposal to incorporate aromatic and medicinal plants around the gardens stands out due to the repellent action they could have on insect pests. A local strategy that was tested by Martínez *et al.* (2024) in vegetable production concluded that this practice is efficient in reducing dependence on pesticide inputs and increasing diversification in peasant systems.

Aromatic species would later promote the exchange of knowledge about traditional uses, highlighting the role that rural women have as custodians of seeds and preservers of associated knowledge (Sanchez *et al.*, 2022). Mahecha-Groot & Leichenko (2024) have pointed out that the introduction of certain plant species goes beyond economic benefit, focusing on specific culinary and even medicinal uses, which in this case was notable.

A livestock production unit consisting of 25 guinea pigs (5 males and 20 females) and 30 laying hens was integrated into each garden to provide an additional source of protein to the participants' diet. This strategy fostered the interaction between crops and animals, a fundamental principle of agroecology (Figure 1d-e).

Surplus vegetable crops were used to supplement animal feed, and the organic waste generated was used as raw material for compost production, consolidating a circular approach. This strategy not only diversified the production system but also contributed to the reduction of production costs and encouraged responsible management of the waste generated (Fite *et al.*, 2022).

Among the lessons learned, the importance of considering the limitations and suggestions of participants when designing strategies of this type stands out to ensure the effectiveness of the agroecological garden. In this sense, collective and democratic actions in decision-making, in addition to contributing to social change and the empowerment of participants, produce endogenous knowledge and solutions that can be managed by community social capital and the reva-

luation of cultural and solidarity actions (Mahecha-Groot & Leichenko, 2024; Martínez *et al.*, 2024).

The results obtained underline the milestone of generating the adoption of practices that include the reduction of external inputs, soil conservation, and the promotion of agrobiodiversity as inherent elements of agroecology (Fite *et al.*, 2022; Martínez *et al.*, 2024). However, to consolidate this process, a profound change is necessary not only at the technical level but also in the socio-political sphere. This gradual transition must be autonomously strengthened by the participants since its long-term success exceeds the interventions that the accompanying entity can carry out (Ramírez, 2022).

Contribution of the agroecological garden

To demonstrate the impact of the agroecological process on food production, the contribution of the gardens to the prioritized groups of the "PCA" indicator was compiled. The results showed that 44.4% of the total production corresponded to cereals and tubers, 11.69% to legumes, 21.8% to vegetables, and 22.14% to meat, fish, and eggs, amounting to a total of 1625 kg (Table 3).

Table 3. *Diversification of the two agroecological gardens and their contribution to the FCS food groups*

Food group	Sown products	Family	Area (m²)*	Unit	Production*
1. Cereals and tubers	Native corn (*Zea mays*)	Poaceae	130	Kg	20
	Potato (*Solanum tuberosum*)	Solanaceae	225	Kg	600
	Yellow potato (*Solanum phureja*)	Solanaceae	220	Kg	102
2. Legumes, nuts and seeds	Pea (*Pisum sativum*)	Fabaceae	168	Kg	190
3. Vegetables	Chard (*Beta vulgaris*)	Amaranthaceae	30	Kg	60
	Broccoli (*Brassica oleracea*)	Brassicaceae	60	Kg	38,4
	Big onion (*Allium cepa*)	Amaryllidaceae	30	Kg	30
	Coriander (*Coriandrum sativum*)	Apiaceae	100	Kg	143
	Cauliflower (*Brassica oleracea*)	Brassicaceae	30	Kg	9
	Lettuce (*Lactuca sativa*)	Asteraceae	40	Kg	22,5
	Parsley (*Petroselinum crispum*)	Apiaceae	30	Kg	15
	Cabbage (*Brassica oleracea*)	Brassicaceae	30	Kg	21
	Carrot (*Daucus carota*)	Apiaceae	30	Kg	15
4. Meats, fish and eggs	Eggs (*Gallus gallus domesticus*) (60 gr)	-	-	Unit	1.800
	Guinea pigs (*Cavia porcellus*) (800 gr)	-	-	Unit	240
	Oatmeal (*Avena sativa*)	Poaceae	180	Kg	60

*Values corresponding to two production cycles (12 months).

In a study conducted in Nariño with women, Sinclair *et al.* (2022) found that the scarcity of food available at home limits options for cooking, thus preventing

the configuration of consumption autonomy. The lack of variety in available ingredients means that decisions about what to cook are strongly conditioned, thus reducing the ability to prepare nutritious and varied meals.

This situation may have broader implications for health and well-being, as a limited and repetitive diet can lead to nutritional deficiencies and negatively impact quality of life (WFP, 2024). However, paradoxically, these issues are rarely accompanied by ongoing assessments or clinical validation, which hinders their comprehensive management (Guzmán *et al.*, 2022).

Therefore, despite the high number of species integrated into the garden, the possibility of continuing to explore strategies that maximize the introduction of species was raised to consolidate food security and generate a transition towards food sovereignty.

On the other hand, although the yield obtained in the orchards was not compared to conventional crops in the region, the participants perceived a small reduction in the harvest. This phenomenon has been evidenced in lettuce and broccoli crops, where a reduction in yield was estimated between 20 and 28% when comparing organic management with conventional monoculture (Martínez *et al.*, 2024). This was indicated to be compensated by the exclusion of synthetic pesticides and fertilizers.

The participants were able to take home a more preferred product, a perspective that reflects a priority in the health and well-being of the family that was underestimated before the installation of the agroecological garden. In addition, in the different harvests, the commercialization logic was discarded since the product resulting from the process was valued.

The livestock component, which produced 1,800 eggs and 240 guinea pigs during the recording period, was highly valued due to its contribution to a scarce part of the diet in the region (Table 3). These foods, rich in protein (MSPS *et al.*, 2019), provided an average of four eggs per week per participant in the last nine months of evaluation. In addition, it was agreed to deliver three guinea pig kits per participant to complete their fattening process and subsequent consumption.

Markos *et al.* (2024) argue that internal or external changes within the household environments, such as the strengthening of agricultural or livestock components, generate seasonal variations that can positively or negatively influence food availability, thereby affecting the value of the FCS indicator.

To maximize the benefits found, it is essential to expand this component in future stages of the project. An expanded approach could include increasing livestock production capacity, which would allow providing a greater amount of protein to families with three or more members. Additionally, the implementation of more efficient management practices.

It is known that household expenditure is concentrated on the acquisition of food, representing around 30% of the family budget, and this situation has worsened in recent years due to inflation and fluctuations in the price of basic products (WFP, 2024). Therefore, influencing this expenditure and nutritional need at a community level through the implementation of agroecological gardens that integrate agricultural and livestock components offers a resilience strategy, especially for a vulnerable group such as single mothers in rural areas.

In this sense, Figure 2 summarizes the six methodological steps that generate a dynamic strategy. Each cycle seeks to obtain quantitative values on the current situation, the planning elements of the agroecological garden, and the analysis of the contribution of the products obtained to the goal of each food group to be efficient in achieving the objective of improving the baseline situation.

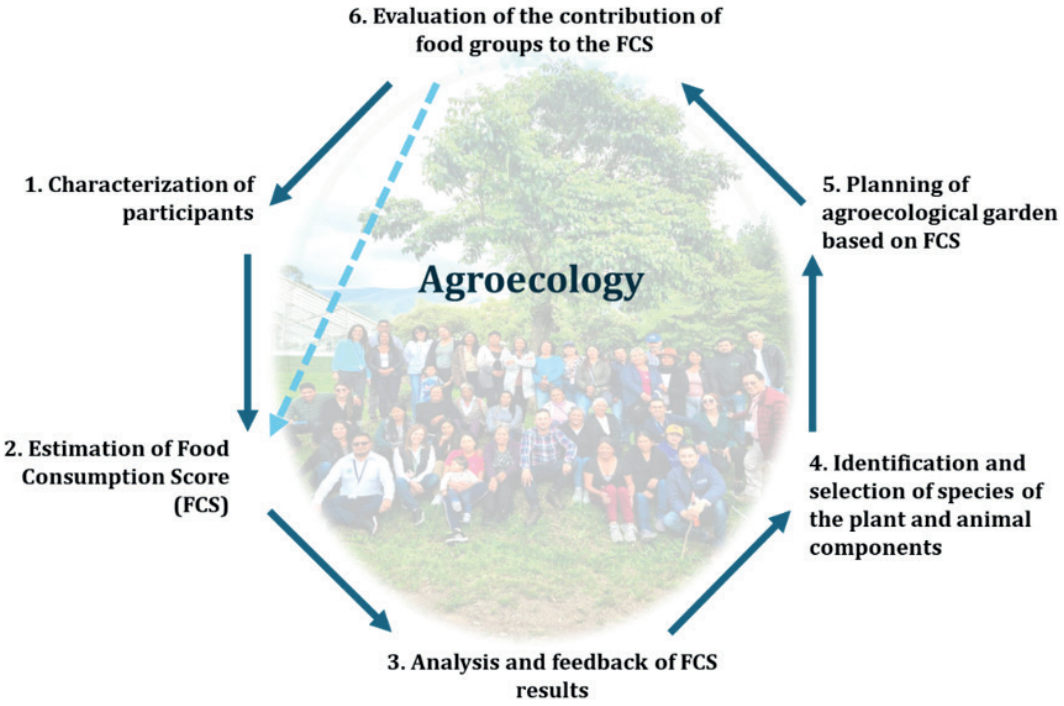

Figure 2. *Methodological proposal to increase food security based on the Food Consumption Score Indicator*

Finally, it should be mentioned that the possibility of integrating the FCS as an indicator capable of producing useful information to identify and track food production needs for a specific population is innovative. Therefore, it is necessary to continue evaluating the use of this instrument so that it can be used by different institutions as a support strategy to promote food security.

CONCLUSIONS

The use of participatory diagnostic strategies, the Food Consumption Score, and agroecological production processes contributed to the increase in food security among rural women heads of households in the Obonuco district in Colombia. The proposed methodology not only affected the availability and access to food but also empowered the participants, making visible their role as guardians of agrobiodiversity, food providers, and economic supporters of their families. This comprehensive approach highlights the importance of participation and local knowledge in building sustainable and resilient food systems.

ACKNOWLEDGMENTS

The authors would like to thank the WWB Colombia Foundation for funding the project identified with ID 1002460 for the rural women of the village of Obonuco. To the Colombian Agricultural Research Corporation, AGROSAVIA. And for his support in the field monitoring of this initiative, to the professional José Luis Benavides.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

Álvarez, D.; Gómez, E.; Ordóñez, H. (2019). Tipología de fincas productoras de arveja (Pisum Sativum L.) en la subregión sur de Nariño, Colombia. *Ciencia y Tecnología Agropecuaria*. 20(1): 659–677. https://doi.org/10.21930/rcta.vol20_num3_art:1593

Departamento Administrativo Nacional de Estadística (DANE). (2022). *Situación de Las Mujeres Rurales En Colombia*. 3º ed. Bogotá: DANE. 20p.

Departamento Administrativo Nacional de Estadística (DANE). (2024). *Encuesta Nacional de Calidad de Vida (ECV) 2023: Resultados para población campesina*. Bogotá: DANE. 27p.

Fite, M.; Kenay A.; Assebe, T.; Oljira, L.; Teji, K. (2022). Factors associated with food consumption score among pregnant women in Eastern Ethiopia: A community - based study. *Journal of Health, Population and Nutrition*. 41(6): 1–9. https://doi.org/10.1186/s41043-022-00286-x

Guzmán, A.; Alajajian, S.; Rohloff, P.; Proaño, G.; Brewer, J.; Jimenez, E. (2022). Academy of nutrition and dietetics nutrition research network: A home garden intervention improves child length-for-age Z-score and household-level crop count and nutritional functional diversity in rural Guatemala. *Journal of the Academy of Nutrition and Dietetics*. 122(3): 640–649. https://doi.org/10.1016/j.jand.2021.04.002

Herrera-Cuenca, M.; Sifontes, Y.; Ramírez, G.; Hernández, P.; Vásquez, M.; Maingon, T. (2022). Encuesta de seguridad alimentaria y nutricional en Venezuela 2020-2021. *Anales Venezolanos de Nutrición*. 35(1): 81–98. https://doi.org/10.54624/2022.35.2.002

Mahecha-Groot, A.; Leichenko, L. (2024). Sowing the seeds of transformation in the Colombian Andes: The role of the huerta (Home garden) in fostering and sustaining agroecological production. *Geographical Review*. 115(1-2): 288–306. https://doi.org/https://doi.org/10.1080/00167428.2024.2317779

Martínez, E.; Marcillo, C.; Revelo, E., Cuervo, M.; Igua, E. (2024). Effect of flowering strips in associated broccoli and lettuce crops on increasing land use efficiency. *Sustainability*. 16(11): 4436. https://doi.org/10.3390/su16114436

Markos, K.; Dake, S.; Bisetegn, F.; Nane, D. (2024). Level of food consumption score and associated factors among households in Konso Zone, Southwestern Ethiopia: a community-based cross-sectional study. *Frontiers in Nutrition*. 11: 1481458. https://doi.org/10.3389/fnut.2024.1481458

Ministerio de Salud y Protección Social (MSPS); Departamento de Prosperidad Social (DPS).; Instituto Nacional de Salud (INS).; Instituto Colombiano de Bienestar Familiar (ICBF).; Universidad Nacional de Colombia. (2019). *Encuesta Nacional de La Situación Nutricional – ENSIN 2015*. Bogotá: MSPS. 65p.

Pinheiro, A.; Quintiliano, D.; Araneda, J.; de Oliveira, R.; Pizarro, T.; Suarez, M.; Marques, R. (2022). Food insecurity and its determinants in a vulnerable area of Santiago, Chile. *Sustainable Food Systems*. 6: 924921. https://doi.org/10.3389/fsufs.2022.924921

Ramírez, J. (2022). Seguridad alimentaria y la agricultura familiar en México. *Revista Mexicana de Ciencias Agrícolas*. 13(1): 553–565. https://doi.org/10.29312/remexca.v13i3.2854

Rivera, G.; Estrada, J.; Romero, F. (2020). *Obonuco: Potencial de Desarrollo*. 2º ed. Pasto: Universidad Cesmag. 123p.

Sanchez, L.; Suárez, E.; Soto, V.; Rosas, L.; Del Castillo, S. (2022). Gender differences in the use of coping strategies to reduce food insecurity in Colombia. *Cuadernos de Saude Publica*. 38(8): 1–19. https://doi.org/10.1590/0102-311XEN252121

Shiratori, S.; Tobita, Y.; Sawadogo-Compaoré, E. (2023). Food security, nutritional supply and nutrient sources in rural Burkina Faso. *Nutrients*. 15(10): 2285. https://doi.org/10.3390/nu15102285

Silva, B.; Guedes, J.; Deise, D.S.; Riquinho, L.; Nunes, F.; de Souza, N.; Galvão, E. (2022). Intersections between rural women's resilience and quality of life: A mixed-methods study. *Revista Latino-Americana de Enfermagem*. 30: 1–13. https://doi.org/10.1590/1518-8345.5671.3521

Sinclair, K.; Thompson-Colón, T.; Bastidas, A.; Del Castillo, S.; Eucaris, M.; Melgar, Q. (2022). Women's autonomy and food security: Connecting the dots from the perspective of indigenous women in rural Colombia. *SSM- Qualitative Research in Health*. 2(1): 100078. https://doi.org/10.1016/j.ssmqr.2022.100078

World Food Program [WFP]. (2024). *Evaluación de Seguridad Alimentaria Para Población Colombiana*. Bogotá, Colombia: WFP. 57p.

World Food Program [WFP]. (2009). *Manual Para La Evaluación de La Seguridad Alimentaria En Emergencias*. 2º ed. Roma, Italia: WFP. 101p.