Women's participation in Sinaloa agriculture: from education, science and production

Participación de la mujer en la agricultura sinaloense: desde la educación, la ciencia y la producción

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Abstract

Guasave, Sinaloa, considered the agricultural heartland of Mexico, relies heavily on agricultural production for its economy, making the agricultural sector a strategic area for analyzing women's participation. In this context, this article aims to analyze women's participation in agriculture from an intersectional perspective that considers gender, educational level, and work role. The study includes students and graduates of Sustainable Agricultural Innovation Engineering, professors, researchers, workers, and producers, also incorporating employers' perceptions of their skills and challenges. The research employed a mixed-methods approach, combining semi-structured interviews, surveys, and documentary analysis of institutional and academic information. The results show a growing interest among women in training in areas related to agriculture; however, structural, cultural, and organizational barriers persist, limiting their entry, retention, and access to decision-making positions. Despite these limitations, the participating women demonstrated a high level of technical skills, leadership, and innovation—qualities positively

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recognized by employers. The study concludes that women's participation is a key element for strengthening and transforming the agri-food sector, and underlines the importance of making women's contributions visible and promoting gender-sensitive policies that foster a fairer, more inclusive and sustainable agriculture, recognizing the strategic role of women in the development of the agricultural sector.

Keywords: women, agriculture, gender, participation, sustainability

Resumen

Guasave, Sinaloa, considerado como el corazón agrícola de México, sustenta gran parte de su economía en la producción agropecuaria, lo que convierte al sector agrícola en un espacio estratégico para el análisis de la participación femenina. En este contexto, el presente artículo tiene como objetivo analizar la participación de mujeres en la agricultura desde un enfoque interseccional que contempla género, nivel educativo y rol laboral. En el estudio se incluyen estudiantes y egresadas de Ingeniería en Innovación Agrícola Sustentable, docentes, investigadoras, trabajadoras y productoras, integrando además las percepciones de los empleadores sobre sus competencias y desafíos. La investigación se desarrolló empleando una metodología mixta que combinó entrevistas semiestructuradas, encuestas y análisis documental de información institucional y académica. Los resultados muestran un creciente interés de las mujeres por formarse en áreas vinculadas a la agricultura; sin embargo, persisten barreras estructurales, culturales y organizacionales que limitan su inserción, permanencia y acceso a puestos de toma de decisiones. A pesar de estas limitaciones, las mujeres participantes demostraron un alto nivel de competencias técnicas, liderazgo e innovación, cualidades reconocidas positivamente por los empleadores. El estudio concluye que la participación de las mujeres representa un elemento clave para el fortalecimiento y la transformación del sector agroalimentario, subrayando la importancia de visibilizar las contribuciones femeninas y promover políticas con perspectiva de género que impulsen una agricultura más justa, inclusiva y sostenible, reconociendo el papel estratégico de las mujeres en el desarrollo del sector agropecuario.

Palabras clave: mujeres, agricultura, género, participación, sostenibilidad.

Introduction

Agriculture is one of the oldest and most essential sectors for humanity; however, it has also been profoundly shaped by structural inequalities between men and women. Historically, patriarchal structures have determined the forms of productive organization in the countryside, limiting women's access to productive resources, their participation in decision-making, and the recognition of their contributions to rural development (Deere & León, 2002; FAO, 2011). Despite their leading role in food production, biodiversity conservation, and the sustainability of local economies, female labor in the agricultural sphere has been systematically rendered invisible or undervalued (United Nations Development Programme [UNDP], 2023).

In recent decades, women's participation in the agricultural sector has increased, necessitating the incorporation of a gender perspective within these spaces to highlight persistent inequalities (Economic Commission for Latin America and the Caribbean [ECLAC], 2019). Furthermore, it is essen-

tial to establish clear mechanisms for their eradication by identifying the factors that contribute to their permanence and proposing strategies for transformation.

In Mexico, the agricultural field continues to be characterized by a strong male presence, reflecting persistent gender gaps across multiple dimensions: from land tenure and technical training to participation in decision-making bodies, labor recognition, and opportunities for innovation. These inequalities are exacerbated in rural areas, where rigid productive structures and limited cultural shifts regarding traditional gender roles predominate (INEGI, 2020).

At the local level, the municipality of Guasave, Sinaloa, bases its economy on extensive agriculture, ranking third in agricultural production at the state level with a productivity of 758,860 tons (Guasave Directorate of Economic Development, 2021-2024 Period). In this region, the integration of women into the sector has grown significantly in recent years, potentially driven by access to Higher Education Institutions (HEIs) offering specialized technical-scientific training programs in agriculture.

In this context, it is pertinent to examine how women integrate into this productive system, the challenges they face in applying acquired knowledge, and their contribution to the development of the Mexican countryside. Likewise, it is fundamental to understand the perceptions of regional employers to identify the dynamics that favor or hinder female labor inclusion in the agricultural sector.

The objective of this research is to analyze the participation of women—including students and graduates of Sustainable Agricultural Innovation Engineering, faculty and researchers, and agricultural workers and producers—in the agricultural sector of Guasave, Sinaloa. This analysis is based on their educational, productive, and labor experiences, as well as the perceptions of agricultural employers regarding female hiring, with the aim of highlighting their contributions and identifying barriers and opportunities. Additionally, the study seeks alternatives that contribute to their inclusion and development in this economically vital sector for the region. A mixed-methods methodology was utilized, integrating data from semi-structured interviews and surveys, supplemented by a documentary review, allowing for a comprehensive integration of the results.

Adopting an intersectional approach, this article seeks to make visible the progress and persistent challenges within the agronomic sector in both Sinaloa and Mexico, contributing to the achievement of greater equity in the agricultural field.

Theoretical Framework

Agriculture and Gender Inequalities: A Global Overview

Agriculture is one of the most significant activities worldwide. However, various studies have demonstrated that, in both developing countries and advanced economies, this sector has been historically structured under patriarchal dynamics that have rendered women's roles in the agricultural sphere invisible (Deere & León, 2002; FAO, 2011). Despite this, women play a fundamental role as food providers for their families.

According to the FAO (2025), women hold a critical role in small-scale farming, agricultural labor, and the sustainability of daily life. Globally, rural women represent more than one-third of the world's population and 36% of the agricultural workforce. As stated by CIMMYT (2024), "It is they who cultivate the land and ensure the future of their communities, playing an innovative and fundamental role in global food security."

National and State Context: Mexico and Sinaloa

In the state of Sinaloa, Mexico, women's participation in the agricultural sector has recorded a notable increase. According to the 2022 Agricultural Census by the National Institute of Statistics and Geography (INEGI), female presence rose from

14% in 2007 to 24.3% in 2022. Of the total 590,328 agricultural workers accounted for in the state, 447,092 are men (75.7%) and 179,702 are women. However, despite this growth, labor conditions remain unfavorable for them: wage gaps persist, many are not recognized as primary breadwinners in their households, and they face obstacles in attaining leadership positions within agricultural workplaces (Amador, 2023).

Gender Perspective in Agriculture: Concepts and Barriers

A gender-focused approach to agriculture recognizes the differentiated participation of men and women in productive systems, stemming from social, cultural, and economic constructs that generate inequalities. This approach seeks to render these gaps visible and promote equity in access to resources, services, decision-making participation, and the benefits of rural development. According to the FAO (2011), "a gender perspective in agriculture involves identifying and overcoming the structural barriers that limit women's full participation in rural development."

Key barriers include limited access to land tenure, restrictions on obtaining credit, difficulties in receiving technical and technological assistance, and a disproportionate burden of domestic work and unpaid care. Furthermore, low participation in decision-making bodies (ECLAC, 2019) and unequal access to agricultural education and training are observed. The FAO (2011) suggests that if women had the same access to productive resources as men, they could increase yields on their farms by 20% to 30%.

Incorporating a gender perspective in agriculture not only addresses principles of equity, equality, and social justice but also enhances productive efficiency and fosters the resilience of agricultural systems against food and climate crises. Various studies demonstrate that considering the needs and knowledge of female farmers increases the impact and sustainability of agricultural projects.

Agricultural Education and Training for Women

Historically, women's access to agricultural education and technical training has been constrained. Explanatory factors include traditional gender roles, the lack of legal recognition for female farmers, institutional discrimination in extension programs, and time constraints resulting from the "double burden" of domestic and professional labor. Furthermore, pervasive stereotypes associate technical agriculture with masculinity; since agricultural activities are often perceived to require physical strength or stature, households frequently prioritize the training of men, who are also more likely to inherit agricultural land (FAO, 2011).

Consequently, female representation in agricultural educational institutions remains low. This is further influenced by unsuitable training schedules, lack of transportation, and deficient basic services in rural areas (FAO, 2023). Added to this situation is the absence of curricula with a gender perspective and pedagogical materials adapted to the realities of peasant women and female entrepreneurs (IICA, 2020b).

At the international level, organizations such as the FAO (2011), IICA (2020b), and UN Women (2018), in collaboration with various governments, have promoted programs to reduce these educational gaps. Notable success stories include the Farmer Field Schools (FFS), which have achieved higher female participation by adapting courses to their schedules and needs. In Mexico, the Universidad Autónoma Chapingo has promoted the inclusion of women in agricultural degrees; however, inequalities persist.

Although the gender gap has narrowed in certain areas, disparities in income remain, particularly in disciplines such as agronomic sciences and engineering (Secretaría de Educación Pública, 2018). In this context, the Tecnológico Nacional de México (TecNM) plays a pivotal role, training 41% of the country's engineers. Currently, 28 of its campuses offer a Bachelor's in Agronomy and 48 provide the Sustainable Agricultural Innovation Engineering

(IIAS) program, totaling 76 campuses dedicated to the agricultural sector (TecNM, 2024).

One such campus is the Instituto Tecnológico Superior de Guasave (ITSG) in Sinaloa, where the IIAS program was introduced in 2015. It has shown significant enrollment growth due to high regional demand. These institutional efforts have contributed to an increasing number of female graduates from programs linked to the agricultural sector, fostering a greater female presence in the scientific field.

Persistent Gaps in Leadership and Decision-Making

According to the United Nations Educational, Scientific and Cultural Organization [UNESCO] (2021), women represent a significant proportion of the total researchers in natural and applied sciences, including agricultural sciences. However, their representation diminishes at higher hierarchical levels. Access to decision-making roles, academic leadership, and directorates of research centers remains limited.

Based on the data from the Gender Platform (2022), women constitute approximately 30% of the scientific personnel in international agricultural research centers. Nevertheless, this participation does not imply equal conditions, as many earn less than their male counterparts, even with superior qualifications. In Mexico, according to the Ministry of Agriculture and Rural Development (SADER), as of the third quarter of 2024, there are approximately 19,800 individuals with agronomic training. Of these, 18.7% are women, while 81.3% are men, a disparity that restricts the transfer of knowledge, innovation, and technology toward female producers (El Universal, 2024).

Relevance to the Case Study: Guasave, Sinaloa

At the global, national, and state levels, women play a strategic role in agriculture, although structural barriers linked to unequal access to productive resources and leadership positions persist in the activity. Incorporating a gender perspective allows for the understanding that these limitations do not stem from a lack of capacity, but rather from historical and social conditions that restrict their full participation.

In Mexico, and particularly in Sinaloa, the female presence in the agricultural sector and in higher education programs has shown significant growth. Nonetheless, gaps in labor recognition and decision-making remain prevalent. In this context, Guasave—as one of the most relevant agricultural regions in the country—constitutes an ideal setting to analyze the participation of women linked to agricultural production, whose experiences reflect both the progress and the challenges of gender equity in this sector. Understanding their role in agricultural activity requires a comprehensive analysis that considers the social, educational, and cultural structures influencing their incorporation into productive labor.

Methodology

This research was conducted using a mixed-methods approach with an exploratory design, combining the simultaneous collection and analysis of qualitative and quantitative data. The objective was to triangulate information and achieve a broader understanding of the phenomenon under study (Hernández-Sampieri et al., 2014; Creswell & Plano Clark, 2018). This methodology enabled the articulation of distinct data types—interviews and structured surveys—while contrasting the perceptions, experiences, and aspirations of women linked to the agricultural sector with the opinions of employers regarding their participation, facilitating a comprehensive understanding of the phenomenon as defined by Johnson et al. (2007).

The study was carried out at the Instituto Tecnológico Superior de Guasave (TecNM Campus Guasave). The target population included students, faculty-researchers, and alumnae of the Sustainable Agricultural Innovation Engineering (IIAS) program, as well as employers, female workers, and agricultural producers in the region of Guasave, Sinaloa, Mexico. This approach allowed

for the diversification of data sources to integrate multiple perspectives on female participation in agricultural activities (Teddlie & Tashakkori, 2009).

Qualitative data collection was conducted through semi-structured interviews with two faculty members/researchers from TecNM Campus Guasave and six agricultural producers from the region. Participants were selected through purposive sampling between April and June 2025. Interviews were recorded with informed consent, transcribed verbatim, and anonymized to ensure confidentiality. For the analysis, the thematic analysis framework proposed by Braun and Clarke (2006) was utilized to identify recurrent patterns and meanings within the narratives. This process was developed in three phases: (1) exploratory reading of the transcribed material, (2) thematic coding, and (3) analytical categorization.

Simultaneously, structured surveys were administered to a non-probability sample consisting of the following groups: 90% of the female students enrolled in the IIAS program (78 respondents) 70% of the program's alumnae 16 respondents), 14 female agricultural workers from the region, and 25 employers within the agricultural sector. The surveys addressed themes such as professional motivations, educational trajectories, gender barriers, perception of the labor environment, and employers' experiences and assessments regarding women's performance in the agricultural field. For the data analysis, descriptive statistics (frequencies and percentages) were applied using Microsoft Excel 365 and SPSS, enabling the identification of trends, perceptions, and disparities among the surveyed groups.

The design of these dimensions is grounded in the findings of the FAO (2011) report, which underscores that rural woman face significant barriers in accessing productive resources, technical training, and paid employment—factors that directly influence their career trajectories and perceptions of the agricultural environment. Furthermore, the report highlights the additional burden of unpaid domestic work, as well as restrictions on access to technology and financial services, reflecting mechanisms of exclusion that limit women's full integration into the sector.

Moreover, to promote equitable participation in agriculture, it is crucial to identify and render visible structural and regulatory obstacles, such as limited access to land, infrastructure, and extension services, as well as gender-based occupational segregation (FAO, 2011; Coronado et al., 2023). These themes were directly incorporated into the data collection instruments, allowing for the capture of both personal perceptions and the contextual conditions affecting professional performance.

The administered questionnaires were semi-standardized, allowing for the collection of both quantitative and qualitative information. Table 1 summarizes the general structure of the surveys, categorized by respondent group:

Table 1.
General structure of surveys used as a data collection tool

Respondent Group	Survey sections	General description
IIAS Students	1.General information 2. Interests and expectations 3. Perceptions of the degree 4. Impact and future outlook	"Personal data, vocational motivation, perception of the agricultural sector, and professional expectations.
IIAS Alumnae	1. General information 2. Competencies and skills 3. Professional and regional impact 4. Challenges and suggestions	Type of employment, assessment of academic training, gender-based obstacles, and recommendations.
Employers	1. General information 2. Performance reviews of IIAS women 3. Comparisons and sectoral contributions 4. Challenges and opportunities	Company characteristics, selection and hiring criteria, and professional experiences with women in the field.
Female Agricultural workers	1. General information 2. Sector experience 3. Labor issues and constraints 4. Temporal comparisons	Activities performed, gender-related challenges, and the evolution of their role in the agricultural field.

As a complementary measure, a documentary review was conducted, encompassing the curricula of the IIAS program at TecNM Campus Guasave, institutional policies, and regional sociodemographic statistics to contextualize the findings. This was done to implement a comprehensive methodology that strengthens the study's internal validity, enabling an approach grounded in an intersectional perspective.

Results and discussion

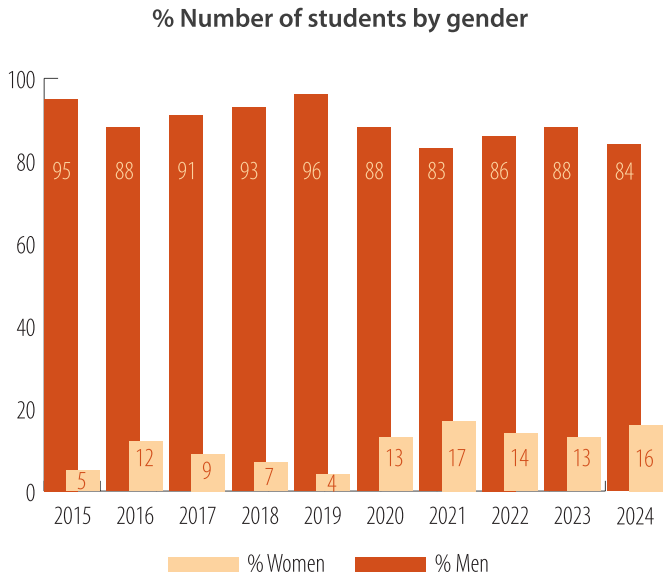
The data analysis allowed for the structuring of the results into three thematic axes: (1) expectations, formative experiences, and educational trajectories; (2) labor participation and gender barriers; and (3) perceptions of regional agricultural employers.

Expectations, Formative Experiences, and Educational Trajectories

The analysis of women's expectations and educational trajectories in the agricultural sector identifies the factors conditioning their opportunities for professional integration and development. Evidence indicates that formative experiences directly influence how women project their future in fields traditionally dominated by men. Therefore, it is pertinent to examine how individual and collective perceptions are linked to effective access to education and professional training.

In this context, historical enrollment data for IIAS students at ITSG revealed a progressive increase in the number of women enrolled in the educational program (see Figure 1). Of the total 480 engineers who graduated from this program between its inception and 2019, only 7.5% were women. In contrast, considering the current enrollment of 828 students for the 2020–2024 period, 14% are female. This trend serves as an indicator that an increasing number of women are interested in participating in and contributing to agricultural development. Nevertheless, challenges regarding their integration and professional development persist; López and Pérez (2020) point out that women entering technical or scientific careers related to agriculture face symbolic, structural, and cultural barriers.

Figure 1.
Graph showing student enrollment trends in Sustainable Agricultural Innovation Engineering at TecNM Guasave campus (2015-2024)



According to data collected from a survey administered to 78 female students in the Sustainable Agricultural Innovation Engineering (IIAS) program at the Instituto Tecnológico Superior de Guasave (ITSG)—representing 90% of the program's female enrollment—a marked interest in the agricultural sector was identified as the determining factor for their academic choice, a motive cited by 55 students (see Figure 2a). Furthermore, 91% expressed a clear vocation for training as engineers, and 78% considered this degree suitable for women, although 18% still reported uncertainty in this regard. Regarding personal motivations, the desire to contribute to sustainable development (10%) and, to a lesser extent, labor opportunities (4%) stand out. These results reflect that the decision to pursue IIAS is primarily guided by a genuine commitment to sustainable agriculture rather than immediate labor integration expectations.

Similarly, the surveyed students expressed a high level of interest in technological innovation within the agricultural sector (36%) and in sustainability and environmental stewardship (31%), evidencing an orientation toward comprehensive solutions

for the current challenges of the rural environment (see Figure 2b). These findings underscore the importance of continuously reviewing and updating curricula, incorporating innovative approaches and a gender perspective, with the goal of training professionals capable of responding effectively to the complexities of the contemporary agricultural sector (FAO, 2023a; IICA, 2020a).

in the agricultural sector is growing, although 31% believe that women still face significant challenges in establishing a position within the field. Notwithstanding these challenges, 94% are satisfied with their decision to study IIAS.

The most important skills identified by the students for professional development were: leadership and teamwork, problem-solving capacity, the

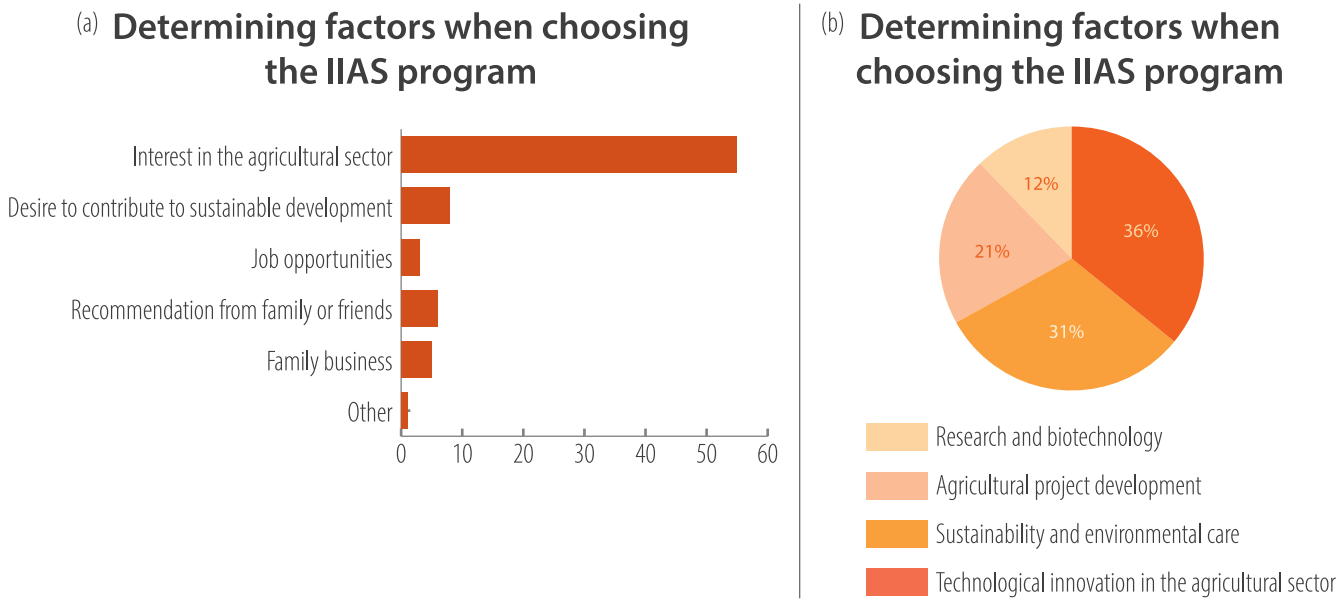


Figure 2.
Survey Results of Female Students in the Sustainable Agricultural Innovation Engineering (IIAS) Program at TecNM Campus Guasave, Sinaloa, 2025

Regarding labor expectations, 64% of the respondents expect to secure employment within the agricultural sector. However, 47% believe they may encounter difficulties in attaining high-level professional positions, and 18% anticipate the possibility of facing wage disparities; consequently, 37% express a desire to start their own businesses. The vast majority believe that this profession will enable them to achieve their professional goals (94%), as illustrated in Figure 3a. Nevertheless, the FAO (2023b) has indicated that women tend to be concentrated in tasks of lower economic value with limited recognition. Despite this, the results suggest that these students possess a high level of confidence in the educational program and in government policies aimed at fostering their full inclusion in the agricultural labor market. Additionally, 47% of the students consider that female participation

management of new technologies, and a sense of responsibility and commitment. This reflects the necessity of combining technical skills with leadership and innovation capabilities in the agricultural sector. Therefore, TecNM Campus Guasave must strengthen its traditional teaching-learning systems with innovative activities that address this area of opportunity (see Figure 3b).

The knowledge most valued by students for their academic training was technical expertise specific to the agricultural sector, combined with practical learning. They consider this combination essential for developing key skills to address and resolve real-world problems in the field, reflecting a vision oriented toward active participation in agricultural contexts. The strengthening of technical and scientific capacities in rural women

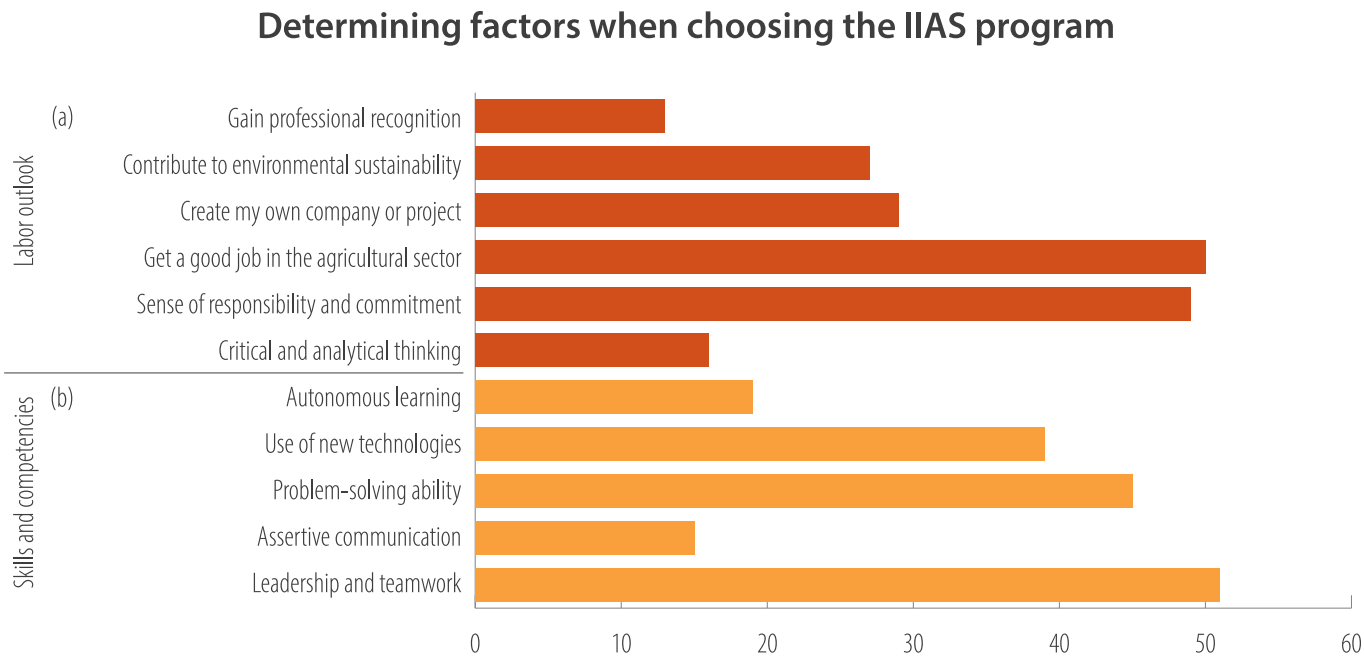


Figure 3.
Survey Results of Female Students in the IIAS Educational Program at TecNM Campus Guasave, Sinaloa, 2025

contributes directly to the development of a more sustainable and equitable agriculture (FAO, 2025). Therefore, these results suggest that IIAS students, in addition to valuing academic training, are closely aligned with the current demands of the agricultural sector.

Regarding social perceptions, 63% of respondents perceive prejudices concerning women's ability to lead agricultural projects. Consequently, they suggest fostering the active participation of women in agricultural research and development projects to enhance the IIAS academic program. They also recommend including content on female leadership in the agricultural sector and creating specific support programs for women. This aligns with findings by IICA (2020b), which highlight a lack of gender-focused curricula within educational institutions and the limited use of pedagogical materials adapted to the agricultural contexts and life trajectories of peasant and entrepreneurial women.

According to the survey results from 16 alumnae (representing 70% of the population), 56% indicated that they are currently employed (Figure 4). This suggests that more than half have successfully integrated into the labor market, although a considerable proportion has yet to find employment within the region. The majority of those employed work in the private sector, while a smaller percentage labor in government institutions or other categories. These companies range from regional to national and international in scope and are located across various regions of the country, including Baja California Sur, Sinaloa, and Guanajuato, reflecting a geographical dispersion of labor opportunities.

Notably, 79% of these female engineers state that their employment is directly related to their field of academic training, demonstrating a professional integration aligned with their studies. These findings are encouraging, as they contrast with the national outlook described by the FAO (2020), which notes that women in the agricultural sphere face greater obstacles in accessing quality employment related to their specialization. While these results may indicate positive progress within the educational and regional context, it remains essential to strengthen strategies that guarantee equitable labor access in the agrifood sector.

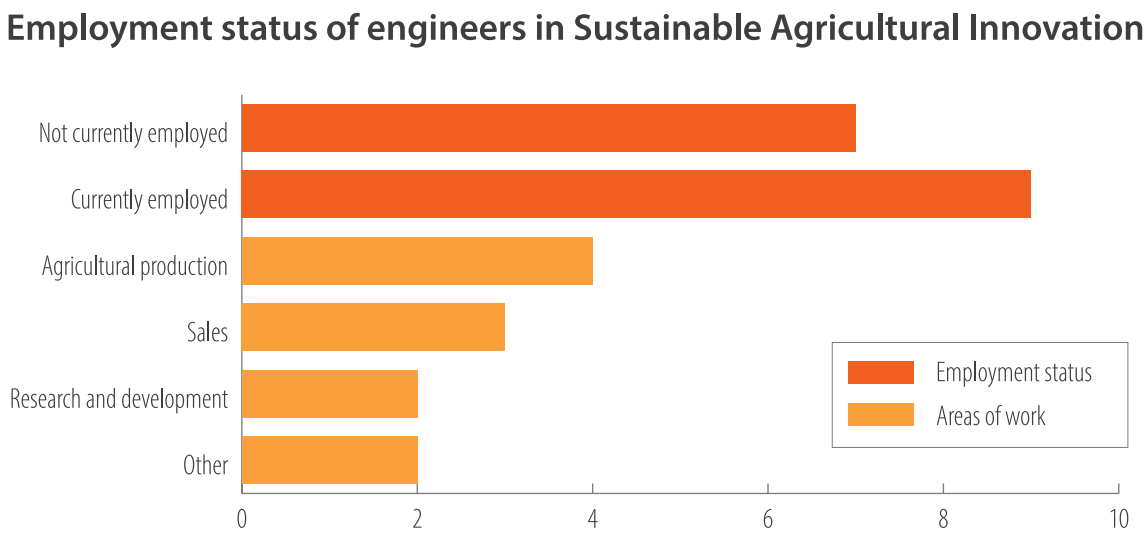


Figure 4.
Survey Results of Alumnae from the IIAS Educational Program at TecNM Campus Guasave regarding Employment Status and Professional Fields, Guasave, Sinaloa, 2025

Among the skills and competencies that respondents prioritize for their professional practice, a sense of responsibility, discipline, order, and respect were identified as paramount, followed by leadership and teamwork, and finally, problem-solving capacity. Regarding the most useful technical knowledge for ensuring effectiveness, they suggest constant field practice, the use of digital agricultural software, and specialized expertise in areas such as integrated pest and disease management (IPM). These results reflect the importance of providing female professionals with continuous training to ensure they remain updated and prepared to meet the evolving demands of the agricultural sector.

Fifty-six percent (56%) of those surveyed affirmed that their gender has influenced their labor opportunities or challenges; furthermore, 62% reported encountering job openings offered exclusively to men (see Figure 5a). This suggests that significant barriers persist in this sector, a trend that aligns with reports from the National Commission to Prevent and Eradicate Violence Against Women (CONAVIM, 2019), which indicated that in Mexico and globally, numerous obstacles remain in the pursuit of gender equality.

Furthermore, the study identified that the primary challenges and barriers faced by female engineers in the workforce are limited access to leadership positions, gender prejudices and stereotypes, and a lack of training and development opportunities (Figure 5b). Notably, the wage gap was not highlighted as a primary issue; however, a lack of defined labor conditions and growth opportunities was identified as a significant concern.

Labor Participation and Gender Barriers

Analyzing female participation in the agricultural sector of Sinaloa, Mexico, reveals the persistent

barriers they face, manifested in gender stereotypes and a disproportionate burden of domestic and care responsibilities. These conditions directly impact the limited integration of women into the agricultural labor market and the structural constraints that still prevail.

To study this phenomenon, a survey was administered to 14 women currently working in the agricultural sector. Their ages range between 40 and 60 years, with educational backgrounds including primary school (26.3%) and university levels (10.5%),

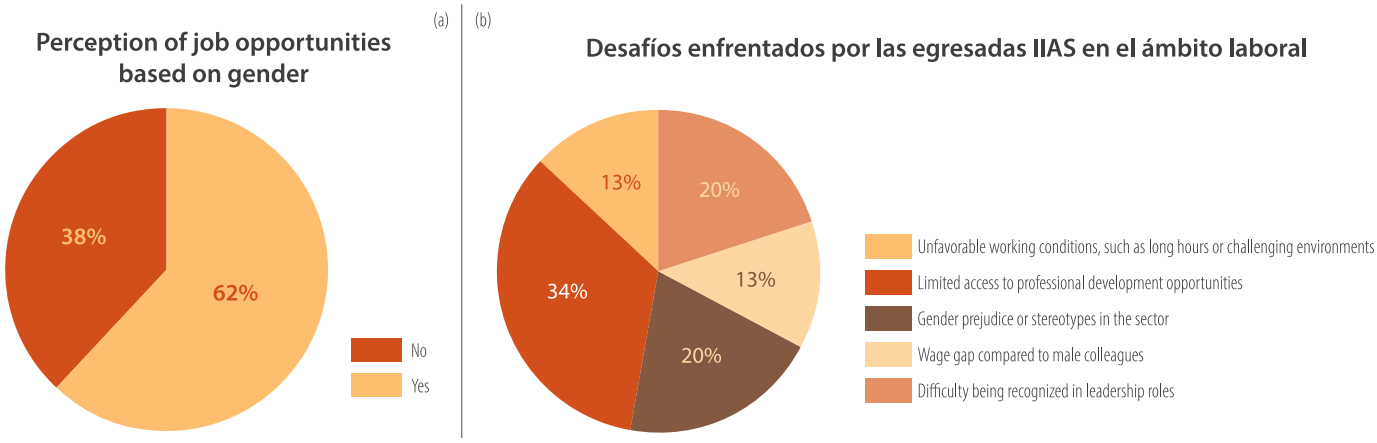


Figure 5.
Survey results from alumnae of the IIAS educational program at TecNM Campus Guasave regarding labor experiences, Guasave, Sinaloa, 2025

though most reached the upper secondary level (31.6%). The majority reside in rural communities in Guasave, Sinaloa, and a significant percentage are single due to widowhood (68.4%). Notably, 85% of the surveyed women reported working full-time in agriculture, primarily in activities such as harvesting, crop maintenance, and agrochemical application. Furthermore, 68.4% have worked in the sector for over fifteen years, suggesting significant career longevity. However, access to social security remains limited for 57.9% of the group.

In terms of compensation, 100% of the women believe their income is proportional to that of their male counterparts. This finding differs from FAO (2020) reports, which indicate that women in the agricultural sector typically receive lower wages and perform roles with less economic recognition.

The primary challenges at the beginning of their careers were a lack of technical knowledge, a shortage of financial resources, and the low valuation of their work. Currently, these barriers have evolved into issues such as limited growth opportunities for women in this activity (57.89%), followed by a lack of competitive salaries (42.11%), as well as underrepresentation in leadership positions and difficulties accessing financing, among others (see Figure 6). These results align with findings from the IICA (2022), which emphasize that rural women lack access to both inputs and technical training services, in addition to being overburdened with unpaid care work.

Finally, 89.5% of respondents stated they have had to exert more effort than men to prove their competence, and only 26.3% have had the opportunity to hold a leadership position. This coincides with reports by Coronado et al. (2023), who highlight the undervaluation of women in technical and leadership roles within agriculture.

The majority of respondents consider that female participation has increased in recent years (84.2%). The strategies employed to overcome existing barriers include the development of support networks, continuous training, and the demonstration of competencies through daily labor. Among the factors that could foster greater inclusion of women in the agricultural sector (see Figure 7), the most prominent are technical training (94.7%), government support programs (94.7%), and increased awareness regarding the role of women in agriculture (89.4%).

Despite the challenges, most women feel satisfied with their participation in the sector. They suggest actions such as improving government support programs, generating incentives for female farmers, facilitating access to technology, and creating conditions that allow for a work-life balance. These suggestions align with CEPAL (2020a),

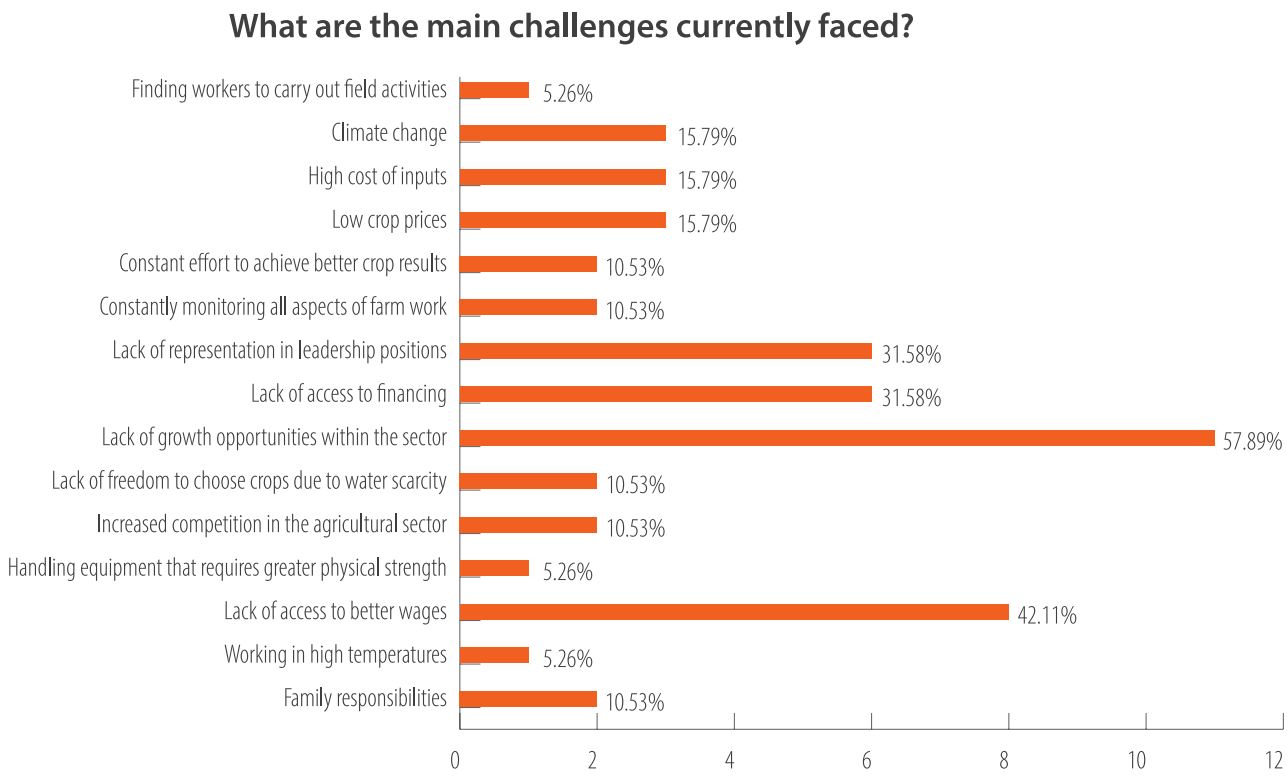


Figure 6.
Survey results from women currently working in the agricultural sector regarding the primary challenges they face, Guasave, Sinaloa (2025)

which emphasizes that tools such as productive inputs and credit are required to enable women to increase their productivity.

Regarding the perception of female participation in agricultural enterprises, only 52.6% of the surveyed women believe that regional companies are taking actions to foster their inclusion, expressing that such efforts are largely driven by the specific needs of the agricultural field.

Concerning their integration into productive activities, the interviewed female producers noted that their entry into this sector was often a result of family inheritance, widowhood, or economic necessity, rather than equitable opportunities. Despite this, they expressed a strong interest in innovation, modernization, and continuous training. Nevertheless, all respondents reported facing social resistance, skepticism from male peers, and difficulty accessing credit or government programs. These experiences can be interpreted as a form of structural exclusion of rural women from strategic resources such as land, financing, and training (FAO, 2020; Deere & León, 2001).

Even though public policies have incorporated a gender perspective, in practice, rural women face persistent barriers in accessing credit, land, and technical assistance (WRI, 2023). Furthermore, in many countries, their rights to essential productive resources, such as loans or inheritances, are not always respected (FAO, 2023). In this context, it is important to highlight that in the municipality of Guasave, Sinaloa, 1,650 out of 5,157 agricultural producers are women, accounting for 32% of the total (JLSGVE, 2023). Although this activity has been traditionally dominated by men, women are actively increasing their participation, contributing knowledge, vocation, and capacity, and gaining growing recognition within the sector.

From an educational standpoint, two female faculty members in the agricultural field were interviewed. Both grew up in rural environments and feel a strong commitment to training women

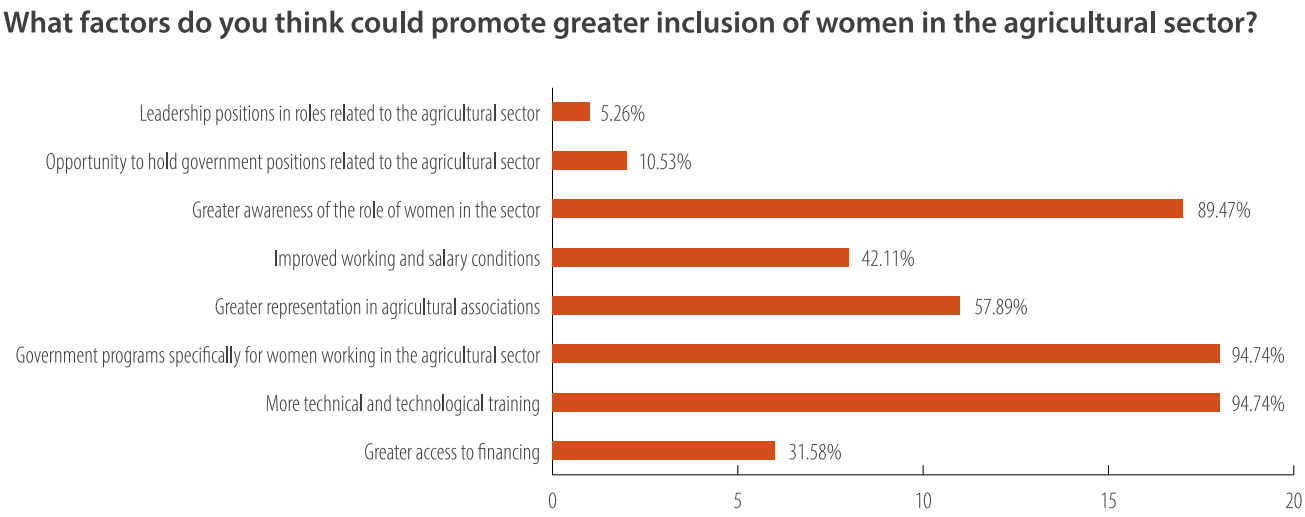


Figure 7.
Survey results from women currently working in the agricultural sector regarding factors that could foster greater female inclusion in the industry, Guasave, Sinaloa (2025)

capable of innovating in the Mexican countryside. They employ educational strategies based on values, real-world practice, and mentorship. They recognize challenges such as cultural resistance in male-dominated spaces and the constant need to validate their work. They highlight progress in female participation, particularly in southern Mexico, although challenges remain. Their motivation is to contribute to sustainability, support communities, and transform the agricultural sector, agreeing that teamwork, continuous training, and perseverance are key to moving toward a more equitable and sustainable field.

The increase in female participation in agriculture can be a decisive agent of change for the conventional systems used in Mexican farming. Landín et al. (2024) indicate that in recent years, female enrollment in engineering careers, including Agronomy, has increased significantly, with female professionals in this area typically serving as prominent examples of success, achieving positive and effective results in crop production.

Perceptions of Regional Agricultural Employers

Employer perceptions are a key element in understanding the dynamics of female inclusion in the agricultural sector. The manner in which employers value the competencies, skills, and gender roles of female workers directly influences hiring practices, labor conditions, and promotion opportunities. Therefore, it is essential to analyze how these perceptions impact the consolidation of a more equitable and inclusive labor market.

To explore these perceptions, 23 employers from various agricultural sectors were surveyed: 78% belong to the primary sector, 13% to the secondary sector, and 9% to the tertiary sector, with a predominance of companies dedicated to grain and vegetable production and agricultural inputs. This indicates that the field of application for female professionals in agronomy in this region is diverse, though primarily focused on agricultural production and marketing.

Responses indicate a low presence of female professionals, specifically from the IIAS program, compared to their male counterparts. In fact, some employers stated they had no female engineers on their staff, while others reported having between one and four female professionals in agricultural areas (see Figure 8a). This data corroborates the statements made by alumnae and the perceptions of current students, reinforcing the position that women still face clear challenges in fully integrating into the agricultural sector. This sample confirms the continuity of structural

trends observed in the region, where women face task assignments restricted by traditional roles, limiting both their economic development and their visibility within the agricultural sector (CEPAL, 2020b; IICA, 2022).

Employers who have hired female agricultural professionals confirm that women possess the capacity to hold any position. Data indicates that the hired engineers perform activities in field supervision, quality control, research and development (R&D), production and processing, marketing and sales, and human resources, among others. The only area with no records of female hires was the maintenance and operation of machinery (see Figure 8b).

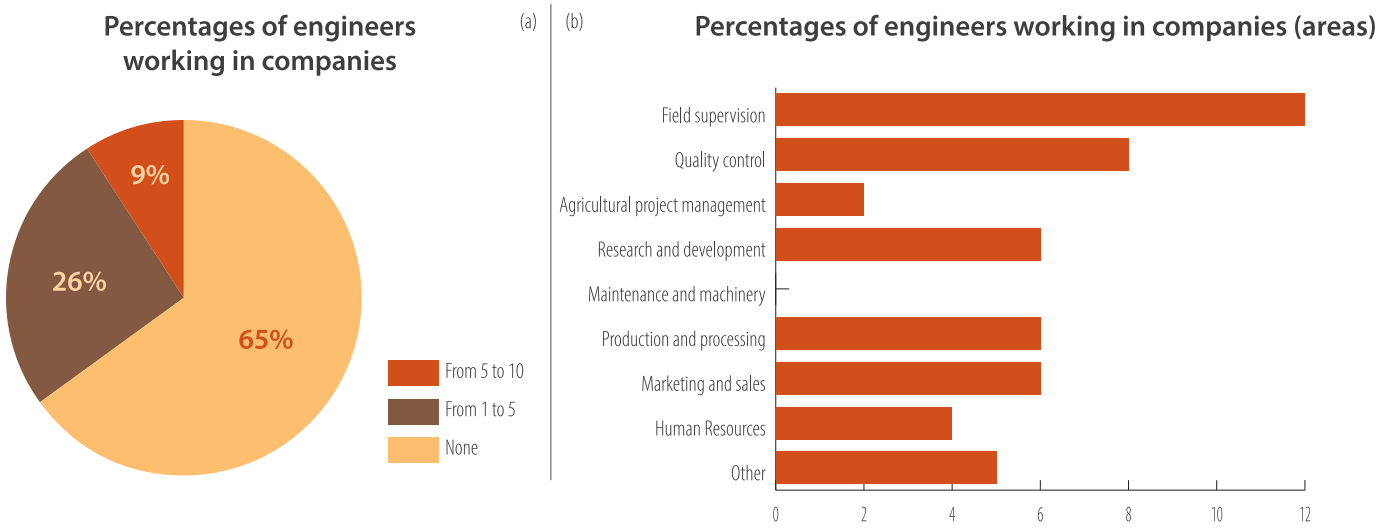


Figure 8.
Survey Results from Agricultural Companies in the Guasave Region, Sinaloa, 2025

Employers identified specific technical and practical skills as fundamental for women to meet the current needs of the agricultural sector. These include field supervision and evaluation, the ability to implement agricultural regulations and certifications, and the use of biotechnological and sustainable techniques. Additionally, they consider proficiency in technological tools, leadership, and teamwork to be essential. These findings suggest that higher education institutions must strengthen practical training to better prepare female professionals for the demands of the labor market.

Although 64% of the respondents admitted to a preference for hiring men for physical labor or intensive field tasks, 83% indicated that, based on their experience, they perceive no significant differences in job performance between men and women. Some responses even highlighted specific qualities in female workers, such as their sense of responsibility, commitment, and analytical thinking (see Figure 9). Furthermore, all respondents expressed the conviction that women can contribute significantly to the agricultural and economic development of the region, reinforcing the relevance of their participation in this sector.

In response to the identified gaps, employers consider it pertinent to foster gender equality in the agricultural sector. They propose implementing measures such as: promoting women in leadership roles, establishing specific professional development programs for women, and applying equal pay policies and labor benefits. This requires greater governmental and corporate support to facilitate women's access to and retention within the agricultural sector.

Conclusions

This research provided a comprehensive analysis of female participation in the agricultural sector of

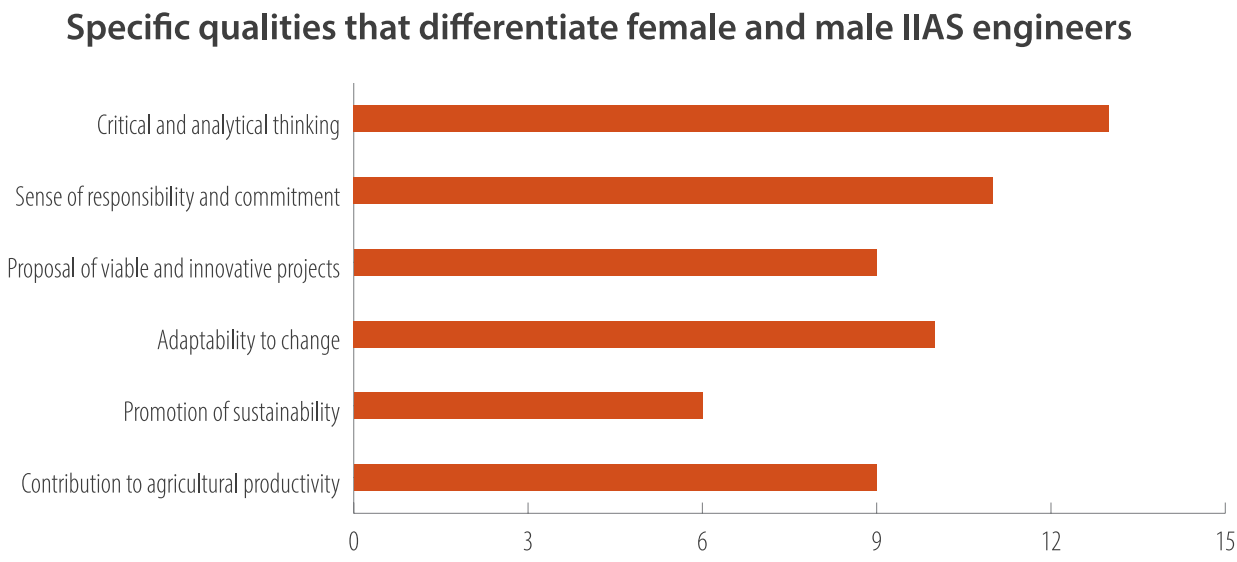


Figure 9.
Survey Results from Agricultural Sector Employers in the Guasave Region, Sinaloa, 2025

Guasave, Sinaloa, considering educational, productive, and labor trajectories, alongside the perceptions of agricultural employers. The results demonstrate that, although access to academic and scientific training in the agricultural field has increased, structural and symbolic barriers still persist, limiting the full and equitable participation of women.

Faculty and researchers showed high levels of commitment to the IIAS program, technical mastery, and a strong interest in contributing to regional agricultural development. Their perceptions align with those of alumnae and producers, who agree that women continue to face obstacles associated with gender stereotypes, a lack of recognition, difficulties in accessing financing, and resistance from key actors in the sector. These factors collectively restrict opportunities for leadership and autonomy in this economic activity.

The training of female professionals in agronomy is a growing process that demands commitment and vocation. Therefore, it is essential to integrate strategies that promote gender equity in the workplace and reinforce practical learning. While most alumnae found employment within a reasonable timeframe in fields related to their training, a significant number felt that their gender influenced their professional trajectory, suggesting a continued need for equity advocacy.

Agricultural employers recognize female technical competencies in administrative or quality control areas, yet gender biases persist regarding field labor or decision-making positions. This phenomenon likely stems from a lack of educational, social, and cultural guidance aimed at labor inclusion with a gender perspective within the agri-food sector.

The results highlight an urgent need to articulate multisectoral strategies that promote gender equity in agricultural activities. This includes the implementation of inclusive public policies and the fostering of an educational culture that values gender perspectives. Such efforts are essential to strengthen equity, enhance the visibility of women's capacities, and advance toward a more just, inclusive, and sustainable agricultural sector.

Authors' contributions:

Elizabeth Salinas Rosales: conceptualization, data curation, methodology, writing: initial and final drafts.

Arikani Soberanes Félix: conceptualization, data curation, analysis, writing: initial and final drafts.

Flor María Ruelas González: conceptualization, data curation, analysis, writing: final draft.

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