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# The Productive Orientation of Rural Extensionists in the Regions of Mexico: A Key Element for Agroecological Transition

**Felipe Gallardo-López [1], Fernando Landini [2] and Mario Alejandro Hernández-Chontal [3,*]**

[1] Colegio de Postgraduados, Campus Veracruz, Postgrado en Agroecosistemas Tropicales, Veracruz 91700, Mexico; felipegl@colpos.mx
[2] National Scientific and Technical Research Council (CONICET), University of La Cuenca Del Plata (UCP), Posadas 3300, Argentina; landini_fer@hotmail.com
[3] Facultad de Ciencias Agrícolas-Xalapa, Universidad Veracruzana, Veracruz 91090, Mexico
* Correspondence: mariohernandez03@uv.mx; Tel.: +52-92-4246-1632

**Abstract:** Considering the agroclimatic and social diversity of Mexico, this paper starts by recognizing the potential of rural extensionists within a policy framework of agroecological transition in the country. This paper identifies the types of productive positioning (agroecological vs. conventional) of rural extensionists located across the diverse states and socioeconomic regions of Mexico. This data is intended to outline particular features for the differentiation and targeting of regional strategies to train extensionists according to their regional context. We analyzed 1448 questionnaires gathered in 2019 via the online platform SurveyMonkey from rural extensionists enrolled in the Mexican Rural Extension System (SERMexicano). The results revealed that extensionists mainly identified themselves with the agroecological model. However, a significant proportion across states and regions still associated themselves with the conventional model. Three types of trends were recognized in relation to the positioning of extensionists, namely agroecological, towards neutrality, and contrasting. According to the socioeconomic regions where extensionists are located, diverse inter- and intraregional nuances among these positionings were also identified. Finally, we conclude by emphasizing the need for this heterogeneity to be considered in order to design and implement programs aimed at transitioning and expanding agroecology in Mexico.

**Keywords:** rural extension; agroecology; rural development; conventional agriculture



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## 1. Introduction

Rural extension (RE), which refers to the work of rural development agents [1], has expanded worldwide since the 1950s. Although its origin dates back to the 19th century, it became a general practice nationwide in the United States over the last century [2]. Likewise, newly independent states in Asia and Africa have also tried to increase food production and extend the benefits of improved agricultural techniques [3]. In Mexico, this practice has been part of public policies focused on rural development since that time [4].

RE has evolved on "how" it is practiced. It ranges from traditional technology transfer to integral support for institutional articulation processes aimed at promoting innovation dynamics in rural areas [1]. Moreover, rural extension has historically been associated with the implementation of the Green Revolution (GR) model [5]. GR has resulted in a global agrifood model based on "large areas planted with genetically modified crops, animals raised in overcrowded confinement, intensive use of chemicals, consolidation of food and agricultural systems under corporate control, loss of small and medium farms, poor conditions and wages for labor in fields and factories, an increase in health problems related to poor nutrition, and policies that support large-scale operations" [6].

In response to these measures, agroecology has emerged as a counter-position to reverse emerging problems and to achieve a sustainable food system based on equity and justice, encompassing the central pillars of human right to food security and nutrition. Thus, it is clear that there is a need for an agroecological transition (AT) to accomplish this goal. This measure requires a systemic transformation, which begins with an ecological approach based on efficient use of resources [7,8] that integrates multiple stakeholders. However, it also involves the deliberate political intention of making changes to reverse environmental degradation and biodiversity loss [9]. In fact, AT encompasses several transitions: (1) at the level of farm subsystems; (2) among rural families, the community, and the landscape; and (3) within territories, regions, and countries [10]. This suggests that the social and political principles of participation, equity, and connectivity, as well as governance of land and natural resources, are essential to accomplish a truly resilient, equitable, and sustainable transformation of food systems [9].

As a synthesis of this coevolutionary process of RE and GR in Mexico, we point out that RE has been a component of public policies focused on rural development since the 1950s. Indeed, a central element within these programs is the person who executes this activity: the extensionist [4]. In the 1960s, a technology transfer program was developed that employed 25,000 extensionists throughout the country, laying the foundation for the National Extension System, which was dissolved in the mid-1980s. This program also influenced the formation of a private extension market. Since 2001, extension activities have been encouraged through programs aimed at sectoral training and technology transfer actions within the framework of the Sustainable Rural Development Law [11]. These RE activities were primarily identified with training and technical assistance processes, which have hitherto revealed dispersed and disjointed efforts [12]. Thus, technical advisory practices, demonstration plots, and specific services on the use of machinery and equipment have been directly aligned with the global agrifood model directed towards productivity. The producer is then considered a passive adopter of technologies, which characterizes a linear approach to intervention and fails to promote the active participation of producers in the design of technological development and innovation projects [13].

Moreover, it should be noted that contrary to the modern paradigm that forms the basis of the results-oriented extension policy discourse in Mexico, small producers were not the priority population, with the focus instead being on those with average income and productive assets [14]. This issue discloses the fact that the scenarios in which extensionists operate have different arrangements. On the one hand, conventional agriculture, which was established in the mid-1940s during the GR, consists of high-income producers, large-scale farms with monoculture, and substantial use of inputs and pesticides [15]. This type of agriculture is principally located in the northern states of Mexico, which are encouraged by productive promotion policies [16] through monetary incentive programs that allow them to maintain their production and productivity [17]. Therefore, this model promotes an agricultural policy of free markets, which supports the interests of national and transnational capital. It also exhibits a high degree of transnationalization in the production of machinery, inputs and intermediate goods, financing, storage and marketing, wholesale and retail markets, and foreign trade of agricultural products [18]. However, this production model induces social and environmental costs by generating pollution, soil degradation, deforestation, reduction in biodiversity, and progressive depletion of natural resources [19]. In agriculture practices related to this model, technological overlaps emerge in which traditional and modern technological components are mixed [20].

In contrast to the conventional type, peasant agriculture is characterized by low levels of production that maintains traditional foods and contributes to a balanced diet, protection of agricultural biodiversity, and sustainable use of natural resources [21]. Agroecology adopts these elements to consolidate an increasing agroecological movement in Mexico where indigenous and mestizo peasants grow crops in a considerable area of farmland [22]. Despite this, the public policies that have been implemented do not yet favor these pro-

ducers as assistance programs have not generated favorable income and employment by stimulating local productive activities [23].

As a result of this historical development of agriculture and agroclimatic diversity, the Mexican government recognizes that "the areas richest in biodiversity are those with the highest rates of poverty and backwardness, due to the lack of institutional policies and programs that revalue peasant agriculture and increase the level of well-being of rural households and satisfy their basic food needs, through self-production of food, marketing of surpluses and generation of employment" [24]. Consequently, the administration is assessing a National Agroecology Plan to conserve and make adequate use of ecosystems and their biodiversity [25]. The government is also implementing programs to promote land care and the well-being of people while reinforcing agroecology and ecological recovery as key elements of peasant territoriality [26]. Therefore, these endeavors disclose the political plan required for the agroecological transition suggested by Wezel, Herren, Kerr, Barrios, Gonçalves and Sinclair [9].

It is important to recognize the fundamental role that rural extensionists can play in the desired transition from the conventional to agroecological model across the different socioeconomic contexts of the Mexican territory. Thus, the general objective of this work was to identify the types of positioning of rural extensionists among the states and socioeconomic regions of Mexico. In particular, this study aimed to identify (a) the socioeconomic characteristics and professional training of extensionists and (b) the types of productive positioning (agroecological vs. conventional) in which extensionists identify themselves. Therefore, this exploratory analysis intends to propose key elements for the targeting and differentiation of regional strategies to train extensionists according to their territorial context.

*Conceptual Framework*

Extensionists hold a crucial role as advisors and providers of technical and productive information to farmers. This is the basis for an overriding interest in identifying if there are differences among Mexico's states and socioeconomic regions in the positions rural extensionists take according to the agroecological or conventional productive approach they identify with. Through this study, we acknowledge the value of identifying such positionings to design differentiated public policies. This article then presents an exploratory analysis that found that in Mexico, compared to other countries, the positioning of rural extensionists tends towards agroecology [27].

For the purpose of identifying the productive positioning of rural extensionists, we analyzed the productive approach (agroecological vs. conventional) extensionists identify themselves with in their field of work. Positioning is when an individual selects a particular action from a series of possibilities according to the context, the situation, and the relationship of the participants in a dialogue. This discursive construction makes a person's actions intelligible and are determined as social acts [28]. In this sense, productive orientation comprises an assessment that rural extensionists make regarding their field of work and their context. Essentially, this process entails a reflective recognition of factors associated with the work they do [29]. The positioning of extensionists in the field of rural extension is an approach to what they do empirically and the understanding they have of it and its objectives [30]. Thus, they can give a direct account of the problems they face [31]. This positioning also involves the extensionists' own reflection on their daily professional work and how they can contribute to their development [32]. Therefore, extensionists themselves are indeed a key information source to identify their weaknesses and training needs in situ and in context [33]. We acknowledge throughout this article the relevance of rural extensionists' understanding of extension work and their own role as extensionists or advisors. However, rural extensionists also face challenges and experiences that transform their identity and their understanding of their own role as a result of their experience and practice [34]. For the purpose of understanding extensionists' professional performance, we need to elucidate the attributes, characteristics, and practices that an individual identifies

and lives as his or her own [35]. Additionally, the positioning of extensionists can help in proposing key elements for the targeting and differentiation of regional strategies to train extensionists according to their territorial context.

To achieve the abovementioned objective, it should be emphasized that the context where rural extensionists operate is heterogeneous. In this case, Mexico is divided into diverse socioeconomic regions that have distinct physical, environmental, ecological, economic, demographic, social, and cultural features. This implies that the positions of extensionists in the different regions account for the unequal conditions found at a broad level within the standard of living, development, or welfare of the communities [36]. These varied conditions include economic, social and cultural, political, administrative, and environmental elements that are essential components of local and regional life [37]. Moreover, these regional conditions allow specialization in economic activities, change the economic structures of each territory, and even modify their productive structure [38]. The primary sector, where extensionists work, becomes the main source of these changes in regional conditions. Thus, this paper suggests the critical role of extensionists for an effective AT, especially because Mexican agriculture is currently in the transition towards a sustainable food system. Hence, highlighting the productive orientation of rural extensionists in relation to the regional heterogeneity of the country can contribute to implementing plans for the diagnosis of needs and opportunities. It is particularly necessary to elaborate, execute, and follow up on rural extension plans, projects, and programs. Apart from contributing to increasing production, identifying the productive orientation of extensionists may improve income distribution, preserve natural resources and the environment, and ultimately develop an organized society [39].

## 2. Materials and Methods

In 2019, a questionnaire designed in the SurveyMonkey® online platform was sent to 500 rural extensionists from each of the states of Mexico (with the exception of the current Mexico City, formerly the Federal District) that are members of the public register of the Mexican Rural Extension System (SERMexicano). A total of 1448 analyzable responses were obtained ($n$ = 1448). Although the sample size was high for a study of this type, it cannot be considered statistically representative as it was a purposive sample. The questionnaire was written in Spanish and included sociodemographic items regarding multiple variables, including sex, age, years of experience as an extensionist, highest level of education attained, educational background, and the state where the extension activity is performed. Additionally, a five-level Likert-type item addressed the contrast between agroecology and conventional agriculture according to the perspective of the respondents. The instruction for this item was phrased as follows:

Two opposing production approaches are presented: agroecology and modern conventional agriculture. Using the following scale, identify the productive approach with which you feel more identified. Select 1, if the option is "Agroecology", select 3 if it is an intermediate (neutral) position and if it is "Modern or conventional agriculture", select 5. You can select the numbers 2 and 4 to show the levels of proximity to one of the two poles.

It is important to clarify that it was recognized that those who answered the questionnaire had knowledge of agriculture relating to the tasks they perform. Therefore, it was assumed that any definition regarding the approaches would be interpreted by a specific position, leading to a bias. Hence, participants were not given a definition for either approach.

In order to analyze the data, we first explored the distribution and association between sociodemographic variables and the "orientation to productive approaches" in relation to the states and regions of the country. For this purpose, the classification of eight macroregions and states pertaining to them were considered as follows: North (Chihuahua, Coahuila de Zaragoza, Zacatecas, Durango, and San Luis Potosí), Northwest (Baja California, Baja California Sur, Sonora, Sinaloa, and Nayarit), Northeast (Nuevo León and Tamaulipas), Central West (Jalisco, Aguascalientes, Colima, Michoacán de Ocampo, and

Guanajuato), East Central (Queretaro, State of Mexico, Mexico City, Morelos, Hidalgo, Tlaxcala, and Puebla), East (Veracruz de Ignacio de la Llave and Tabasco), South (Guerrero, Oaxaca, and Chiapas), and Yucatan Peninsula (Yucatan, Campeche, and Quintana Roo) regions [40]. These macroregions serve as a suitable tool to compare such contexts as well as point out essential factors for the development of the regions within the country [41].

Subsequently, a new data matrix was structured based on the records regarding the distribution of positions gathered for each state. The variables assessed were the state, the regions, and the percentages of extensionists who opted for a given positioning. Two multivariate grouping techniques were applied to these variables. Dendrogram and k-means [17] were utilized to identify groups of states according to the reported "orientation to productive approaches". This analysis comprised the descriptive statistics from each productive orientation and the states that constitute these groups. According to the distribution, three positions were identified: agroecological, tending to neutrality, and contrasting. Afterwards, the Kruskal–Wallis technique was applied to determine statistical differences between the groups of states and the positioning of the extensionists. Statistica software [42] was utilized for the exploratory data analysis and nonparametric and multivariate techniques.

Finally, in the questionnaire, in addition to questions relating to sociodemographic information and productive positioning, four Likert-type slogans were included to evaluate extension activities carried out by rural extension workers and determine experiences inherent to their activity and their territorial context. Here are the prompts:

*The demands and expectations of the producers must be the starting point of all extension work (1DE).*
*Technological transfer is the main task of rural extension (2TT).*
*To achieve their objectives, extensionists must work in coordination with the actors and institutions that are in their territory (3OE).*
*A good extension agent must think about their producers, but also about the set of actors and institutions in their territory (4GE).*

In the evaluation, 1 meant "totally disagree", 3 indicated an intermediate position, and 5 meant "totally agree". Participants could also use 2 and 4 to show greater proximity to one of the two poles (Table 1). The results are displayed according to their percentage distribution.

**Table 1.** Likert-type slogans to evaluate extension activities.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Totally disagree | Disagree | Neither agree or disagree | Agree | Totally agree |

## 3. Results

### *3.1. Background of Extensionists*

From the total number of extensionists surveyed ($n$ = 1448), 23% were women and 77% were men. The average age of women was 37 years, and the mean number of their years of experience as extensionists or advisors was 6 years. For men, these values were 43 and 10 years, respectively.

Regarding educational attainment, the results indicated that university level was the predominant highest level of education completed by a majority of the extensionists surveyed. However, the analysis of the distribution by sex revealed a slight tendency for women to have a higher level of education (almost five percentage points). This is evidenced by the contrasting percentages of master's and doctorate degrees between men and women. The distribution of the level of education for women was as follows: bachelor's degree 0.9%, doctorate 3.9%, master's 16.9%, technical 2.7%, and university 75%. The distribution for men extensionists was as follows: bachelor's degree 1%, doctorate 3%, master's degree 13.2%, technical 3%, and university 78.7%. Regarding Bachelor of Science (BSc) degrees of extensionists, the data showed that agronomy and veterinary were the predominant

majors for both women and men. The distribution pertaining women extensionists showed that 28.3% of women rural extensionists have a degree in agronomy engineering, 1.5% in forestry engineering, 0.3% in animal husbandry engineering, 0.6% in social work/assistant work, and 12.3% in veterinary medicine, while 4.8% did not have a professional degree and 50.6% did not specify any major. Data analyzed from male rural extensionists showed that 50.6% had a degree in agronomy engineering, 2.1% in forestry engineering, 0.7% in animal husbandry, 0.5% in social work/assistant work, and 10.8% in veterinary science, while 4.7% did not have a professional degree and 29.1% did not specify it.

### *3.2. The Productive Orientation of Extensionists*

The distribution of the variable "orientation to productive approaches" is illustrated in Figure 1. As can be observed, there was a major tendency towards agroecology at the country level. However, almost half of the distribution showed a neutral position or a tendency towards the conventional model. Additionally, the predominance of agroecological positioning was maintained at the level of socioeconomic regions, although not all regions showed the same percentages. The percentage of conventional agriculture in the East region was close to the agroecological option; this represented the maximum quantity among the eight regions. The data showed a marked contrast between the South, Yucatan Peninsula, and East Central regions.

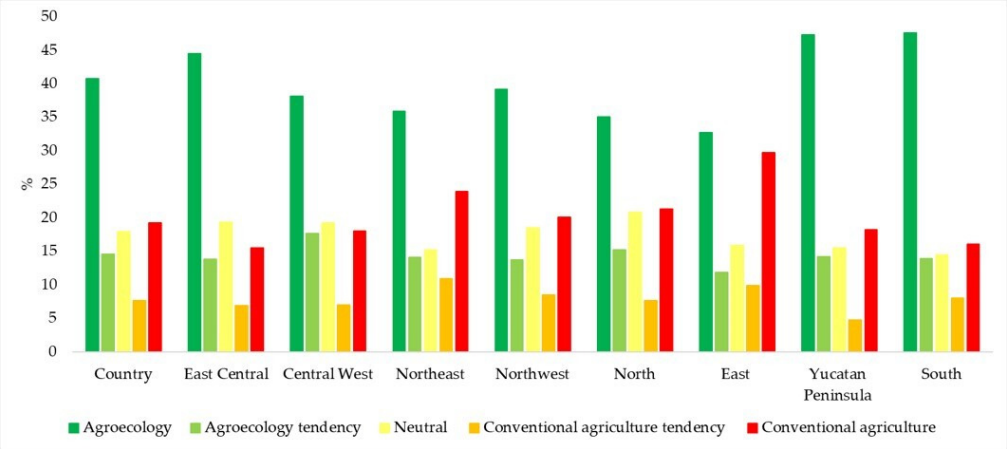


**Figure 1.** Distribution of the productive model with which extensionists identified themselves according to socioeconomic regions in Mexico. Source: own elaboration.

The analysis of the distribution of productive orientations according to states indicated that the majority of rural extensionists identified with the agroecological option. The exception was Tabasco and Aguascalientes, where the percentages of association with the "totally in agreement with the conventional model" exceeded the opposite category. Likewise, Figure 2 shows that extensionists from Jalisco and Coahuila states tended towards the neutral option. Considering these results and through the multivariate grouping techniques, we decided to construct a typology of states according to the percentage distribution of the five positioning categories.

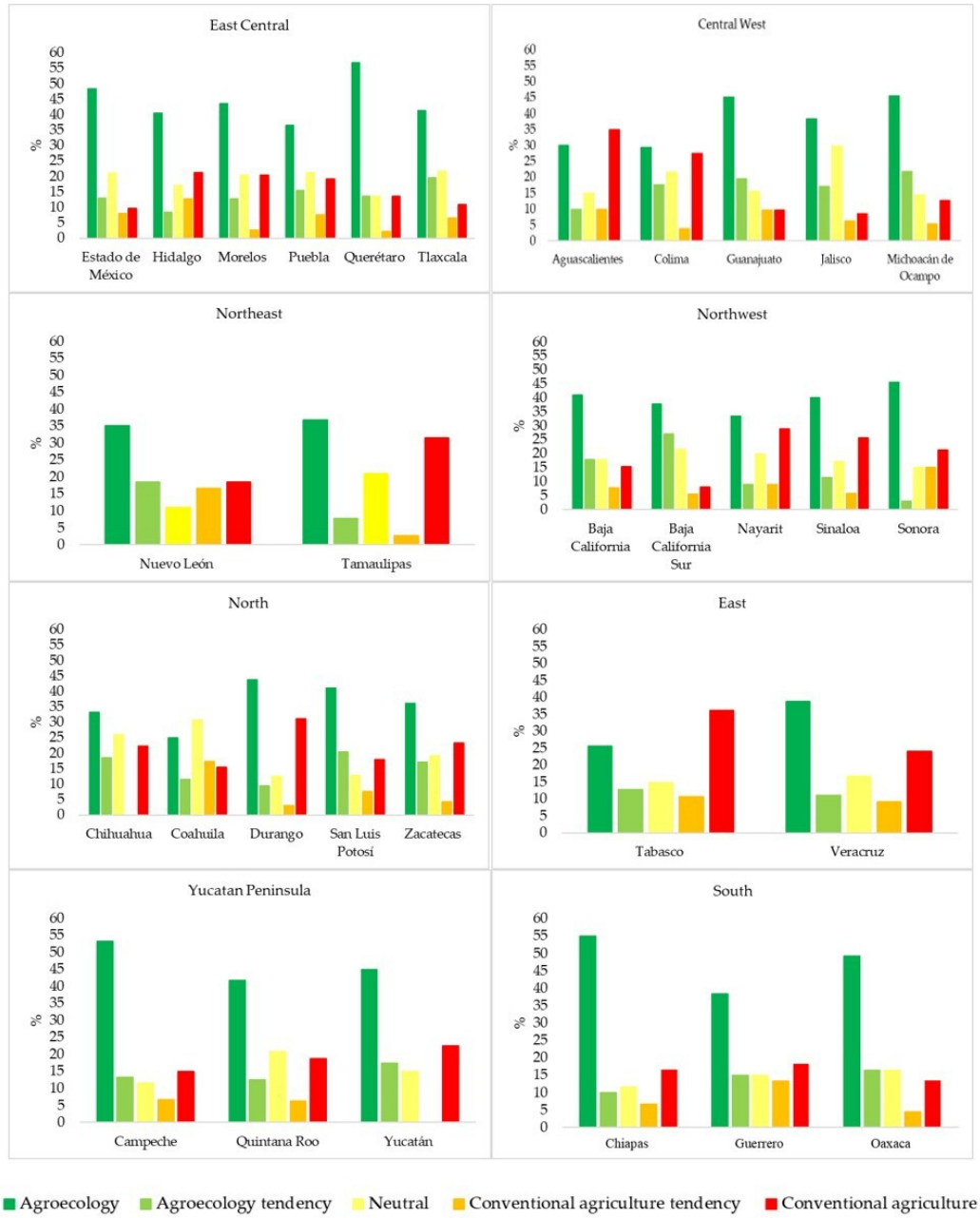


**Figure 2.** Distribution of the productive model with which the extensionists identified themselves according to states in Mexico. Source: own elaboration.

The abovementioned analysis resulted in the identification of three groups. The first group was considered "agroecological" and included the states of Querétaro, Estado de México, Guanajuato, Michoacán de Ocampo, Sonora, Campeche, Yucatán, Chiapas, and Oaxaca. The second group was identified as "tending towards neutrality" and comprised the states of Hidalgo, Morelos, Puebla, Tlaxcala, Jalisco, Nuevo León, Baja California, Baja California Sur, Chihuahua, Coahuila, San Luis Potosí, Zacatecas, Quintana Roo, and Guerrero. Finally, the third group was categorized as "contrasting" and included Aguascalientes, Colima, Tamaulipas, Nayarit, Sinaloa, Durango, Tabasco, and Veracruz (Table 2).

**Table 2.** Typology of Mexican states according to the distribution of the productive model with which the extensionists identified themselves.

| Groups | Members | Agroecology | | Agroecology Tendency | | Neutral | | Conventional Agriculture Tendency | | Conventional Agriculture | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Sd * | Mean | Sd | Mean | Sd | Mean | Sd | Mean | Sd |
| Agroecological | 9 | 49.31 | 4.63 | 14.25 | 5.57 | 14.97 | 2.79 | 6.51 | 4.38 | 14.96 | 4.50 |
| Tending towards neutrality | 14 | 37.84 | 4.67 | 16.56 | 4.54 | 20.39 | 5.69 | 8.18 | 5.07 | 17.03 | 4.85 |
| Contrasting | 8 | 34.72 | 6.18 | 11.14 | 3.04 | 17.35 | 3.25 | 6.77 | 3.28 | 30.02 | 4.28 |

* Standard deviation. Source: own elaboration.

Based on the Kruskal–Wallis analysis, we found differences between the groups of states in four of the five positionings (Figure 3). The "tending to conventional agriculture" position yielded the lowest percentages and showed no significant differences among the three groups. Even though there were differences between the groups in the intermediate positionings "tending towards agroecology" and "neutral", the percentages of the "agroecological" and "conventional" positionings showed the most significant differences. Figure 3 illustrates these statistical differences determining the distinction between the types of productive orientations.

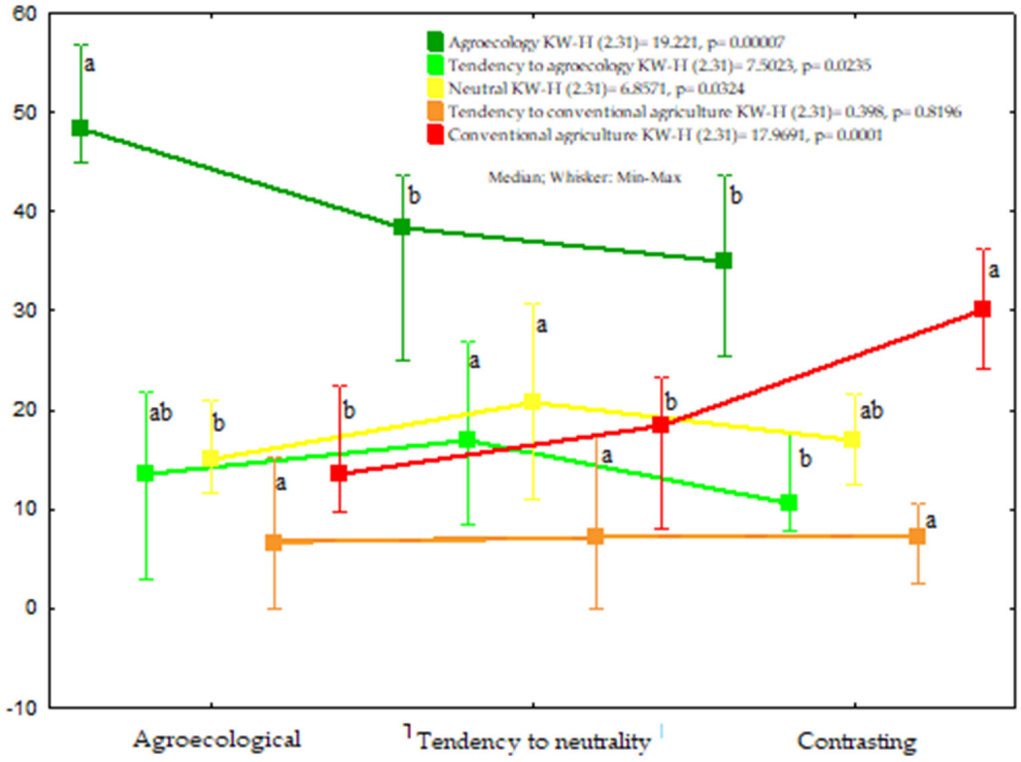


**Figure 3.** Differences between state groups in relation to extensionists' positions. Source: own elaboration. Note: Values with the same letter within each marker do not differ statistically.

Figure 4 shows the distribution of Mexican states according to their group and region. The North and Northeast regions showed the position of "tends to neutrality" with no agroecological status. The South, Yucatan Peninsula, and Central West regions tended towards "agroecological". The rest of states were heterogeneous, meaning the three types of tendencies were found.

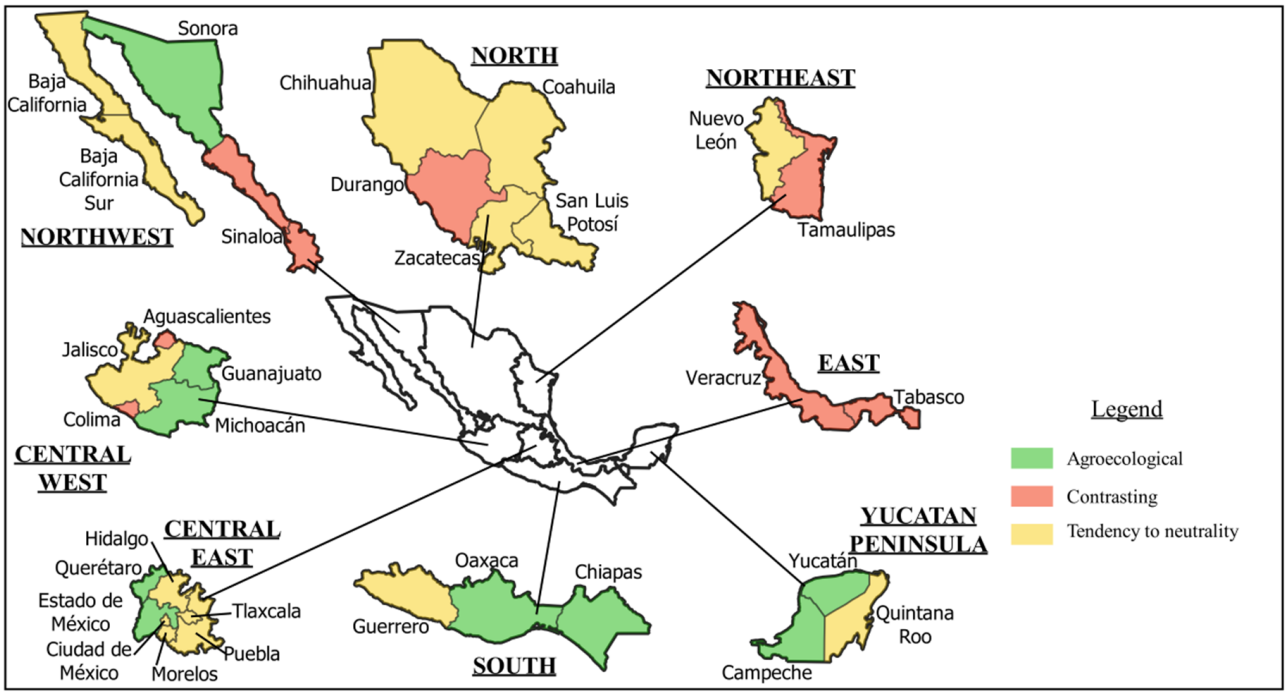


**Figure 4.** Distribution of states in relation to the group to which they belong and the region where they are located. Source: own elaboration.

### *3.3. Assessment of Rural Extension Activities*

In general, rural extensionists indicated a positive assessment of extension activities, with "agree" and "totally agree" being the most common (Table 3). Extension agents considered that the demands and expectations of the producers, as well as the interaction and dialogue, were the starting point for the extension work and for obtaining better results. A relevant aspect is that they considered technological transfer to be the main task of rural extension.

**Table 3.** Assessment of rural extension activities by rural extensionists.

| Prompts | Totally Disagree | Disagree | Neither Agree or Disagree | Agree | Totally Agree |
|---|---|---|---|---|---|
| | | | % Percentage | | |
| 1DE | 4 | 5 | 6 | 36 | 50 |
| 2TT | 4 | 10 | 11 | 41 | 34 |
| 3OE | 3 | 2 | 4 | 39 | 52 |
| 4GE | 3 | 1 | 3 | 42 | 52 |

Source: own elaboration.

## 4. Discussion

### *4.1. Background of Extensionists*

The mean age and experience obtained in this research were consistent with the data reported from different studies conducted and published in the Mexican context. For instance, a study that analyzed the profile of extensionists in Baja California Sur reported that the majority of extensionists were between 31 and 40 years of age. Of all the participants, 34% were involved in livestock services, and no participation of women in agricultural services was reported [4]. Additionally, data from a survey conducted in the State of Mexico indicated that 64.7% of extensionists were men and 35.3% were women. Their ages ranged from 26 to 60 years, with a mean of 36 years. Of the surveyed extensionists, 17.6% had at least one year of experience and 17.7% worked for 12 to 15 years [43]. Another study conducted in the same state showed that 35.3% of the extensionists were women and that

64.7% of men worked in the public sector. In the private sector, 38.5% of labor participation was female and 61.5% male. The mean age for extensionists working in the public sector was 36 years, while it was 35 years in the private sector [44]. Despite the evident similarities in the data analyzed, a lower percentage of participation of women extensionists was found in this study. Undoubtedly, this finding is contradictory to the emerging phenomenon of feminization of Mexican farm work in recent years [45].

Moreover, the results of this exploratory data analysis were similar to those reported by Mayoral García, Cruz Chavez, Duarte Osuna and Juárez Mancilla [4] in Baja California Sur. The researchers found that 100% of the agricultural service extensionists had a BSc in agronomy engineering. In the State of Mexico, extensionists who had undergraduate (70.6%) and graduate (29.4%) degrees attained this level of education at institutions that offer agricultural programs, such as the Universidad Autónoma Chapingo (52.9%) and Colegio de Postgraduados (23.5%) [43]. A similar study indicated a relationship between academic institution and educational level. The findings revealed that extensionists who had undergraduate degrees studied at the Universidad Autónoma de Chapingo, whereas those who had postgraduate studies (master's and doctorate in science) studied at the Colegio de Postgraduados del Estado de México [44]. Nevertheless, the results of this research showing the lower percentage of postgraduate studies (14% master's degree and 3% doctorate) corroborated those reported by Monsalvo Zamora, Jiménez Velázquez, García Cué, Sangerman-Jarquín, Martínez Saldaña and Pimentel Equihua [43] in the state of Mexico (29.4%). This may reflect the historical centrality of postgraduate options and opportunities within the main areas of knowledge pertaining to extensionists.

### *4.2. The Productive Orientation of Extensionists*

The productive orientation of the rural extensionists surveyed showed a significant number of cases with an orientation towards agroecology (>34%) or a tendency towards it, while a smaller percentage of participants (<17%) were oriented to the conventional paradigm. These findings are relevant not only in relation to the negative impacts of the conventional production model but also the ongoing transition to agroecology. Extensionists can play an important role in promoting institutional changes aimed at valuing and transitioning to agroecology [46]. Although this research does not allow us to determine what extensionists understand by agroecology and conventional agriculture, it clearly shows a positive assessment of agroecology as an idea at the national level, by states, and in the regions (Figures 1, 2 and 4).

Furthermore, the positions of rural extensionists demonstrate the emergence of new challenges for agriculture in Mexico. This is particularly relevant for the policy framework of the 2018–2024 term because, according to official documents, the government is strongly focused on the agroecological transition process [25]. Thus, training strategies for extensionists should aim for AT that mainly considers the heterogeneity of positionings among extensionists, states, and regions. At a global scale, the role of technical extensionists has evolved from a bureaucratic model of basic service to a more comprehensive one that includes a gender and youth vision [47]. This innovative approach has not yet permeated within Mexican agriculture. Another main implication of this approach entails two marked distinctions of extension in Mexico: (1) reduction of the extension services, including training to the extensionists themselves, and (2) the focus on reevaluating the knowledge generated through dialogue and within the processes of practical training in agroecology, which is only reinforced by the logic of building an ecosocial paradigm or "agroecological extensionism" [48]. The latter is considered one of the most effective learning tools for the development or territorialization of agroecology. Moreover, in this agroecological scenario, a dialogue emerges between peasant and allied nonpeasant epistemologies where extensionists can play a relevant role [49].

Another significant factor for the agroecological transition is that rural extensionists work within heterogeneous regional contexts found in the economic and social diversity of Mexico's territories and states. Therefore, identifying the types of productive positionings

and their characteristics as well as the diverse challenges involved can contribute to offering training strategies for extensionists according to their local context. In the subsequent sections, a synthesis of these particular settings is presented and primary elements of these contexts are outlined based on the findings of the study.

First of all, the state of Sinaloa is located in the Northwest region, and it is one of the main agricultural producers at the national level as well-established entrepreneurs are located in this state. The main factors that contribute to establishing these enterprises include the technological level and the current form of organization within companies [50]. These characteristics allow them to increase their production, which are mainly export-oriented crops [51]. However, strong pollution problems and environmental costs have been accentuated due to the application of fertilizers and pesticides as well as inputs contained in the technological packages [52]. In view of these issues, the Mexican government has introduced actions to produce white corn following an agroecological transition that avoids the use of glyphosate. These measures are aimed at achieving sustainable production, with the intention of replicating the model throughout commercial agriculture in the country [53].

The state of Chihuahua is located in the North region and shares similar agricultural production characteristics with Sinaloa. Its commercial agriculture is characterized by having specialized machinery and technified irrigation, which generates superior productive efficiency [54]. The entrepreneurial and transitional agriculture (medium and large producers) of this region comprise a privileged sector with a higher production scale than most grain producers in Mexico. They also uphold advanced levels of organization and capitalization [55]. The state of Tamaulipas is located in the Northeast region and is characterized by having diverse agricultural areas that exhibit a high production potential. Due to this, farmers with entrepreneurial attitude and high yields are principally located in the North [56], whereas the Central and mainly the South regions display a low production potential [57]. These contexts reflect the challenges identified by Tittonell, et al. [58], who recognized the major contribution of agroecology research at the family scale. However, the authors acknowledge that a notable issue to overcome is the less significant impact of research on medium- and large-scale production.

The state of Puebla is located in the Central East region, where agriculture is mainly provided by peasant production units. These units are important in food production and are based on strategies for managing scarce resources and taking advantage of family labor and experience [59]. In certain areas of the state, such as Sierra Norte, producers exclusively plant for food quality purposes, although other activities provide them with monetary income [60]. This fact is indicated by the levels of productivity attained under rainfed conditions [61]. The State of Mexico is also located in the Central East region, where the productivity of agriculture shows low production levels. Additionally, low rural prices for agroindustrial crops as well as harvesting of flowers, vegetables, and forages are focused on the agroexport model [62]. Hidalgo is another state located in the same region, where the production of small agricultural producers is based on cultivation under a form of family work. This type of farming emphasizes the intergenerational transmission and conservation of traditional knowledge of sowing methods and plants. The appreciation for the work of the land, animals, and the rural environment are also reinforced by this approach to agriculture [63]. Indeed, these aspects are central to the agroecological transition.

The East region includes the states of Veracruz and Tabasco. Veracruz has particular characteristics in relation to its territorial and productive heterogeneity, even though a large part of the state maintains a self-consumption agriculture. This productive orientation is followed by a transition to agroecology and, to a lesser extent, commercial agriculture. Additionally, there are a few areas in Veracruz with a vast diversity of crops produced and other territories where monoculture predominates [17]. For instance, agriculture in the Sierra de Zongolica is characterized by the application of rudimentary agricultural techniques. This implies that crop yields are low, and self-consumption is complemented by small-scale animal husbandry, which includes poultry, pigs, sheep, and goats [64].

In other territories, agriculture is not due to profitable cash crops, and even when the activity is maintained, the indigenous population only has access to unstable income and low wages [65]. Traditional agroforestry systems and cacao plantations in Tabasco are high-priority practices as the production and sale of cocoa is fundamental for family subsistence [66].

Moreover, the South region holds appropriate conditions for the production of a wide variety of crops, which is essential for the agroecological transition process. A significant proportion of agriculture in Chiapas is focused on crops with high-level economic value of export-oriented agroindustrial production (coffee, banana, cocoa, and oil palm) [67]. Notwithstanding, there has been a decrease in the production of basic grains, which is associated with the decline of agricultural activities in production units due to the introduction and expansion of crops destined for industrialization [68]. This basic agriculture focuses on the intensive use of rural family labor whose main priority is to ensure supply for self-consumption during the year, with any surpluses being sold [69]. A similar scenario occurs in Oaxaca, where many agricultural activities involve mechanisms for family and communal reciprocity that embrace the cultural heritage of the communities [70]. Finally, Guerrero holds highly productive crops with export potential, such as mango; yet, this promising productivity has had insufficient impact on agricultural exports [71].

The Yucatan Peninsula region includes the states of Campeche, Quintana Roo, and Yucatan. The latter has a key role in the agroecological transition due to its historical agroecological practices. For instance, the intentional sedimentation and redeposition of soils from lagoon and swamp systems to milpas, forest polycultures (pet kot in Maya Yucateco), and family gardens are utilized as natural fertilizers to increase agricultural and forest productivity [72]. These agroecological techniques show two divergent tendencies: (1) farmers maintain their community organization and traditional agricultural practices that enable self-sufficiency and the common management of their natural resources, and (2) modifications emerge from the intervention of the conventional agriculture model characterized by the use of technological package inputs [73]. Therefore, one of the risks of the implementation of current public policies such as Sembrando Vida, even though the program maintains a discourse towards agroecology, is how different forms of community organization and the program's operational functions will be recognized [26]. Campeche has similar characteristics to Yucatan as it maintains a type of ecological agriculture based on traditional agroforestry systems. This structure is an important source of food, with the family group representing the social unit for production and work organization [74]. Furthermore, a main issue in Campeche is that small producers face the risk of disappearing due to the consolidation of transnational agroindustrial companies with large-scale plantations [75].

Finally, the Central West region encompasses the states of Michoacán, Jalisco, Colima, Aguascalientes, and Guanajuato. These are generally considered as highly productive areas as their crop production follows industrial agriculture, despite the fact that they encounter negative effects on soil fertility [76]. Michoacán shows, to an extent, a small-scale food production system in which productive strategies are associated with agricultural management and technology diversification, apart from government interventions in rural infrastructure [77]. In contrast, Colima has highly profitable agriculture and crops, principally lemon cultivation [78].

### *4.3. Assessment of Rural Extension Activities*

There are two important aspects in relation to the evaluation of extension activities. The first two (1DE and 2TT) show two opposing visions: the first is ad hoc to agroecology and oriented towards rural extension focused on dialogue, while the second is based on the conventional production model. The remaining two (3OE and 4GE) deal with aspects centered on the territory in the sense that the knowledge of extension workers about the actors and institutions can contribute to the targeting of extension programs oriented towards agroecological transition. However, what is relevant is that even when extension

workers mostly position themselves in agroecology or a trend towards it, they still consider technology transfer to be the main activity of extension. This is a starting point for the case of Mexico, i.e., if you want to transition to agroecology and extension workers have a very important role, it is essential that their training should be rural extension centered on dialogue.

The abovementioned is a scenario that is replicated in different latitudes. At the global level, it is recognized that when speaking of extension, one thinks of a paradigm composed of approaches aimed at increasing agricultural production through the transfer of technologies from experts to farmers. However, the current context must consider the active role that extensionists play in perpetuating and challenging existing practices with a more humane orientation to extension [79]. Regarding experiences of extension activities and transition to agroecological approaches, a study in Nigeria showed that extension and advisory activities are influenced by current agricultural policy and that extensionists focus exclusively on intensive agricultural practices due to transformation of the agricultural agenda [80]. The same authors suggested a participatory approach to policy formulation and information dissemination that incorporates farmers' traditional knowledge. This shows similarity with the current case of Mexico, in which agroecology is being encouraged at the public policy level.

Similarly, at the international level, a radical change is suggested from the academic curricula that encourages rural extension processes focused on agroecology through the establishment of field schools for farmers and that also considers the specific diversities of the location in terms of limitations and production potential [81]. In Mexico, there is progress in this regard, with programs that have technical support schemes, such as the Peasant Learning Communities of the Sembrando Vida program and the Field Schools of the Production for Well-Being program, in the search for transition and territorialization of agroecology [82].

In general, the main challenge consists of materializing the potential of extensionists to support the transition and expansion of agroecology in Mexico. This endeavor suggests considering the positioning of extensionists and the diverse managerial, productive, and social purposes across states and regions. As we previously discussed, numerous agricultural factors indicate issues and possible solutions pertaining to each state and region of the country. Thus, recognizing these factors will contribute to achieving a deeper understanding of the agroecological future and transition processes [83].

### *4.4. Implications and Limitations*

Some limitations to this study need to be acknowledged. First, no specific rural extension activity, such as demonstrations, training, advice, or technical assistance, was evaluated. What extensionists exactly consider agroecology was also not considered. Furthermore, the study was only exploratory regarding the dynamics extensionists perceive. We considered that the questions asked would lead the respondents to directly answer about a given productive positioning. Hence, they enabled extensionists to express their assumptions and allowed us to capture their responses in a more spontaneous context. Other questions would show a broader view of these positionings to an extent, and the results obtained were determined by the context from which they emerged.

This work was based on a simple strategy to evaluate the positioning of rural extension agents in the territory of Mexico based on a Likert-type item. This methodology constitutes a contribution in itself as it allowed evaluation of the personal positions from the point of view of the extension workers. This made it possible to determine that the extensionists surveyed had a moderate orientation towards agroecology. This demonstrates the critical capacity of extension agents regarding their own training and their potential to promote changes at the level of productive approaches [46]. In addition, this study interweaves a series of elements related to regional and productivity characteristics and the potential transition to agroecology as well as the assessment of rural extension work from the

perspective of extension workers. This can serve to guide agroecological rural extension in the current context of the promotion of agroecology by the Mexican government.

The results of this study are not necessarily generalizable to all extensionists as it is quite likely that others outside the sample have different positions. In addition, the concepts of agroecology and conventional agriculture were obtained from the respondents themselves to avoid definitions that were prepositioned from specific or biased perspectives. The study also opens the door for future research. For example, it may assist in studying the extension activities carried out by rural extension workers within the programs implemented by the Mexican government that promote agroecology and in investigating how spaces for interaction and dialogue are being generated or built.

## 5. Conclusions

This exploratory study reveals a predominance of male rural extensionists and, at the same time, indicates a downward tendency in the participation of women. Additionally, the results show that extensionists principally identify themselves with the agroecological model. Conventional agriculture, which comprises three types of productive orientations according to the extensionists' positioning (agroecological, tending to neutrality, and contrasting), is favored within diverse regions of Mexico.

These orientations also form diverse inter- and intraregional groups in relation to particular socioeconomic regions of the country. As the exploratory results show, agroecological identification is prevalent among extensionists, although there is still a considerable tendency towards neutrality or a clear identification with the conventional agriculture model. The results of this study may be relevant for rural extensionists, extension program implementers, decision-makers, and research institutions considering these actors contribute to the ongoing review of the professional work and training of rural extensionists in the current agroecological transition process in Mexico. Furthermore, extensionists still consider technology transfer to be the main activity of rural extension, although the current literature and direction of extension points towards a more humanistic orientation.

Ultimately, the challenge is not only to corroborate the hypothesis that extensionists can potentially contribute to the transition and expansion of agroecology in Mexico but to also design and implement differentiated strategies that address the differing management techniques, productive and social purposes, and positioning of extensionists. This study also has possible limitations as it only explored the productive positions of extensionists and not their conceptualization and practice. Considering this, the findings of this study can guide further research, especially future studies on rural extension and its impact on agroecological transition.

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