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AGRICULTURAL EXTENSION AGENTS' BELIEFS AND PERCEPTIONS TOWARD SUSTAINABLE AGRICULTURE IN THE KURDISTAN REGION OF IRAQ

Sharmin Faraj*Department of Agricultural Communication, Education, and Leadership, The Ohio State University, Columbus, Ohio, USA.*

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ABSTRACT

Sustainable agriculture is essential for ensuring long-term food security, environmental protection, and rural development. Agricultural extension agents play a critical role in promoting sustainable agricultural practices by transferring knowledge and encouraging farmers to adopt innovative and environmentally friendly methods. However, the beliefs and perceptions of extension agents can significantly influence the effectiveness of these efforts. This study examines the beliefs and perceptions of agricultural extension agents regarding sustainable agriculture in the Kurdistan Region of Iraq. This study employed a quantitative research design. Data were collected from 89 agricultural extension agents using a structured questionnaire and analyzed using descriptive statistics. The results indicate that extension agents generally hold positive beliefs toward sustainable agriculture and express favorable perceptions of several sustainable practices, particularly soil testing and the use of organic fertilizers such as animal manure. The findings highlight the importance of strengthening extension education, training programs, and institutional support to enhance the promotion and adoption of sustainable agricultural practices. These results provide valuable insights for policymakers and agricultural development organizations seeking to improve sustainable agriculture initiatives in the region.

*Corresponding Author: Sharmin Faraj**Email: Sharminfaraj@gmail.com**© The Author(s) 2026.*

INTRODUCTION

Sustainable agriculture plays a critical role in ensuring long-term food security while conserving essential natural resources, including soil, water, and biodiversity (Tilman et al., 2002; Pretty, 2008). Rapid population growth continues to place increasing pressure on agricultural systems, often resulting in environmental degradation, soil depletion, and declining ecosystem resilience (Robertson and Swinton, 2005; de Barcellos et al., 2011). In Iraq, particularly in the Kurdistan Region, agriculture remains a key contributor to food security and economic stability. However, decades of unsustainable practices, institutional challenges, and limited strategic investment have constrained

agricultural productivity and resource sustainability (Mahmud, 2021; Jongerden et al., 2019). Sustainable agriculture provides a comprehensive framework to address these issues by promoting efficient resource utilization, environmental stewardship, and strengthened rural livelihoods (Pretty and Hine, 2001). Agricultural extension agents serve as critical intermediaries between research institutions and farming communities, facilitating the transfer of knowledge and encouraging the adoption of improved agricultural practices. Their beliefs, attitudes, and perceptions significantly influence farmers' decisions to adopt sustainable technologies and management strategies (Tiraeyari et al., 2013). Despite their pivotal

role, limited empirical research has examined extension agents' beliefs and practical engagement with sustainable agriculture in the Kurdistan Region. This gap underscores the need for a context-specific investigation into their professional perspectives and implementation practices.

This study is guided by several theoretical perspectives that explain how agricultural extension agents influence the promotion and adoption of sustainable agricultural practices. The Diffusion of Innovations theory suggests that the adoption of new agricultural technologies depends on how individuals perceive characteristics such as relative advantage, compatibility, and complexity (Everett M. Rogers, 2003). Within agricultural systems, extension agents serve as key intermediaries who communicate innovations and influence farmers' decisions to adopt improved farming practices. Their beliefs and perceptions regarding sustainability therefore play a significant role in shaping the diffusion of sustainable agricultural technologies. In addition, the Theory of Planned Behavior explains that individuals' behavioral intentions are influenced by attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). In the context of agricultural extension, agents who hold positive attitudes toward sustainable agriculture and feel confident in their ability to promote these practices are more likely to encourage farmers to adopt environmentally sound farming methods. Previous research also highlights that extension agents' knowledge, perceptions, and professional experience influence their ability to effectively transfer sustainable agricultural practices to farmers (Tiraieyari et al., 2013; Islam et al., 2021). Together, these perspectives suggest that extension agents' beliefs, knowledge, and perceived capacity to promote sustainable practices are critical factors shaping the implementation and diffusion of sustainable agriculture in the Kurdistan Region of Iraq. Therefore, the objective of this study is to examine the beliefs and perceptions of agricultural extension agents toward sustainable agriculture practices in the Kurdistan Region of Iraq.

Specifically, the study aims to:

1. Examine the general beliefs of agricultural extension agents toward sustainable agriculture.
2. Assess extension agents' perceptions of specific sustainable agricultural practices.

To address these objectives, the following section reviews existing literature on agricultural extension, sustainable agriculture adoption, and the theoretical perspectives that guide this study.

Literature Review

Agricultural extension agents serve as critical intermediaries between research institutions and farming communities, providing technical guidance, advisory support, and knowledge transfer to promote the adoption of sustainable agricultural practices (Sulaiman & Misnan, 2022; Alotaibi et al., 2025). Their effectiveness is shaped by multiple factors, including professional knowledge, attitudes, level of training, institutional support, and intrinsic motivation. However, structural and systemic challenges, such as centralized extension systems, inadequate financial and logistical resources, and limited participatory programming, often constrain agents' outreach and influence, reducing the likelihood of successful innovation adoption among farmers (Islam et al., 2021).

Recent research highlights that farmers' adoption of sustainable practices is closely linked to the availability and quality of extension services. Contact with extension agents, participation in training programs, and access to technical guidance have been shown to facilitate the adoption of sustainable agricultural practices (Hameed and Sawicka, 2023). Conversely, low reliance on extension services, insufficient guidance, and limited institutional support may hinder effective knowledge transfer, emphasizing that the success of sustainable practice adoption depends on both the expertise of extension personnel and the quality of information provided to farmers.

Smallholder farmers, who manage a significant proportion of agricultural land, face complex, interrelated challenges in the Middle East, including climate variability, water scarcity, soil degradation, economic pressures, and limited access to agricultural innovations (Ghanayem and Nor, 2025). These factors mutually exacerbate vulnerability, reduce productivity and yield stability, and negatively affect food security, particularly among vulnerable populations.

Studies in arid Gulf Cooperation Council (GCC) states indicate that the adoption of sustainable urban agriculture technologies is influenced by a combination of social, economic, and institutional drivers, while constraints such as water scarcity, fragmented markets,

and limited institutional support hinder widespread uptake (Ramadan et al., 2025). These findings reinforce the importance of tailored extension services, capacity-building programs, and supportive policies to promote sustainable agricultural practices, reflecting challenges similar to those observed in the Kurdistan Region of Iraq. Participatory and decentralized extension approaches have been shown to enhance the adoption of sustainable agricultural innovations by empowering agents, strengthening farmer engagement, and improving communication flows (Sghaier et al., 2021). Behavioral and contextual determinants—including professional confidence, access to resources, and perceived behavioral control—mediate the relationship between extension agents' advisory engagement and farmers' adoption of sustainable practices.

Recent research has increasingly emphasized collaborative learning, farmer empowerment, and the co-creation of context-specific innovations (Prajapati et al., 2025). For example, studies on model farmers in India demonstrate that individuals with similar official responsibilities can assume markedly different roles, influencing both the efficiency and equity of knowledge transfer within extension networks (Taylor and Bhasme, 2018). Complementing this, a systematic review highlights that farmers' adoption of sustainable innovations is shaped by enabling factors such as environmental values, innovation characteristics, and individual traits, while barriers include complexity, innovation aversion, and perceived lack of control over adoption (Rizzo et al., 2024).

Together, these studies suggest that extension agents must not only facilitate participatory learning but also consider the diverse personal, social, and psychological factors influencing farmers' adoption of sustainable practices. Integrating these insights allows for the design of context-sensitive interventions that enhance adoption efficiency, equity, and sustainability outcomes.

While the literature highlights the importance of extension agents, participatory approaches, and regional challenges in promoting sustainable agriculture, there is limited empirical research examining the beliefs, perceptions, and practical engagement of extension agents in the Kurdistan Region of Iraq. Existing studies emphasize general adoption barriers and regional smallholder challenges but do not fully capture the local dynamics, professional capacities, or contextual constraints faced by extension agents in Kurdistan.

Addressing this gap is critical for understanding how extension agents can effectively bridge the knowledge-to-practice gap and promote the adoption of sustainable agricultural practices. This study, therefore, aims to provide context-specific insights into extension agents' beliefs, perceptions, and implementation practices in the Kurdistan Region, informing strategies to enhance professional development, institutional support, and field-level adoption of sustainable practices. This study is guided by the Diffusion of Innovations theory (Rogers, 2003) and the Theory of Planned Behavior (Ajzen, 1991). Diffusion of Innovations posits that adoption of new technologies depends on perceived characteristics such as relative advantage, compatibility, and complexity. Extension agents serve as intermediaries in this process, influencing farmers' adoption decisions by communicating innovations effectively. The Theory of Planned Behavior highlights that attitudes, subjective norms, and perceived behavioral control shape behavioral intentions. Extension agents with positive attitudes toward sustainable agriculture, confidence in their professional capacity, and institutional support are more likely to encourage adoption of sustainable practices among farmers. However, a recent study in North-Central Nigeria found that more than half of extension agents exhibited unfavorable attitudes toward climate-smart agricultural practices, and participation in their dissemination was moderate at best (Ojo et al., 2025). This highlights that even when agents conceptually support sustainability, practical engagement may be limited by training, experience, or structural constraints.

By integrating these theoretical perspectives with empirical evidence from global, regional, and local studies, this research emphasizes the pivotal role of extension agents in translating favorable beliefs into practical adoption of sustainable agricultural innovations in the Kurdistan Region.

METHODOLOGY

Study Area

This study was conducted in the Kurdistan Region of Iraq, located in the northern part of the country. The region includes four administrative provinces: Erbil, Duhok, Sulaymaniyah, and Garmian. Agriculture represents an important sector in the regional economy and plays a significant role in supporting rural livelihoods and local food production. Major agricultural

activities include the cultivation of cereal crops, vegetables, and fruit trees, as well as livestock production. The Kurdistan Region has experienced increasing challenges related to agricultural sustainability, including soil degradation, inefficient resource use, and the impacts of climate variability. In response, government institutions and agricultural extension services have been working to promote improved farming practices and sustainable agricultural development.

Agricultural extension services in the region are coordinated primarily through the Ministry of Agriculture and Water Resources, where extension agents provide technical guidance, training, and advisory support to farmers. These agents serve as important intermediaries between research institutions and farming communities, facilitating knowledge transfer and encouraging the adoption of improved agricultural technologies. Therefore, understanding extension agents' beliefs and perceptions toward sustainable agriculture is essential for strengthening extension programs and promoting sustainable farming practices in the Kurdistan Region of Iraq.

Population and Sampling

The study population consisted of 178 agricultural extension agents working across four provinces of the Kurdistan Region of Iraq: Duhok (n = 35), Erbil (n = 49), Sulaymaniyah (n = 82), and Garmian (n = 12). Using cluster sampling based on verified ministry lists to ensure accuracy (Krejcie & Morgan, 1970), a total of 89 extension agents participated in the study, representing approximately 50% of the target population. The sample size was considered adequate based on the sampling guidelines proposed by Krejcie and Morgan (1970), which suggest that a sample of approximately 118 respondents is sufficient for a population of 178 at a 95% confidence level. Although the final sample consisted of 89 respondents, it still represented approximately half of the total population of extension agents in the region and was considered sufficient for descriptive analysis.

A total of 89 completed questionnaires were returned out of 110 distributed surveys, resulting in a response rate of 80.9%, which is considered acceptable for survey research in agricultural extension studies.

Participants were selected using purposive criteria to ensure that respondents had relevant professional

experience. The selection criteria included employment as an agricultural extension agent for at least two years, active involvement in promoting sustainable agricultural practices, and willingness to participate in the study.

Instrumentation, Data Collection and Analysis

A descriptive survey research design was employed to examine extension agents' beliefs and perceptions regarding sustainable agriculture. Data were collected using a structured questionnaire consisting of three main sections. The first section measured the demographic characteristics of the agricultural extension agents including the age, education, and gender of respondents. The second section measured extension agents' beliefs using 24 Likert-scale items ranging from 1 (strongly disagree) to 5 (strongly agree). These items addressed economic, environmental, and social dimensions of sustainable agriculture. The third section measured respondents' perceptions of specific sustainable agricultural practices, including soil testing, organic amendments, crop rotation, integrated pest management, waste recycling, and fertilizer management.

The questionnaire was adapted from previous studies (Allahyari et al., 2008; Al-Subaiee et al., 2005; Connors et al., 2004; Chen, 2003). The instrument was translated into Kurdish and reviewed by three experts from Sulaymaniyah University to ensure clarity and content validity. A pilot test was conducted with five extension agents in Erbil to confirm the clarity and relevance of the questions. The reliability of the instrument was acceptable, with a Cronbach's alpha coefficient of 0.71.

Data were collected between June and November 2023 through mailed and emailed surveys. To assess potential nonresponse bias, early and late respondents were compared, and no significant differences were found ($Z = -0.313$, $p = .754$). The collected data were analyzed using IBM SPSS Statistics version 29. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated to summarize respondents' beliefs and perceptions. A mean score of 3.0 or higher was considered indicative of favorable perceptions toward sustainable agriculture.

Ethical Considerations

Participation in this study was voluntary. Respondents were informed about the purpose of the research and assured that their responses would remain confidential.

No personal identifying information was collected, and all data were used solely for academic research purposes.

Demographic Characteristics of Respondents

The demographic characteristics of the agricultural extension agents including the age of respondents ranged from 35 to 74 years, with a mean age of 47 years (SD = 8.85), indicating that most participants were middle-aged and experienced in their professional roles. In terms of gender distribution, the majority of respondents were male (95.7%), while female respondents represented 4.3% of the sample. This distribution reflects the male-dominated structure of agricultural extension services in the study area.

Regarding educational attainment, 35.65% of respondents held a bachelor's degree or community college diploma, 27% had completed high school, and 29.7% had an elementary level of education. Additionally, 7.65% of respondents reported having no formal education. These results indicate variation in the educational background of extension agents, which may influence their understanding and promotion of sustainable agricultural practices.

Beliefs Toward Sustainable Agriculture

Table 1 presents agricultural extension agents' beliefs regarding sustainable agriculture across economic, environmental, and social dimensions. Overall, respondents demonstrated favorable beliefs toward sustainable agriculture, with a mean score of 3.66 (SD = 0.43). The highest-rated belief statement was that sustainable agriculture conserves natural resources for the benefit of future generations (M = 4.8), indicating a strong consensus among extension agents regarding the environmental importance of sustainable agricultural practices. Similarly, respondents strongly agreed that agricultural knowledge provided through extension services contributes to the success of sustainable agriculture (M = 4.4), and that maintaining healthy soil is a key element of sustainable farming (M = 4.4).

Several other statements also received relatively high agreement, including the importance of knowledge exchange among producers (M = 4.4) and the role of recycling renewable natural resources (M = 4.4). These findings suggest that extension agents recognize the environmental and social dimensions of sustainable agriculture and view knowledge dissemination as an

important mechanism for supporting sustainable farming systems.

However, some belief statements received lower ratings. For example, the statement that sustainable agriculture requires low farm capital investment received the lowest mean score (M = 2.8), suggesting that respondents perceive sustainable practices as potentially requiring financial investment or technological resources. Similarly, the statement that sustainable agriculture values nature for its own sake received a moderate rating (M = 3.0). These results indicate that while extension agents strongly support sustainability principles, their perceptions of economic feasibility may influence their views regarding the practical implementation of sustainable farming systems.

Perceptions of Sustainable Agricultural Practices

Table 2 presents extension agents' perceptions of specific sustainable agricultural practices. The results indicate moderate support for several practices associated with soil and nutrient management. Soil testing (M = 3.5) and the use of animal manure (M = 3.5) received the highest mean scores among respondents, indicating relatively strong agreement regarding their importance in sustainable agricultural systems. Similarly, the use of green manure received moderate agreement (M = 3.1), suggesting that extension agents recognize the benefits of organic soil fertility management. Several other practices such as conservation tillage, integrated pest management, mechanical weeding, and reduced herbicide rates received neutral to moderate ratings (M ≈ 3.0). These results indicate that extension agents are generally familiar with these practices but may vary in their perceptions regarding their practical implementation. In contrast, several sustainable practices received relatively low ratings. These include recycling agricultural waste (M = 2.3), reduced fertilizer use (M = 2.3), rotational grazing (M = 2.3), and insect-resistant crops (M = 2.2). The lower perception scores for these practices may reflect technical, economic, or institutional constraints that limit their promotion or adoption. Overall, the results suggest that although extension agents hold favorable attitudes toward sustainability concepts, some specific practices are perceived as more difficult to implement within the current agricultural context of the Kurdistan Region.

Table 1. General beliefs of extension agents toward sustainable agriculture.

Sustainable agriculture belief statement	Ec/Ev/So	N	Mean	SD
Sustainable agriculture conserves natural resources for the benefit of future generations	So	89	4.8	0.4
Agricultural knowledge from extension is important for the success of sustainable agriculture	Ec	89	4.4	0.7
Development of healthy soils is important for sustainable agriculture	Ev	89	4.4	0.7
Exchange of knowledge about locally designed technologies among producers promotes sustainable agricultural practices	So	89	4.4	0.5
Sustainable agriculture promotes the recycling of renewable natural resources	Ev	89	4.4	0.7
Sustainable agriculture promotes local marketing of agricultural production	EC	89	4.1	0.7
Local knowledge of farming in a community is an indication	Ev/So	89	4.0	0.9
Sustainable agriculture promotes specialised crop and livestock enterprises	Ec	89	4.0	0.9
Local farming practices contribute to the success of sustainable agriculture	Ec	89	3.9	1.3
Sustainable agriculture reduces the need for over-reliance on external sources of inputs	Ec	89	3.9	1.0
Integrating diverse crops with livestock enterprises promotes sustainable agriculture	Ev/so	89	3.8	1.1
Sustainable agriculture practices emphasise the rural landscape	So	89	3.8	1.1
The size of a community impacts the development of sustainable agriculture	Ec	89	3.8	0.9
Innovations in agricultural technology determine the success of sustainable agriculture	Ec	89	3.7	1.0
Farm size influences farm management practices	Ec	89	3.4	1.3
Crop rotation is important to achieving sustainable agriculture	Ev	89	3.4	1.3
Sustainable agriculture increases returns to farm labour	E	89	3.4	1.0
Sustainable agriculture values nature for its own sake	So	89	3.0	1.1
Sustainable agriculture indicates low farm capital investment and technology	Ec	89	2.8	0.8

Ec = economic; Ev = environmental; So = social

1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree; n: number of respondents; SD = standard deviation

Table 2. Perceptions of agents regarding sustainable agriculture practices.

Sustainable Agriculture Practices	n	Mean	SD
Soil test	89	3.5	1.11
Use of animal manure	89	3.5	1.23
Use of green manure	89	3.1	0.93
Conservation tillage	89	3.0	1.00
Integrated pest management	89	3.0	0.87
Mechanical weeding	89	3.0	1.00
Reduced rates of herbicide	89	3.0	1.41
Reduced tillage	89	3.0	1.41
Fall-seeded cover crop	89	2.9	0.93
Crop rotation	89	2.9	1.19
Narrow strip intercropping	89	2.5	0.88
Low-input livestock facilities	89	2.5	0.73
Herbicide-resistant crops	89	2.4	0.73
Use of nitrification inhibitor	89	2.4	1.42
Nitrogen application	89	2.4	0.73
Row banding of herbicides	89	2.4	0.88
Recycling agricultural waste	89	2.3	1.66
Reduced nitrogen rates	89	2.3	1.35
Reduced use of fertilizer	89	2.3	1.32
Rotational grazing	89	2.3	1.66
Insect-resistant crops	89	2.2	0.83

Note. 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

DISCUSSION

The findings of this study indicate that extension agents generally hold positive beliefs toward sustainable agriculture and express favorable perceptions of several sustainable practices, particularly soil testing and the use of organic fertilizers such as animal manure. High mean scores were observed for practices such as soil testing and the use of animal manure, suggesting that extension agents recognize the importance of environmentally responsible farming approaches. These results indicate that extension personnel are aware of the role that sustainable agriculture can play in maintaining soil fertility, conserving natural resources, and promoting long-term agricultural productivity. Although extension agents demonstrate strong conceptual support for sustainable agriculture, the results also suggest that translating these beliefs into practice may present certain challenges. The high ratings for statements related to natural resource conservation and soil management reflect a strong awareness among extension agents of the environmental benefits associated with sustainable agricultural systems. Similar findings have been reported in earlier studies emphasizing the critical role of extension professionals in promoting environmental stewardship and sustainable land management (Pretty and Hine, 2001; Chizari et al., 1999).

Despite this general awareness, the results reveal comparatively lower perceptions regarding the implementation of several specific sustainable practices. Practices such as recycling agricultural waste, reducing fertilizer use, and rotational grazing received relatively lower ratings among respondents. These findings suggest the existence of a knowledge-to-practice gap, in which extension agents may support the principles of sustainability but encounter difficulties when promoting certain practices at the farm level. Previous research has similarly indicated that limited technical training, inadequate institutional support, and resource constraints can hinder the effective promotion and adoption of sustainable agricultural innovations (Al-Subaiee et al., 2005; Tiraieyari et al., 2013). Recent research also supports this finding. For example, Ojo et al. (2025) reported that many extension agents in Nigeria exhibited unfavorable attitudes toward climate-smart agricultural practices and only moderate participation in promoting these practices, largely due to limited training and institutional support.

The findings of this study can also be interpreted through the perspective of the Diffusion of Innovations theory proposed by Rogers (2003). According to this framework, innovations that are perceived as having greater relative

advantage, compatibility with existing practices, and ease of implementation are more likely to be adopted. In the present study, practices such as soil testing and the use of animal manure received higher perception scores, possibly because they are relatively familiar and easier to integrate within existing farming systems in the region. In contrast, practices such as agricultural waste recycling or rotational grazing may require additional infrastructure, technical knowledge, or changes in farm management practices, which could limit their perceived feasibility and adoption.

Furthermore, the results align with the principles of the Theory of Planned Behavior developed by Ajzen (1991), which suggests that behavior is influenced by attitudes, subjective norms, and perceived behavioral control. While extension agents may possess positive attitudes toward sustainable agriculture, their ability to actively promote these practices may depend on the level of institutional support, access to training, and availability of technical resources. Consistent with this perspective, previous studies have shown that positive attitudes among extension personnel do not always translate into widespread adoption among farmers when structural constraints or limited capacity exist (Taylor and Bhasme, 2018; Rizzo et al., 2024).

Overall, the findings highlight the importance of strengthening the professional capacity of extension agents to effectively promote sustainable agricultural practices. Targeted training programs in areas such as nutrient management, agricultural waste recycling, integrated pest management, and sustainable livestock management could enhance the ability of extension personnel to support farmers in adopting environmentally sound practices. In addition, stronger collaboration between research institutions, extension services, and agricultural policymakers may help improve knowledge transfer and facilitate the practical implementation of sustainable agriculture initiatives. Strengthening these institutional and technical capacities will be essential for improving the effectiveness of agricultural extension systems and supporting the transition toward more sustainable agricultural development in the Kurdistan Region. These findings are important in the Kurdistan Region of Iraq, where extension services remain a primary mechanism for transferring agricultural knowledge to farmers.

CONCLUSIONS

This study examined the beliefs and perceptions of agricultural extension agents toward sustainable

agricultural practices in the Kurdistan Region of Iraq. The perspectives of extension professionals are essential because they serve as key intermediaries between research institutions and farmers, facilitating the dissemination of agricultural innovations and promoting environmentally responsible farming practices. The findings revealed that extension agents generally hold positive beliefs regarding sustainable agriculture, particularly in relation to soil conservation and the use of environmentally friendly farming practices such as soil testing and the application of animal manure. However, the results also indicated lower perceptions regarding the implementation of certain practices, including agricultural waste recycling, reduced fertilizer use, and rotational grazing. These findings suggest that while extension agents recognize the importance of sustainability, several technical, institutional, and resource-related factors may limit the practical promotion of some sustainable agricultural practices. The results highlight the need for strengthening the capacity of agricultural extension systems in the Kurdistan Region. Providing targeted training programs, improving institutional support, and enhancing collaboration between research institutions and extension services could help bridge the gap between knowledge and practice. Strengthening these efforts will contribute to improving the effectiveness of extension services and supporting the long-term sustainability of agricultural development in the region.

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