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Application of Complexity Theory and Agricultural Innovation System Approaches to Evaluate Performance of the New Agricultural Extension System: The Case of Iran

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ABSTRACT

A well-designed Agricultural Extension System (AES) can facilitate transitions towards sustainable agriculture. However, in most developing countries, AES has failed to promote sustainable agricultural development. The New Agricultural Extension System (NAES) was initiated to facilitate agricultural development in Iran. However, there is still no definite reflection on the influences of NAES on agricultural development. Therefore, this research aimed to evaluate the performance of NAES. To ensure an integrative and holistic analysis of the NAES's performance, the Complexity Theory (CT) and Agricultural Innovation System (AIS) approaches were used. To gather data, survey research was conducted in Fars Province, southern Iran. A multi-stage random sampling was used to identify the designated extension agents. The findings indicated that effective implementation of the NAES needs facilitated interaction through network mediation ($\bar{X}$= 71.6), creation of an enabling context for the delivery of extension services ($\bar{X}$= 66.6), improved communication and marketing infrastructures ($\bar{X}$= 72), development of a value chain ($\bar{X}$= 71.4), acceptance of self-organization ($\bar{X}$= 67.8) and adoption of complexity-aware management ($\bar{X}$= 66). The results also identified the hindering effects of demographic, structural and psychological factors on the practical application of CT and AIS principles. Some recommendations and implications are offered to improve the effectiveness of NAES.

Keywords: Agricultural development, Capacity building, Complex adaptive system, Extension agents, Fars province.

INTRODUCTION

Sustainable agricultural development seeks to provide life-supporting nutritious food for an affluent and urbanized population, in a way that builds and improves the capacity of the underlying support systems (Gabel, 2015). It also pursues ways to make farming practices more compatible with climatic stressors, formulate policies and strategies that help solve complex issues, promote linkages across sectors to deal with complex challenges, and improve farmers' access to advanced technologies (Berthet *et al*., 2016). Moreover, it attempts to provide adequate knowledge and information to enhance agricultural productivity, while improving the quality of natural resources (Olorunfemi *et al*., 2020). This agricultural system seeks to afford the spaces that allow relevant actors to co-innovate and co-develop the knowledge, practices and technologies that can increase the agricultural productivity of

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small-scale farms (Pigford *et al*., 2018; Turner *et al*., 2016; Zarei *et al*., 2020). Transitioning to sustainable agriculture is often not easy. However, the agricultural innovation system (AIS) is a promising tool to support the transformation of the agricultural sector (Klerkx *et al*., 2010).

The AIS approach rejects the simplistic linear model of technological knowledge transfer. It diagnoses innovation as the consequence of a co-evolutionary and interactive process (Smits and Kuhlmann, 2004), in which a vast network of relevant actors is engaged. AIS considers the functionality of the whole agricultural system as a unified entity (Lamprinopoulou *et al*., 2014). It combines technological, economic, social and institutional changes (Klerkx *et al*., 2010). AIS is recognized as a Complex Adaptive System (CAS). As a social system, CAS comprises multiple interactive, interconnected and interdependent sub-components that are distinguished by their non-linear, diverse, emergent and co-evolving dynamics (Waddock *et al*., 2015). CAS does not lend itself to control because of its unpredictable nature (Arkesteijn *et al*., 2015). However, complexity-aware interventions in AIS can enhance the relevant actors' skills in systematic experimentation (Douthwaite and Hoffecker, 2017), improve the functioning of agricultural institutions (Hounkonnou *et al*., 2016), and serve as a route for the development of sustainable strategies and modern technologies in addition to implementing the existing co-developed knowledge and technologies into local contexts.

Well-designed and well-functioning Agricultural Extension Systems (AESs) may foster the interactions needed to solve complex challenges and facilitate transitions towards sustainable agricultural systems. However, in most developing countries, AES is facing several challenges, such as unprofessional design of advisory programs, inappropriate service delivery systems, a disproportionate ratio of extension workers to farmers, an insufficient budget, and a lack of end-user participation in the planning process of extension programs (Alimirzaei *et al*., 2019; Anang *et al*., 2020; Ashraf *et al*., 2021; Davis *et al*., 2020; Emmanuel *et al*., 2016; Rezaei-Moghaddam and Karami, 2008; Zare *et al*., 2020). To promote the relevance and effectiveness of AES, Iran's government has introduced the New Agricultural Extension System (NAES). NAES was initially executed in 12 provinces, including Fars Province, and was then implemented in the whole country. The main principles of the NAES are: addressing the needs of all smallholder and progressive farmers, giving more power to local AESs and concentrating on region-specific program planning, providing demand-driven advisory services to enhance agricultural productivity, re-organizing the AES centers, enhancing the capacity to co-develop and co-manage knowledge, and promoting the knowledge and skills of extension workers (Ranaei Kordshouli and Mortazavi, 2016).

Few studies have been conducted on the issue of evaluating the effectiveness and success of the NAES in Iran (e.g., Alizadeh *et al*., 2018; Ansari, 2017; Jafari *et al*., 2021; Rezaei-Moghaddam and Fatemi, 2019). Furthermore, most studies have dealt with the deficiencies of NAES planning and implementation using extrinsic values, while less information is available about the intrinsic reality of the NAES at the operational level. Moreover, almost all the field studies have investigated the general attitude of experts using qualitative research methods, or SWOT (strengths, weaknesses, opportunities, and threats) analysis and there is no widely agreed framework for investigating the effectiveness of NAES. Also, routine assessments (i.e., investigating the economic impacts of NAES) provide little guidance on how to increase the efficiency of NAES. It seems that the Complexity Theory (CT) and AIS approaches offer some criteria. However, to the best of our knowledge, the CT and AIS approaches have never been applied for evaluating the NAES performance. As a result, this study considers the tenets of the

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CT and AIS approaches and conceptualizes NAES as a CAS. Therefore, the performance of NAES (the NAES offers technical advice to farmers, facilitates innovations and communications, and supplies necessary services to promote agricultural productivity, food security, and rural development) can be affected by how the complex agricultural systems are structurally constituted according to the existence of a dynamic collection of performers, their communications across different levels, the organizations that affect their behavior, and the presence of knowledge, financial and physical incentives and infrastructure in the AIS aimed to support extension and advisory services. However, empirical evidence on the benefits and contributions of these tenets in furthering the process of AES reformation has remained limited. In particular, the current trends and shifts in agricultural research and development processes (such as demand-driven and interactive research), policy reforms (sharing of costs, privatization, decentralization, market liberalization and others) and the agricultural context are facing enormous challenges. Agricultural research and development processes, therefore, need a relatively new paradigm that incorporates these reforms. Therefore, this paper aims to: (1) Assess the NAES's performance using the principles of the CT and AIS approaches; and (2) Determine the factors influencing the application of the CT and AIS principles.

Agricultural Innovation System and Complexity Theory: The Conceptual Framework for Analyzing the NAES Performance

AIS is a holistic, trans disciplinary and systemic approach to determining the complexity of emerging technological, institutional and social innovations (Turner *et al*., 2016). AIS can be described as "a network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into economic use, together with the institutions and policies that affect the way different agents interact, share, access, exchange and use knowledge" (Hall *et al*., 2006). AIS de-centers research as a primary source of innovation and involves networks of heterogeneous actors like farmers, researchers, input providers, dealers, extension agents and government officers in the co-production of technological innovations (Maru, 2018). AIS also emphasizes the necessity of institutional changes in transforming some rules, norms and policies to ensure equitable distribution of technologies or opportunities within local contexts (Klerkx *et al*., 2010; Maru, 2018). Adopting an AIS approach to investigate agricultural problems needs recognition of its relevant tenets (Figure 1). AIS requires acknowledgment and integration of several elements, levels and actors' interests regarding agricultural problems (Schut *et al*., 2015). Also, it calls for holistic recognition of the innovation capacity of the agricultural system to continuously define and prioritize opportunities and constraints for innovation in the context of a complex system (Leeuwis *et al*., 2014). Moreover, AIS needs an understanding of the institutional and structural conditions that can enable or impede innovation in the agricultural system (Klerkx *et al*., 2012).

AIS can be considered a CAS due to the interactions involved in the network of heterogeneous actors regarding various aspects of innovation (Spielman *et al*., 2009, Figure 1). CAS is defined as a self-organizing system comprised of multiple interacting actors and processes (Gare, 2000). The interaction of the elements in a CAS provides some emergent characteristics that cannot be comprehended by investigating the individual elements of the system (Goldstein, 1999). Moreover, CAS is in a steady flux (Chae, 2014) and may vary with time, geographic and social contexts (Walton, 2014). Adopting the CAS theory to study agricultural systems requires the identification of its relevant aspects

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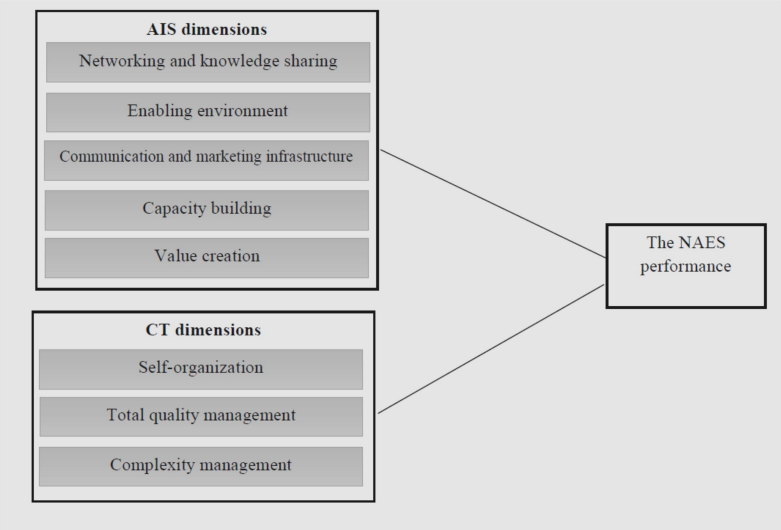

Figure 1. Conceptual framework for evaluating the NAES performance.

(Trenholm and Ferlie, 2013). CAS comprises diverse elements or agents such as policies, resources, and activities, which are adaptive for a better fit (Siggelkow, 2002). These adaptive elements non-linearly interact with each other based on their capacity to respond and local cues or rules of behavior (Stacey, 2003). Moreover, the environment that a given self-organization system faces is distinguished as a transitionary and rugged landscape with many successes and failures (Cooper, 2008). Co-evolution is crucial for CAS to envisage the continuous changes in the rugged landscape (Chae, 2014).

MATERIALS AND METHODS

Research Setting

The study was conducted in the Fars Province, in southern Iran. In 2015, a pilot NAES was launched to better respond to the problems and concerns of Fars subsistence and commercial farm families. To ensure equity and integrity, a provincial committee comprised of managers, deputies, and specialists from the Fars Agricultural Jihad Organization was established. At the first stage, the area was divided into 600 zones based on several criteria, such as climatic conditions, natural or geographical boundaries, and cultivation area. To address the significant effect of the NAES on raising the efficiency and effectiveness of extension and advisory services, the committee members decided to implement the NAES first in the smaller areas. However, the NAES was later expanded to cover the entire zones. Accordingly, 95 zones supported by 14 Extension Service Centers were selected as the pilot area (Figure 2). Moreover, some extension agents were randomly chosen from the province, township, and sub-county extension offices to contribute to the pilot NAES project. These designated agents were responsible for supplying door-to-door and inclusive services to farm families in the specified zones (village or villages). Each designated agent had to determine an appropriate plan of action for meeting the identified needs and provide various agricultural and rural advisory services any time the farmers called.

Sampling and Survey Instrument

To evaluate the NAES's performance and its corresponding drivers, survey research was conducted. The extension professionals (i.e., the designated agents) were the target population (N= 95). A multi-stage random

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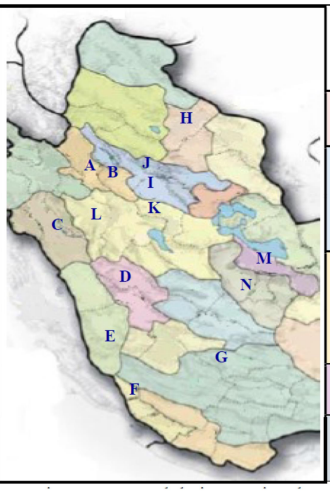
County	Service Center	No. of zones/ Agents
Sepidan	Homaijan (A)	7
	Beiza (B)	6
Kazeroon	Hoomeh (C)	6
Firoozabad	Hoomeh (D)	13
Farashband	Dehram (E)	2
Mohr	Asir (F)	2
Larestan	Juyom (G)	4



County	Service Center	No. of zones/ Agents
Safa Shahr	Ghader Abad (H)	6
Marvdasht	Hoomeh (I)	15
	Naghsh Rostam (J)	10
Shiraz	Zarghan (K)	10
	Siakh Darengoon (L)	4
Estahban	Eij (M)	4
Fasa	Shibkooh (N)	6

Figure 2. Location of the service centers and their associated number of NAES zones.

sampling was used to identify the designated agents (n= 65). With this respect, a proportional sample of extension service centers (i.e., 50%) was randomly selected. The randomly selected extension service centers were *Naghsh Rostam*, *Hoomeh Marvdasht*, *Ghader Abad*, *Homaijan*, *Zarghan*, *Siakh Darengoon*, and *Hoomeh Firoozabad*. Then, all designated agents of the selected extension service centers were targeted for participation.

The data was collected through a questionnaire. A literature review was conducted to address the variables that are explained in Table 1. A panel of experts at Shiraz University confirmed the face validity of the questionnaire. A pilot study was performed in four non-pilot service centers in Fars Province (i.e., Darioun, Seyedan, Ramjerd, and Hoomeh Shiraz) to evaluate the reliability of the instrument (Table 1). Cronbach's alpha coefficients for study variables ranged from 0.76 to 0.91 (Table 1), higher than the acceptable value of 0.7 (Taber, 2018).

Data Analysis

To investigate the research aims, initially the data was evaluated for normal distribution and potential outliers. Since the CT and AIS indicators had different scales, they were standardized into a uniform 0-100 scale. Next, a paired sample T-test was applied to compare the importance of CT and AIS principles and the performance of NAES in adhering to such principles. After that, stepwise regression was applied to determine factors affecting the adoption of the CT and AIS principles in Fars Province. For these purposes, SPSS version 22 was used.

RESULTS AND DISCUSSION

Evaluating NAES Performance Using the CT and AIS Principles

The AIS Dimensions

Because of growing criticism of linear technology transfer, extension agents believed that the NAES required new collaborative methods for knowledge co-generation, networking, and sharing ($\bar{X}$= 71.57; Table 2). Such a process needs the fluid engagement of many stakeholders and the formation of new connections. However, the performance of the NAES was relatively modest in acknowledging the partnership of multiple stakeholders, linking different parts

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Table 1. Study variables.

Variable			Explanation	Cronbach's Alpha coefficient
The NAES performance	AIS dimensions[a]	Networking and knowledge sharing	Improved networking, linking and knowledge sharing among relevant NAES actors; 10 ordinal items ranging from 1 (very low) to 5 (very high)	0.83
		Enabling environment	Enhanced technological, institutional, policy, financial and entrepreneurial support to NAES; 9 ordinal items ranging from 1 (very low) to 5 (very high)	0.76
		Communication and marketing infrastructure	Enhanced information and communication, processing, transport, market, storage and financial infrastructure available to NAES; 4 ordinal items ranging from 1 (very low) to 5 (very high)	0.85
		Capacity building	Improved capacity of the NAES stakeholders at individual, organizational and inter-organizational levels to increase adoption of the co-developed and co-innovated knowledge and technologies, and enhance the culture and governance of innovation; 9 ordinal items ranging from 1 (very low) to 5 (very high)	0.79
		Value creation	Increased market access and opportunities, developed value chain, enhanced income growth, improved use of natural resource and ecosystem performance; 9 ordinal items ranging from 1 (very low) to 5 (very high)	0.83
	CT dimensions	Self-organization	The process by which relevant agents in NAES interact on the basis of their own local rules of behavior without any overall blueprint (Stacey, 1996); 4 ordinal items ranging from 1 (very low) to 5 (very high)	0.84
		Total quality management	Organization-wide efforts to make climate in which all extension agents continuously increase their ability to improve processes, provide advisory services and reinforce culture of innovation; 10 ordinal items ranging from 1 (very low) to 5 (very high)	0.89
		Complexity management	Devising and implementing nontraditional solutions, methods and methodologies to cope with the problems arising from complexity of human-technology and human-natural system interactions; 13 ordinal items ranging from 1 (very low) to 5 (very high)	0.91
	Satisfaction		The measure of extension workers' pleasurable emotional state regarding their job; 8 ordinal items ranging from 1 (very low) to 5 (very high)	0.81
	Age		The age of the extension agent	-
	Gender		The gender of the extension agent; 2 nominal items including 1 (male) and 2 (female)	-
	Extension coverage		Number of farmers covered by the agricultural extension programs and services of each responsible agent	-
	Zone area		Total zone area the extension agent is responsible for	-

[a] To evaluate the NAES, the dimensions of AIS performance proposed by Daane *et al*. (2009) were adopted.

of the agricultural systems, and sharing composite and multi-faceted knowledge ($\bar{X}$= 42.46; Table 2), which is similar to the findings of Afrad *et al*. (2019). Since networking and the sharing of knowledge are the main panaceas for agricultural development, the government should implement policies that facilitate the broader participation of multiple stakeholders and the formation of new networking and development consortia.

[DOI: 10.22034/JAST.26.1.13]

Table 2. The NAES performance based on the CT and AIS indicators.

Dimensions	Importance[a]		Performance[a]		T	Sig.
	Mean	SD	Mean	SD		
Networking and knowledge sharing	71.57	17.33	42.46	18.47	8.78	0.0001
Enabling environment	66.57	22.50	36.19	19.35	7.67	0.0001
Communication and marketing infrastructure	72.01	18.39	51.82	21.10	6.32	0.0001
Capacity building	69.14	18.98	39.57	17.43	9.55	0.0001
Value creation	71.36	21.28	37.00	22.46	9.21	0.0001
Self-organization	67.78	21.82	37.30	21.28	8.50	0.0001
Total quality management	75.26	16.93	39.95	21.68	9.75	0.0001
Complexity management	65.95	18.94	35.69	16.48	8.67	0.0001

[a] The mean value ranged from 0 to 100.

Also, the designated agents perceived that the appropriate performance of the NAES relies heavily on a set of enabling conditions that promote the emergence of advanced extension services ($\bar{X}$= 66.57; Table 2). They confirmed the necessity of creating an enabling environment for the NAES by providing a flexible institutional setting, initiating joint investment of public and private funds, promoting human resources, and strengthening the innovative abilities of the research centers and professionals. However, Fars province relatively failed in setting an enabling environment ($\bar{X}$= 36.19; Table 2). A similar problem has been reported for Cambodia (Suvedi *et al*., 2018), Pakistan (Baloch and Thapa, 2019) and Vietnam (Minh, 2019). Therefore, the government should create an enabling environment for the fluid participation of stakeholders in research and extension.

The extension agents deemed that communication and marketing infrastructures play a significant role in shaping the processes that are critical for the NAES ($\bar{X}$= 72.01; Table 2). They asserted that the NAES has the potential to increase the capacity of farmers for co-innovation and co-development by providing adequate access to knowledge and information. Also, the development of agriculture was perceived as dependent on the availability of processing, transportation, marketing, storage, and financial infrastructure. Benefiting from various media (e.g., audio-visual, broadcast, electronic, mass, news, print and social networks), adequate access to useful information was provided. However, not all farmers had enough access to marketing infrastructure ($\bar{X}$= 51.82; Table 2), which is consistent with the findings of Babu *et al*. (2019). Therefore, it is essential for government and administrators to revisit institutional contexts, facilitate the co-management and co-development of knowledge, initiate new trends for agricultural and market development, and strengthen financial infrastructures. Furthermore, the respondents believed that the capacity building of the related stakeholders was highly required at all levels to increase the efficiency of NAES ($\bar{X}$= 69.14; Table 2). Based on their declaration, better results at local, regional, and national levels can be expected when the NAES is able to do the followings:

- Increase the participation of the relevant actors in addressing priorities and planning the NAES strategies;
- Promote collaboration between the public and private sectors to develop participatory innovations, connect the extension agents with the research centers, NGOs, and private entrepreneurs, and provide opportunities to facilitate communication and share the relevant knowledge;

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- Increase adaptation to the complex challenges facing agricultural development and,
- Enhance the sensitivity of agricultural organizations to stakeholder demands in an era of rapid change.

While the NAES's performance in capacity building for relevant actors was relatively moderate ($\bar{X}$= 39.57; Table 2), this is consistent with the findings of Afrad *et al*. (2019) and Baloch and Thapa (2019). In this respect, the farmers' decisions did not significantly affect the NAES's priorities and strategies, and most practices were decided and planned at the provincial level. Moreover, the collaboration of relevant actors was still limited due to the deficiency of intermediary actors.

Also, the designated agents claimed that value creation was highly influential in improving the NAES's performance ($\bar{X}$= 71.36; Table 2). They believed that value creation might include the promotion of new agricultural products, the introduction of new ways of marketing, the identification of new market opportunities, development of new ways for the provision of advisory services, renovation of destructed ecosystems, conservation of biodiversity, alleviation of poverty, and raising farm income. However, the NAES performance was relatively weak in the creation of added value ($\bar{X}$= 37.0; Table 2) as it did not manage to support economically sound and ecofriendly products, and it showed low accountability in developing remunerative markets, in accordance with the findings of Singh and Burman (2019).

The CT Dimensions

The extension agents perceived that self-organization was highly imperative for the effective performance of the NAES ($\bar{X}$= 67.78; Table 2). They also revealed that the NAES should increase adaptation to external shocks as the current environment is dynamic. Dealing with external shocks may pose a lower difficulty if the NAES is organized by flexible and uncomplicated rules, and if it creates vertical or hierarchical communication and coordination for the fast configuration of new patterns. However, the NAES was relatively unable to set itself up as a self-organizing institute ($\bar{X}$= 37.30; Table 2), which is also noted by Klerkx *et al*. (2012). To achieve the NAES's goals, implementing supporting policies that will increase the flexibility of agricultural extension systems and facilitate communication and coordination between the different levels are required. The NAES was perceived as a scheme of the Ministry of Agriculture, and the extension workers discerned limited authority to adjust the environment in ways matching the NAES's goals. Moreover, the designated agents believed that total quality management could make a boundless contribution to the achievement of the NAES's goals ($\bar{X}$=75.26; Table 2). They asserted that the effectiveness of NAES can be improved by raising the organizational culture, enhancing commitment to the NAES, and providing continuous planning, monitoring, analyzing, and evaluating the NAES's programs. However, the NAES did not easily lend itself to total quality management due to institutional and financial constraints ($\bar{X}$= 39.95; Table 2). To enhance the commitment of the NAES and promote continuous monitoring and evaluation of this system, demand-driven approaches should be adopted. These approaches mobilize the continuous engagement of the relevant actors in extension planning and practices, and also provide opportunities to improve the system.

The extension agents believed that complexity management was highly required for the effective implementation of the NAES ($\bar{X}$= 65.95; Table 2). They emphasized that promoting knowledge management and institutional learning, enhancing stakeholder involvement in managing the NAES, improving public-

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private partnerships, restructuring agricultural extension centers, introducing unique standards for operational procedures, and dividing the NAES into different subsystems could increase its efficiency. However, the NAES acted relatively poor in managing the complexity ($\bar{X}$= 35.69; Table 2).

Factors Influencing Adoption of the CT and AIS Approaches

The results indicated that the determined variables explained 62.8% of the total variance in adopting the CT and AIS principles (Table 3). The standardized regression coefficients revealed that age was the most important predictor of CT and AIS thinking adaptation (Table 3). The older extension agents insisted more on implementing the new complexity-innovation-based agricultural extension system, in conflict with the findings of Kamara *et al*. (2019). It seems that the lessons that emerged from their past experiences (i.e., the successes and failures of the conventional extension system) motivated the older agents to adopt the CT and AIS approaches. Also, the findings illustrated that gender played an important role in adopting the CT and AIS principles (Table 3). Male extension agents showed a greater tendency to adopt the CT and AIS principles compared to their female counterparts.

Moreover, the zone area had a significant effect on the adoption of the CT and AIS approaches (Table 3). The CT and AIS principles were more widely adopted by extension agents, whose responsibilities covered a larger geographical area. These designated agents acknowledged the importance of stakeholder participation, communication, and networking in the implementation of the NAES activities. They perceived that successful delivery of extension services is mainly dependent on the engagement of different relevant actors (e.g., the lead farmers) in the process. Also, satisfaction has an important influence on the application of CT and AIS principles, in line with the findings of Dehghanpour *et al*. (2022). This implies that the effectiveness of the CT-AIS- based NAES relies closely on the interest and time dedicated to it, and it denotes that the dissatisfied extension agents were inclined to have a lower adoption rate. Furthermore, the findings revealed that extension coverage played a significant role in applying the CT and AIS principles (Table 3), consistent with the findings of Anang *et al*. (2020) and Brown *et al*. (2018). It means that extension agents who were interacting with a large number of farmers expressed less desire to apply the CT and AIS principles.

CONCLUSIONS

The findings proved that the CT and AIS approaches are useful tools for enabling systemic, multi-level evaluation of reformed extension systems. Government and policy makers could therefore encourage and

Table 3. Determinants of the application of the CT and AIS principles.

Variable	Unstandardized coefficients	Standardized coefficients	t	Sig
Constant	-292.813	-	-2.811	0.008
Age	13.289	0.756	5.940	0.0001
Gender	92.980	0.479	3.872	0.0001
Satisfaction	1.617	0.300	2.175	0.037
Extension coverage	-0.215	-0.288	-2.622	0.013
Zone area	0.0005	0.346	3.016	0.005
R= 0.792 R^2= 0.628	Adjusted R^2= 0.582	F= 13.901	Sig= 0.0001	

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support intensive research in sectors, sub-sectors, or commodities of interest, using these analytical frameworks to understand the strengths, weaknesses, policy and programming alternatives. The AIS approach indicated that facilitation of the relevant stakeholders' interaction through network mediation, the creation of enabling context, developing communication and marketing infrastructure, value creation, and capacity building can significantly affect NAES performance and outcomes. Also, the CT approach indicated that accepting self-organization, total quality management, and adopting complexity-aware management have significant influence on the successful performance of NAES. Moreover, regression analysis indicated that demographic (i.e., age and gender), structural (i.e., zone area and extension coverage), and psychological (i.e., satisfaction) factors had affected the adoption of the CT and AIS approaches. Therefore, particular attention should be paid to these drivers to prevent their negative effects on applying the CT and AIS approaches among extension agents. Increasing the number of extension agents, re-organizing zone areas, training the young designated agents, hiring well-qualified extension functionaries, and providing appropriate recognition and financial and non-financial incentives are helpful for the designated agents to adhere to the principles of CT and AIS thinking.

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کاربرد نظریه پیچیدگی و رویکردهای نظام نوآوری کشاورزی برای ارزیابی عملکرد نظام نوین ترویج کشاورزی: مورد ایران

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چکیده

نظام ترویج کشاورزی به خوبی طراحی شده (AES) می‌تواند گذار به کشاورزی پایدار را تسهیل نماید. با این حال، در اکثر کشورهای در حال توسعه، AES در زمینه‌سازی توسعه پایدار کشاورزی شکست خورده است. براي تسهیل روند توسعه کشاورزی در ایران، نظام نوین ترویج کشاورزی (NAES) شکل گرفت. با این حال، هنوز بازتابی قطعی در مورد اثرات NAES بر توسعه کشاورزی وجود ندارد. بنابراین، این پژوهش با هدف ارزیابی عملکرد NAES انجام شد. برای اطمینان از انجام تحلیلی یکپارچه و کل‌نگر در زمینه عملکرد NAES، از رویکردهای نظریه پیچیدگی (CT) و نظام نوآوری کشاورزی (AIS) استفاده گردید. به‌منظور گردآوری داده‌ها، نسبت به انجام پژوهش پیمایشی در استان فارس؛ جنوب ایران اقدام شد. عاملین ترویجي مشارکت کننده در طرح نظام نوین ترویج نیز از طریق روش نمونه‌گیری تصادفی چندمرحله‌ای انتخاب شدند. یافته‌ها نشان داد که اجرای اثربخش NAES مستلزم تسهیل تعامل از طریق ایجاد شبکه ($\bar{x}$ = ۷۱.۶)، ایجاد بستری مناسب برای ارائه خدمات ترویجی ($\bar{x}$ = ۶۶.۶)، بهبود زیرساخت‌های ارتباطی و بازاریابی ($\bar{x}$ = ۷۲)، توسعه زنجیره ارزش ($\bar{x}$ = ۷۱.۴)، خودسازماندهی ($\bar{x}$ = ۶۷.۸) و مدیریت نظام‌های پیچیده ($\bar{x}$ = ۶۶) است. همچنین نتایج نشانگر اثرات بازدارنده عوامل جمعیت‌شناختی، ساختاری و روانی بر کاربرد عملی اصول CT و AIS بود. برای بهبود اثربخشی NAES برخی توصیه‌ها ارائه شده است.

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