RUCH PRAWNICZY, EKONOMICZNY I SOCJOLOGICZNY
Rok LXXXVII – zeszyt 3 – 2025
https://doi.org/10.14746/rpeis.2025.87.3.15

DAN LI,[a] CAIYAO WU,[b] HAOQI SONG,[c] RAFAŁ BLICHARZ[d]

NUDGE IN THE SCIENCE AND TECHNOLOGY POLICIES OF CHINA: THE EXPERIENCE OF SCIENCE AND TECHNOLOGY COMMISSIONERS SYSTEM IN SHENYANG

NUDGE W POLITYCE NAUKOWEJ I TECHNOLOGICZNEJ CHIN: DOŚWIADCZENIA Z SYSTEMEM KOMISARZY DS. NAUKI I TECHNOLOGII W SHENYANG

The Science and Technology Commissioners System (STCS) is an important measure implemented in China to address the bottleneck in rural talent and the underdevelopment of science and technology. This article explores the implementation of the system in rural areas of China, focusing on the behavioural economic perspective of cognitive and behavioural biases in different participants' decision-making. Shenyang, as a representative base of agricultural production in China, has taken multiple measures to facilitate the implementation of the system. Field interviews revealed that the core challenges in implementing the STCS stem from cognitive biases and from inadequate promotion of behavioural change. These factors contribute to policy rigidity, mismatched service supply and demand, low farmer acceptance, and ineffective supervision and evaluation. Under the framework of *nudge theory*, this study provides an extensive comparative analysis of international systems, and proposes establishing a 'Shenyang Science and Technology Commissioners Service Cloud Platform' and setting up a 'comprehensive, multi-stakeholder and dynamic' performance evaluation model.

Keywords: nudge theory; Science and Technology Commissioner System; policy implementation
JEL: D91, O38, Q16

System Komisarzy ds. Nauki i Technologii (STCS) jest ważnym środkiem wdrożonym w Chinach w celu rozwiązania problemu niedoboru wykwalifikowanych kadr na obszarach wiejskich

[a] Northeastern University, Shenyang, China / Uniwersytet Północno-Wschodni, Shenyang, Chiny
lidanneu@mail.neu.edu.cn, https://orcid.org/0009-0001-0119-6928

[b] Northeastern University, Shenyang, China / Uniwersytet Północno-Wschodni, Shenyang, Chiny
2400066@stu.neu.edu.cn, https://orcid.org/0009-0004-4062-7841

[c] Dalian University of Technology, Dalian, China / Uniwersytet Politechnika Daliańska, Dalian, Chiny
haoqisong@mail.dlut.edu.cn, https://orcid.org/0009-0007-4882-8105

[d] University of Silesia in Katowice, Poland / Uniwersytet Śląski w Katowicach, Polska
rafbli@wp.pl, https://orcid.org/0000-0002-3826-519X

RPEiS 87(3), 2025: 257–276. © WPiA UAM, 2025. ISSN (Online) 2543-9170 ISSN (Print) 0035-9629

oraz niedostatecznego rozwoju nauki i technologii. Artykuł bada wdrożenie systemu na obszarach wiejskich Chin, koncentrując się na behawioralnej perspektywie ekonomicznej dotyczącej uprzedzeń poznawczych i behawioralnych w podejmowaniu decyzji przez różnych uczestników. Prowincja Shenyang, jako reprezentatywna baza produkcji rolnej w Chinach, podjęła wiele działań w celu ułatwienia wdrożenia systemu. Wywiady w terenie wykazały, że główne wyzwania związane z wdrożeniem STCS wynikają z uprzedzeń poznawczych i niewystarczającej promocji zmian zachowań. Czynniki te przyczyniają się do sztywności polityki, niezgodności popytu i podaży usług, niskiej akceptacji rolników oraz nieskutecznego nadzoru i oceny. Wykorzystując teorię *nudge*, badanie to zapewnia szeroką analizę porównawczą systemów międzynarodowych i proponuje stworzenie „Platformy chmurowej usług komisarzy nauki i technologii Shenyang" oraz „kompleksowego, wieloosobowego i dynamicznego" modelu oceny wydajności.

Słowa kluczowe: teoria nudge; system komisarzy nauki i technologii; wdrożenie polityki
JEL: D91, O38, Q16

I. INTRODUCTION

The initiative of sending technical personnel to rural areas to promote scientific and technological development is gaining ground globally. For example, in the United States, land-grant universities have played a central role in developing and delivering scientific and technological services, particularly through research on new techniques and the provision of training (Ringling & Marquart, 2020). Research indicates that offering farmers financial and technical assistance addresses challenges in agricultural production, facilitates the transfer of agricultural technology, and accelerates the flow of resources, thereby enhancing overall agricultural productivity and innovation (Norton & Alwang, 2020; Takahashi et al., 2020).

In China, the Science and Technology Commissioners System (STCS) was established to address the shortage of scientific and technological capacity at the rural grassroots level (Cai, 2020). The system was first launched in Nanping City, Fujian Province, in 1999, and has since gone through four development stages: initial pilot, national promotion, international promotion, and the establishment of a national system (Zhu & Jin, 2023). Today it represents an essential institutional arrangement at the national level, aimed at promoting the balanced allocation of urban and rural elements, and addressing the shortcomings of rural talents (Li & Wang, 2024). In the current period, there is a need for theoretical discussion on how to implement the system at a higher level and on a broader scale in order to guide science and technology commissioners to serve rural grassroots communities better.

Shenyang City, Liaoning Province, as one of China's key agricultural production bases, places great importance on the implementation of the STCS. To date, an investment of over 40 million yuan has been used to train and support 246,000 farmers, yielding significant results in boosting local industries and increasing farmers' incomes. However, some difficulties in implementing the system in Shenyang still exist. Results show that differences in cognition and behaviour among government departments, science and technology commissioners, and farmers complicate coordination in policy implementation and pose a major challenge to the effectiveness of these implementations.

Using nudging in China has potential institutional advantages, since the groups subject to such policies tend to support it as a form of decentralization and welfare promotion (Huang & Liu, 2020). The most significant contribution of this study lies in introducing nudge theory from behavioural economics and constructing an analytical framework for the implementation of the STCS in Shenyang. The practical difficulties in Shenyang were identified through field interviews, and the obstacles to system implementation, along with their root causes, were analysed. Drawing on a comparative analysis of international systems, this study proposes interventions to improve the decision-making processes at different levels of implementation, ensuring more effective system operation.

II. LITERATURE REVIEW

The Science and Technology Commissioners System (STCS) represents a strategic effort by the Chinese government. Several scholars have explored the connotations and characteristics of the STCS, focusing on its role in the promotion of agricultural science and technology. The system was originally defined as the government's use of unique guarantee and incentive policies, the allocation of special resources, and the selection of scientific and technological personnel to work at the grassroots level to promote science and technology and implement scientific and technological projects (Zeng & Zhao, 2009). The STCS also transcends traditional boundaries, facilitating a nexus between production, education, and research. The system can integrate agricultural science and education, enabling the application of scientific innovations in agriculture (Zhu & Jin, 2023); it can also address farmers' needs by extending research results to specific production processes through relevant institutions, thereby supporting the optimization and upgrading of agricultural production (Magruder, 2018). Essentially, the core of the STCS is a government-modelled extension of agricultural science and technology, guided by the market with close cooperation among scientific and technical personnel and farmers (Xiao & Ye, 2020).

Agricultural science and technology extension is inherently collaborative, involving government departments, universities, research institutes, and farmers (Cofré-Bravo, 2018; Emeana, 2019; Zhu & Jin, 2023). Ates and Cakal (2014) emphasized the government's leading role, especially in developing countries, where governments bear particularly heavy responsibilities. Ahmadpour et al. (2016) argue that universities should be consulted in the process of extending agricultural science and technology. Furthermore, the communication and cooperation of agricultural research institutes (Movahedi & Ghanbari, 2014), institutional extension services (Makate & Makate, 2019), and extension project teams (Wijaya, 2019) are fundamental for the system's success. However, farmers remain the ultimate beneficiaries of the STCS. Kassem et al. (2021) suggest that farmers' satisfaction with the quality of extension services is essential for designing programmes that meet farmers' needs and local agroecological conditions. Similarly, Zhu and Jin (2023) emphasize the importance of a farmer-centred approach, advocating for the cultivation of local 'demonstration households' to facilitate technology adoption and provide peer-based learning opportunities.

Research shows that the adoption of new agricultural innovations is often lower than desired or, indeed, anticipated compared with what would be predicted if farmers acted solely as profit-maximizing agents (Howley, 2022). Studies of farmers' behaviour have suggested a variety of explanations for this situation. These include economic considerations such as transaction costs and application burden, as well as structural farm characteristics (Lastra-Bravo et al., 2015; Jiang & Liu, 2019). There is also a rich body of literature which points to the importance of sociological and psychological factors that influence the adoption of sustainable practices (Dessart et al., 2019; Cloete, 2019; Howley & Ocean, 2022). These studies highlight the importance of 'good farmer' identities and peer effects (Mills et al., 2018), farmer ideas and literacy (Zhang & Liu, 2022), and underlying psychological dispositions such as risk aversion (Cloete, 2019).

Nudge theory, as introduced by Thaler and Sunstein (2008), proposes that small, non-coercive changes in the choice architecture can influence people's behaviour in predictable ways without restricting their freedom. In the context of public policy, nudge theory has been applied to optimize decision-making processes, improve policy outcomes, and encourage more favourable behaviours. Battaglio et al. (2018) argue that greater attention should be paid to how cognitive biases affect decision-making within public organizations when providing public managers with a reliable basis for improving policy outcomes. Moseley and Thomann (2021) discussed how a series of cognitive biases and heuristic methods affect the policy implementation behaviour of street-level bureaucrats. Ding (2022) also emphasized that people need the help of grassroots government when facing difficulties in making behavioural choices due to high complexity, low frequency, or poor feedback. In essence, the literature highlights the importance of looking beyond the technical aspects of agricultural production and farm structure when seeking to understand the adoption of new farm practices.

As a model of agricultural science and technology extension with Chinese characteristics, the STCS aims to promote the transmission of modern production factors such as science and technology, capital, skilled personnel, and information to the front line of rural areas by implementing a series of policies and regulations such as selection incentives, fund management, and performance evaluation. However, existing research shows that discussion of system implementation lacks theoretical application and often neglects psychological factors such as the cognition and behaviour of participants in agricultural science and technology extension, thereby limiting its effectiveness. Therefore, this study focuses on Shenyang City, Liaoning Province, develops a specific analytical framework based on nudge theory, and identifies the key factors influencing the effective implementation of the system.

III. METHODOLOGY

From the perspective of nudge theory, this study employed in-depth interviews to explore the difficulties and root causes of system implementation in Shenyang. These interviews focused on various interviewees' psychological feelings, behaviour choices, and demand feedback. Additionally, international comparisons were incorporated, comparing our findings with those from other countries that have implemented similar agricultural technology programmes, further supporting our analysis. We highlight the common difficulties, key lessons learned, and optimization paths applicable to the STCS.

1. Data

This study uses first-hand data and secondary data. First-hand data were collected over a two-month period in 2024. Because the institutional design of the STCS dictates that roles and responsibilities are relatively uniform across participants, we used purposeful sampling to select 16 participants from various roles, including 3 staff members of Shenyang and county (city) science and technology bureaus, 4 township and village cadres, 4 farmers, and 5 heads of science and technology missions from universities. These participants cover all 13 administrative districts of Shenyang, with ages ranging from 26 to 63. Their professional backgrounds span agriculture, economics, management, and information technology, and they all have experience with the STCS, either through guiding, participating in, or receiving its services. This diverse and representative sample provides a comprehensive understanding of the system.

Additionally, participatory observation was conducted during a one-month internship, during which we attended city-wide STCS project deployment meetings and collected secondary data such as academic literature and official policy documents, which can help validate our interview findings.

2. Analysis framework

Based on nudge theory and the implementation process of the STCS in Shenyang, this study constructs an analytical framework of 'one centre, two analysis nodes, three optimization links, six guiding principles, and six focus directions', consisting of two parts: technical design and process design.

2.1. Technical design: Nudge analysis of the implementation of the STCS in Shenyang

In the technical design, 'one centre' refers to the optimization of the implementation effectiveness of the STCS in Shenyang. 'Two analysis nodes' refer to cognitive and behavioural analysis nodes. At the cognitive analysis node, nudge theory holds that real people are 'social people', and their decisions are not always rational. When faced with a lack of experience and information, an intuitive thinking system often dominates (Thaler & Sunstein, 2008). Therefore, cognitive biases should be considered when designing nudges (Thaler & Sunstein, 2023). In this study, these biases are expressed as anchoring bias, availability bias, and representativeness bias (Table 1) in the context of implementing the STCS.

Table 1

The effect of cognitive biases on the behaviour analysis node

Bias type	Decision characteristics	Evasion strategy
Anchoring bias	People often anchor a known number and adjust in the wrong direction	Impose a clever anchor point on people's minds to influence the choices under special circumstances
Availability bias	People often judge the possibility of events and perceive risks according to their cognitive accessibility	Give examples of related problems and events, or similar situations, to boost people's confidence
Representativeness bias	People often put too much faith in small samples and make conjectures and judgments based on certain characteristics or descriptions	Use probability theory to reveal the occurrence of a certain feature or description and other related reasons

Source: the authors' elaboration based on Thaler and Sunstein (2008).

On the behavioural analysis node, David Halpern (2018) mentioned the 'EAST' framework of nudge. Combined with the STCS' specific situation, the framework emphasizes that the government decision-making and the promotion behaviour of science and technology commissioners need to have four characteristics (Table 2): easy, attractive, social, and timely, which can improve the acceptance of farmers and other clients and facilitate practice.

Table 2

Four promotion behaviour characteristics under the behaviour analysis node

Promotion characteristics	Characteristic connotation	Intervention strategy
Easy	Easy-to-understand and implement measures are easier to guide people to change their behaviours	Simplify, reduce trouble, and take advantage of friction costs

Table 2 (*continued*)

Promotion characteristics	Characteristic connotation	Intervention strategy
Attractive	Behaviours that look interesting and attractive are more likely to be chosen	Put forward suggestions or measures that are emotionally attractive or at least convincing
Social	People are more susceptible to the behaviour of those around them who are similar to themselves	Cultivate the connection between individuals and groups
Timely	Measures taken before behaviour formation, or when behaviour is disturbed for certain reasons, are more effective	Intervene early, intervene at critical moments, and overcome the 'time inconsistency preference'

Source: the authors' elaboration based on Thaler and Sunstein (2023).

Thaler and Sunstein state that a sound selection system can effectively avoid people's cognitive and motivation deficiencies, guide them to act in the expected direction, and put forward 'six guiding principles': motivation, default options, anticipated errors, understanding trade-offs, feedback, and structural compound selection (Table 3). In addition, they also stress that incentives must be taken into account, and that appropriate incentives should be applied to the right people (Jia, 2023; Thaler & Sunstein, 2023).

Table 3

Six guiding principles of nudge theory

Guiding principles	Main content
Motivation	Designers pay attention to the individual's primary motivation and design choices that meet the designer's expectations
Default options	At the beginning of policy implementation, reasonable default options should be set based on policy objectives
Anticipated errors	A good selection system can anticipate possible errors and correct or avoid them in advance
Understanding trade-off	A sound selection system can improve people's ability to make trade-offs and enable them to make satisfactory choices
Feedback	Designing feedback system can help people evaluate and optimize their behaviour
Structure complex choices	The probability of people making better choices depends on the complexity of the selection system

Source: the authors' elaboration based on Thaler and Sunstein (2008).

Based on the ‘six guiding principles’ of nudge theory, this study explores nudge strategies in practice, which constitute the ‘six focus directions’ of the research. First, stakeholders’ motives should be coordinated and common goals and visions established. Second, the default options should be optimized and adjusted, with those beneficial to the public set as the default values. Third, early warnings should be issued to anticipate errors and reduce the negative impact in the face of risks by strengthening dynamic monitoring. Fourth, key information should be delivered at critical moments to help people make more rational choices. Fifth, performance results should be publicized, which can not only enhance policy implementation but also stimulate participants’ enthusiasm. Sixth, implementation processes should be simplified, unnecessary ‘friction costs’ avoided, and the probability of making better actions improved.

2.2. Process design: Process optimization of the STCS implementation in Shenyang

The STCS is an institutional arrangement implemented across departments, levels, and industries. Therefore, the optimized paths of the system should not be limited to a single outcome angle. This study focuses on the dynamic process of implementing the system, integrates the ‘three optimization links’ of policy implementation, service implementation, and supervision and evaluation. It sets out primary tasks and optimization objectives to promote ‘better implementation of policies’, ‘better implementation of services’, and ‘more effective supervision and evaluation’ (Table 4).

Table 4

Primary tasks and optimization objectives at the optimization level

Optimization levels	Primary tasks	Optimization objectives
Better implementation of policies	Design and implement relevant policies and implementation processes	Ensure the effective implementation of policies and enhance fairness, transparency, and participation
Better implementation of services	Promote better service by science and technology commissioners at the grassroots level	Truly meet the individual needs of farmers and other clients
More effective supervision and evaluation	Supervise and evaluate science and technology commissioners’ work and service performance	Achieve ‘comprehensive, multi-stakeholder and dynamic’ supervision and evaluation

Source: the authors’ elaboration based on the practice of implementing the STCS.

IV. FINDINGS

1. Difficulties with implementing the STCS in Shenyang

1.1. Difficulties in policy implementation

The implementation of the STCS in Shenyang faces significant challenges due to outdated and non-operational policies. Although 'The Implementation Opinions on Deepening Science and Technology Commissioners System to Promote Rural Innovation and Entrepreneurship' were issued in 2016, its goals were not updated in 2020, complicating the design and execution of related plans in Shenyang. Additionally, while policies on project management, selection incentives, and financial support have been introduced, many lack clear operational guidelines and unified standards, leading to inconsistent understanding and interpretation across different levels of government. For example, the financial support measure of 'guiding financial institutions such as policy banks and commercial banks to increase credit support within the scope of business' does not specify how such 'guidance' should be put into practice.

Another critical difficulty is that the executive power of grassroots government is insufficient. Science and technology departments in economically underdeveloped areas, where most science and technology commissioners are located, are weak compared to agricultural departments. With limited financial resources and poor coordination abilities, local governments struggle to implement policies effectively. Moreover, the publicity and promotion of relevant policies in Shenyang still operate on a 'peer-to-peer' and 'small team' basis and have not yet been fully rolled out and formed centralized publicity activities. In interviews, science and technology commissioners generally said that some farmers have doubts about the services provided and even question 'whether to sell technology, seeds or pesticides'. Grassroots cadres also reported that 'almost no publicity activities such as interpretation of relevant policies have been carried out.'

1.2. Difficulties in service implementation

The development of the science and technology commissioner system is limited to a single professional field, with insufficient services covering the whole industrial chain. Interviews with the head of Shenyang Agricultural University revealed that the science and technology missions have not yet formed multidisciplinary and interdisciplinary teams. While they excel in agricultural planting and R&D, many lack practical market experience. They are often helpless when faced with problems in product processing, marketing, and e-commerce circulation, which easily leads to the phenomenon of 'increasing production without increasing income'. As a result, it is difficult to fully respond to the practical needs of farmers at present.

Communication and cooperation between science and technology commissioners and rural science and technology extension forces are poor. With scattered rural service points and low levels of informatization, there is a significant issue of 'information islands'. Staff at the Shenyang Science and Technology Bureau said: *We often encounter the problem that science and technology commissioners in different regions submit the same technical requirements* (20240916-G-01, 20240917-G-02). Faced with this situation, science and technology commissioners from different regions responded: *There is almost no communication between different regions, so we cannot obtain information about the service trends of various projects* (20241009-T-01, 20241011-T-03, 20241015-T-05). Meanwhile, township cadres and village cadres fail to play an effective role in supporting and guiding, and science and technology commissioners have little communication with college students, 'village officials', village committees, and other personnel. Moreover, local talents often find it challenging to join the teams, so a joint force has not yet been formed.

Farmers' willingness to accept the STCS is not strong, and their participation is weak. Influenced by deep-rooted ideas, some farmers find it difficult to fully understand the significance and value of the system. Despite recognizing the potential benefits of new technologies, some farmers are hesitant due to the risks involved. As they said in interviews, *We are willing to accept new technologies, but if they fail, we may lose money this year* (20241114-F-03, 20241115-F-04). This cautious attitude, combined with a limited understanding of complex technologies, prevents farmers from fully adopting the complex new technologies introduced by science and technology commissioners.

1.3. Difficulties in supervision and evaluation

The supervision of science and technology commissioners in Shenyang faces several challenges, including a lack of effective oversight, inefficient methods, and poor management of intermediate processes. First, commissioners are managed by multiple units – such as universities and local science and technology departments – which leads to weak supervision due to fragmented responsibility. Second, the Shenyang Science and Technology Bureau still mainly relies on traditional supervision methods, such as regular reporting and material inspections, rather than adopting modern technology and data-driven approaches. Additionally, the lack of dynamic tracking, with only a written summary submitted every six months, makes it difficult to address issues in real-time, resulting in a disconnect between the implementation process and actual needs.

Evaluation of project effectiveness is also problematic, with unreasonable standards and unscientific indicators. Performance is often assessed based solely on whether the tasks outlined in agreements with service units are met, leading to a focus on completing minimum requirements rather than addressing farmers' real needs. Moreover, the existing evaluation indicators are mostly at the quantitative level of service, such as increases in production and income, the introduction of new varieties introduced, and the acreage covered, while ignoring the evaluation of farmers' satisfaction, the attitude and efficiency of science and technology commissioners, and other qualitative aspects. This means that the evaluation results may not truly reflect the actual work effectiveness.

2. The root causes of the difficulties in the implementation of the STCS in Shenyang

2.1. Cognitive analysis node: Cognitive bias led by intuitive thinking

Availability bias affects cognitive decision-making. Under pressure to show results, grassroots governments often prioritize projects with visible success or easily quantifiable outcomes, while neglecting more complex, long-term solutions that could benefit farmers. Universities tend to focus on academic qualifications and professional skills when selecting team members, overlooking practical market experience and industry-wide service capabilities that are crucial for addressing farmers' needs. Similarly, some science and technology commissioners are more motivated by academic achievements such as papers and patents than by addressing real market demands or farmers' operational challenges. Farmers, driven by a fear of risk and loss, often stick to traditional methods or opt for new technologies they perceive as easy to apply, even if these technologies offer smaller potential benefits.

Anchoring bias hinders trade-off judgment. In policy design, the government sets expectations for grassroots science and technology departments too high, assigning them excessive responsibilities while ignoring difficulties such as limited resources and insufficient overall planning in actual implementation. Some science and technology commissioners focus their 'anchor points' on low quantitative performance evaluation indicators, such as the number of new technology promotions, field visits, and training sessions, while ignoring farmers' real needs. This results in poor service effects and even negative impacts. Meanwhile, due to lack of knowledge and understanding of relevant information, some farmers anchor the expected benefits of new technologies too low, pay too much attention to the risk of loss, and underestimate the possible economic benefits.

Representative bias causes results to deviate from expectations. The government tends to rely on past policies and existing data, which leads to conservative and outdated measures that fail to address emerging challenges. Similarly, science and technology commissioners sometimes use established cases or topics that do not consider the varied economic conditions, soil types, or technology acceptance levels among farmers, which means they cannot meet farmers' individual needs. In addition, when faced with the new technologies promoted by science and technology commissioners, some farmers are more inclined to choose the technologies that have been successfully verified by neighbours or relatives, and they are resistant to the unknown technologies recommended by science and technology commissioners.

2.2. Behaviour analysis node: Analysis of participants' promotion of behavioural characteristics

The ease of the project approval process is insufficient. The project establishment process for Shenyang's science and technology missions is mainly carried out through four aspects: research needs, team formation, agreement signing, and application materials, while the approval process involves five stages: preliminary examination by the applicant, review by the Municipal Science and Technology Bureau, expert review, preparation of the project plan, and publicity. However, this process is often slow and time-consuming, with administrative tasks such as communication and coordination significantly delaying progress. As noted by the head of the Shenyang Agricultural University's mission, *During the two-year project period, the approval process can take up to six months, delaying some projects' implementation* (20241010-T-02, 20241011-T-03). This increases the risk for science and technology commissioners and leads to farmers' distrust of their services.

Lack of attractiveness in service behaviour. The interviewed science and technology commissioners generally said that *the existing incentive policies can't play a significant role in the promotion of professional titles and awards* (20241014-T-04, 20241015-T-05). Therefore, some commissioners pay more attention to meeting the requirements of the dispatching units rather than addressing the actual needs of farmers. At the same time, project leaders who fail to complete the task are regarded as untrustworthy in the field of science and technology and are barred from undertaking municipal projects for three years, which limits flexibility and discourages innovation. Additionally, many commissioners fail to engage directly in fieldwork or provide training, which undermines the practical application of their work in rural production.

Lack of social characteristics in promotional behaviour. On the one hand, the government's publicity and promotion of the system implementation goals and purposes, as well as the service mode and legal status of science and technology commissioners, remain insufficient, and the outstanding deeds or successful cases of science and technology commissioners have not been disseminated in groups. On the other hand, commissioners and farmers lack strong common interests, and no cooperatives or communities based on capital or technology shares have been set up. In the absence of clear incentives, commissioners often prioritize their own interests, neglecting broader social goals.

Lack of timeliness in feedback behaviour. The absence of dynamic communication channels hinders timely feedback between science and technology commissioners and farmers. First, the lack of a feedback platform affects the effective communication between commissioners and farmers. Second, farmers' participation in providing feedback is passive. Farmers who are used to being the recipients of resources are rarely able to express their interests in time due to the lack of sufficient information and the ability to evaluate technology. Third, under the influence of 'time inconsistency preference', participants may exhibit short-sighted behaviour that favours short-term achievements and ignores long-term values.

In summary, the difficulties in implementing the STCS in Shenyang stem in part from cognitive biases and behaviour characteristics that influence decision-making at various levels. These result in policies and services that are misaligned with the real needs of farmers, hindering the effectiveness of the STCS.

3. International comparisons of the agricultural technology extension systems

We compared the agricultural technology extension systems in four countries: China, the United States, the United Kingdom, and Japan. The comparison is made on three aspects: policy implementation, service implementation, and supervision and evaluation. By analysing the experiences, we can draw valuable lessons for optimizing China's STCS, including universal patterns, key lessons, and successful approaches to optimization.

Table 5

Comparative analysis of the agricultural technology extension systems in China, USA, UK, and Japan

Links	China	USA	UK	Japan
Policy implementation	Multiple policies and plans support agricultural innovation; however, policies lack coordination and integration among stakeholders.	Strong collaboration between academia, industry, and research; but limited attention to localized, small-scale agricultural needs.	Government-driven policies with a focus on information sharing; heavy reliance on government control, limiting flexibility.	Focus on government-private partnerships and long-term innovation policies; policies can be slow to adapt to global trends or shifting agricultural needs.
Service Implementation	Many innovation incentives and funding mechanisms exist; slow adaptation to local farming needs and market dynamics.	Universities lead with abundant funding and a strong research base; services are often disconnected from actual farmer requirements.	A well-structured, government-supported knowledge-sharing network; weak linkage with the private sector in rural areas.	Strong emphasis on advanced agricultural technologies, such as robotics and AI; high costs of technological innovations hinder widespread adoption.
Supervision and evaluation	Government departments are active in policy oversight and performance evaluation; evaluation lacks real-time feedback mechanisms and dynamic adjustments.	Federal and state governments share responsibility, ensuring wider reach; evaluation criteria can sometimes be too rigid or short-term focused.	Continuous public-private cooperation for oversight and feedback; evaluation lacks flexibility and adaptability to rural changes.	Robust monitoring systems and a strong focus on data-driven evaluations; complex evaluation processes can lead to delays in adapting to farmer needs.

Source: the authors' own analysis based on institutional practices of various countries.

These countries' agricultural technology extension systems reflect certain universal patterns and challenges (Ayris et al., 2023; Cao, 2024; Chen et al., 2020; Kishioka et al., 2017; Prokopy et al., 2019) such as coordination among stakeholders, the need for better engagement with local farmers, more dynamic and effective feedback loops, and the importance of integrating both government and private sector efforts. These findings demonstrate that our findings are consistent with and contribute to broader academic dialogues, thereby validating their reliability. By expanding on these foundational findings, we have further developed optimized paths under the framework of nudge theory, which align closely with both existing research and the broader goals of agricultural revitalization.

4. Optimized paths for the implementation of the STCS in Shenyang under the framework of nudge theory

4.1. Optimized paths of policy implementation

Current policy implementation and service extension behaviour do not effectively meet the diverse needs of farmers. To enhance policy coherence and stakeholder alignment, it is crucial to harmonize the motivations of government agencies, science and technology commissioners, and farmers. In the implementation of the STCS in Shenyang, government departments pay more attention to social and economic benefits, and science and technology commissioners focus on personal career development and the transformation of research results. In comparison, farmers are more concerned about increasing production and income. Therefore, government departments should update the existing policy objectives in time to ensure consistency between policies, and provide policy support in line with the interests of science and technology commissioners and farmers.

Incentive policies should integrate career advancement opportunities, such as the promotion of professional titles, priority in research project applications, and enhanced profit-sharing ratios for technology transfers. Selection policies should encourage graduate tutors to participate in the work of science and technology commissioners, promote excellent lecturer-level science and technology commissioners as professional master tutors, and grant them preference in enrolment indicators. Meanwhile, implementing a merit-based reappointment system can align individual career paths with broader policy goals. In terms of financial support policies, financial institutions should receive specific guidance on credit mechanisms, including localized agricultural microloans. For example, Japan's Agricultural Cooperatives (JA) system highlights the effectiveness of tailored financial products in addressing rural credit gaps (Kishioka et al., 2017).

Moreover, streamlining approval processes through digital integration would reduce administrative friction. Government departments should fully integrate the specific process of project approval, clarify the responsible subjects of each link, integrate relevant policies and resources of all parties, set up a ‘one-stop’ comprehensive service window, build an online approval platform, and significantly shorten the start-up cycle of the project. At the same time, key approval stages should adopt standardized timelines and real-time tracking, while urgent projects benefit from expedited channels. In addition, the project matching process of science and technology commissioners should pay more attention to users’ needs, optimize the service coordination mechanism, provide an ‘easy-to-use’ operation mode and concise menu options, and promote the efficient allocation of resources.

4.2. Optimized paths of service implementation

To bridge the gap between policy intent and service outcomes, service design must align with farmers’ behavioural patterns and agricultural cycles to prevent farmers from losing interest and trust. On the one hand, reasonable options must be set to optimize service promotion behaviour. Meanwhile, the influence of social psychology on farmers’ behaviour should be considered. First, using social strategies such as ‘the choice of the majority’, farmers should be organized to visit outstanding cases around them promptly so that they can link the implementation of the system with positive images such as increasing production and income. Second, interdisciplinary science and technology missions should be set up to enhance the service capacity of the whole industrial chain and provide precise technical training and personalized solutions according to the farming season and farmers’ needs. Third, we should recognize the inherent connection and trust between local talents and farmers, provide them appropriate salary subsidies and career development opportunities. We should also utilize the critical role of township cadres and village cadres in policy interpretation, demand feedback and work coordination, establish grassroots science and technology commissioners’ workstations, which can enhance policy execution and service effect.

On the other hand, it is necessary to build an information platform and enhance the ability of trade-off and judgment. Pushing adequate key information can reduce decision-making mistakes caused by anchor deviation. A unified information platform is essential to reduce anchoring bias and information asymmetry in the landing of STC services. Drawing from the UK’s digital village initiatives, such as integrated agricultural data systems (e.g. Agricultural Census Database, National Soil Database and Single Subsidy Payment Database) and rural e-governance tools, the ‘Shenyang Science and Technology Commissioner Service Cloud Platform’ should be created, which would integrate multiple functions such as data presentation, demand release, achievement matching, interactive consultation, case promotion, and problem feedback. This platform could promote information sharing and decision-making cooperation between the relevant departments, enhance the service enthusiasm and coordination of science and technology commissioners, and improve farmers’ acceptance and participation in services.

4.3. Optimized paths of supervision and evaluation

In order to improve the effectiveness of supervision, error warnings should be sent to strengthen the supervision of intermediate processes. Relying on the establishment of the 'Shenyang Science and Technology Commissioners Service Cloud Platform,' science and technology commissioners can publicly record the service process on the platform, which can be accompanied by pictures and videos when conditions permit, and encourage the adequate supervision of the public, to strengthen the dynamic tracking of the project implementation process. Early warning information would be sent to the project leader at the key nodes of project operation, including specific timelines, stage objectives, and standards such as mid-term inspection and project closure evaluations, as well as the consequences of failing these review, in order to urge commissioners to take practical actions to improve performance. In addition, the corresponding fault-tolerant mechanism should be designed to give some tolerance to the errors caused by innovation attempts and promote the service quality and innovation ability of science and technology commissioners.

At the same time, it is necessary to publicize performance results and optimize the performance evaluation mode. Given the unreasonable performance evaluation indicators and weak feedback behaviour in Shenyang, this paper proposes a performance evaluation model of 'comprehensive, multi-stakeholder and dynamic'. The government should establish a suitable feedback mechanism based on the timely disclosure of the work effectiveness and evaluation results of science and technology commissioners and conveying feedback on difficulties in the system implementation process to the competent departments. The evaluation scope should be extended to include commissioners' work processes, service recipients' satisfaction, and long-term sustainable performance evaluation. At the operation level, multi-stakeholders such as third-party evaluation agencies, peer experts, and clients should be involved in the evaluation process, and commitments regarding job promotion, rewards, and recognition for science and technology commissioners – whether linked to their duties or to annual assessments – should be honoured promptly.

In addition, drawing on the experience of the multi-stakeholder cooperation model in the United States (e.g. the joint management of 12 offices of the United States Department of Agriculture), the government should further improve the early warning system for analysing agricultural information. Moreover, the 'Agricultural Outlook Conference' tool should be activated in a timely manner to study and formulate the development plan for China's agricultural outlook work (Xu, 2013), so as to smooth the channels for the transformation of new agricultural technologies into reality, and to promote high-quality and sustainable development of agriculture.

V. CONCLUSIONS

This study investigates the implementation of the Science and Technology Commissioners System (STCS) in Shenyang, China, and explores the cognitive biases and behavioural obstacles encountered by various stakeholders during its execution. It highlights significant challenges in the policy's implementation, including a mismatch between service supply and demand, low farmer acceptance, and ineffective supervision and evaluation. The analysis reveals that cognitive biases, such as availability, anchoring, and representativeness have led to rigid policies that do not fully address the diverse needs of farmers in rural areas.

One of the key findings is the identification of 'information silo' problems and slow administrative processes, which have hindered the effectiveness of the STCS. The study proposes a solution based on a 'comprehensive, multi-stakeholder and dynamic' performance evaluation model, combined with a cloud platform, aimed at optimizing policy implementation. These findings are critical for improving the responsiveness of policies to rural needs and enhancing the overall engagement of farmers.

The application of *nudge theory* in this study provides a novel framework for influencing cognition and behaviour, improving the decision-making process among stakeholders, and offering a new perspective for research on the implementation of the STCS. On the one hand, it expands research in agricultural science and technology policy, extends the research content of the STCS, and provides a sound theoretical reference for promoting scientific and technological innovation achievements to truly benefit farmers. On the other hand, it helps to improve the management efficiency of government departments, strengthens the ability of science and technology commissioners to perform their duties, and increases farmers' enthusiasm, thereby promoting the transformation of agricultural scientific and technological achievements.

The findings of this study offer several actionable recommendations for decision-makers. First, there is a clear need to reconsider current policy frameworks to account for the diverse needs of farmers and reduce the impact of cognitive biases. Second, improving communication channels between government departments, scientific advisors, and farmers is essential for enhancing the adoption and acceptance of agricultural technologies. Finally, the proposed information-sharing cloud platforms and streamlined approval processes will significantly improve the efficiency and effectiveness of the STCS.

In conclusion, this study contributes to a deeper understanding of the complexities surrounding the implementation of science and technology policies in rural areas. By integrating behavioural economics with policy design, the STCS can be more effectively tailored to meet the evolving needs of farmers, thus promoting sustainable rural development. However, to what extent the optimized paths proposed in this study – based on the nudge theoretical framework – can play an effective role in implementing the STCS still needs to be tested through an expanded sample size that includes a broader range of participants from other provinces and rural areas, as well as through the incorporation of more quantitative performance data. Meanwhile, evidence-based decision-making should be used to continuously promote the optimization of nudging, so as to better meet the diversified scientific and technological needs of farmers in the new era, providing powerful innovation and development momentum for the high-quality development of agriculture.

Author contributions / Indywidualny wkład autora (CRediT): **Dan Li** – 50% (Conceptualization / Konceptualizacja; Funding acquisition / Pozyskanie funduszy; Investigation / Przeprowadzenie badań; Project administration / Administracja projektu; Supervision / Nadzór; Validation / Walidacja; Writing – original draft / Pisanie – pierwszy szkic; Writing – review & editing / Pisanie – recenzja i edycja). **Caiyao Wu** – 30% (Data Curation / Zarządzanie danymi; Formal analysis / Formalna analiza; Investigation / Przeprowadzenie badań; Writing – original draft / Pisanie – pierwszy szkic; Writing – review & editing / Pisanie – recenzja i edycja). **Haoqi Song** – 15% (Data Curation / Zarządzanie danymi; Visualization / Wizualizacja; Writing – original draft / Pisanie – pierwszy szkic). **Rafal Blicharz** – 5% (Resources / Zasoby; Writing – review & editing / Pisanie – recenzja i edycja).

Conflict of interest / Konflikt interesów: The authors declare no conflict of interest. / Autorzy nie zgłosili konfliktu interesów.

Funding / Finansowanie: This work was supported by the Science and Technology Strategy Research Project of Liaoning Province, China (grant no. 2024JH4/10200008). / Artykuł uzyskał wsparcie w ramach Projektu Badań Strategicznych w Dziedzinie Nauki i Technologii prowincji Liaoning, Chiny (nr grantu 2024JH4/10200008).

The use of AI tools / Wykorzystanie narzędzi AI: The authors declare no use of AI tools. / Autorzy oświadczyli, że nie korzystali z narzędzi AI.

Data availability / Dostępność danych: The data used is confidential. / Dane są poufne.

References / Bibliografia

Ahmadpour, A., Mirdamadi, S. M, & Soltani, S. (2016). Attitude towards on-the-job e-learning: The case of agricultural extension workers in Iran. *Journal of Agricultural Science & Technology*, *18*(1), 27–38. http://jast.modares.ac.ir/article-23-4238-en.html

Ates, H., & Cakal, Z. G. (2014). Views of extension personnel on extension methods and transition to private extension: The case of Isparta province. *Journal of Agricultural Science & Technology*, *16*(16), 1529–1541.

Ayris, K., Dixon, E., Mauchline, A., & Rose, D. C. (2023). Investigating stakeholder participation in UK agricultural robotics development. In *Proceedings of the First International Symposium on Trustworthy Autonomous Systems* (pp. 1–5). https://doi.org/10.1145/3597512.3597531

Battaglio Jr, R. P., Belardinelli, P., Bellé, N., & Cantarelli, P. (2019). Behavioral public administration ad fontes: A synthesis of research on bounded rationality, cognitive biases, and nudging in public organizations. *Public Administration Review*, *79*(3), 304–320. http://doi.org/10.1111/puar.12994

Cai, X. P. (2020). Talents sink and villages prosper-institutional innovation of science and technology commissioners in rural revitalization. *Chinese Talents*, *6*, 7–9. (in Chinese)

Cao, X. Q, Xing, H. Q, Chen, M. Q., Wei, X. (2024). Development and suggestions of agricultural science and technology innovation policy in China – An empirical analysis based on Germany, the United States and Japan. *Research on Science and Technology Management*, *44*(22), 37–46. (in Chinese)

Chen, T. J., Ren, Y. F., & Ke, X. H. (2020). Comparison of agricultural science and technology innovation system in Europe and America and enlightenments to China. *Journal of Agricultural Science and Technology*, *22*(11), 1–10. https://doi.org/10.13304/j.nykjdb.2020.0569

Cofré-Bravo, G., Klerkx, L., & Engler, A. (2019). Combinations of bonding, bridging, and linking social capital for farm innovation: How farmers configure different support networks. *Journal of Rural Studies*, *69*, 53–64. https://doi.org/10.1016/j.jrurstud.2019.04.004

Dessart, F. J., Barreiro-Hurlé, J., & Van Bavel, R. (2019). Behavioral factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics*, *46*(3), 417–471. https://doi.org/10.1093/erae/jbz019

Ding, L. K. (2022). Probe into the nudge governance model of grassroots government. *Leadership Science*, (04), 96–100. https://doi.org/10.19572/j.cnki.ldkx.2022.04.024 (in Chinese)

Emeana, E. M., Trenchard, L., Dehnen-Schmutz, K., & Shaikh, S. (2019). Evaluating the role of public agricultural extension and advisory services in promoting agro-ecology transition in Southeast Nigeria. *Agroecology and Sustainable Food Systems*, *43*(2), 123–144. https://doi.org/10.1080/21683565.2018.1509410

Halpern, D. (2018). *Nudge: How small actions promote great change* (practical ed.; B. Liang, F. Yu & C. Pan, trans.). CITIC Publishing House. (in Chinese)

Howley, P., & Ocean, N. (2022). Can nudging only get you so far? Testing for nudge combination effects. *European Review of Agricultural Economics*, *49*(5), 1086–1112. https://doi.org/10.1093/erae/jbab041

Huang, Z. B., & Liu, L. (2020). Push intervention is not widely used in China because of behavioral economics analysis. *Public Management and Policy Review*, *9*(02), 55–68. https://doi.org/10.19445/j.cnki.15-1103/g3.2019.02.020

Jia, C., & Mustafa, H. (2023). A bibliometric analysis and review of nudge research using VOS viewer. *Behavioral Sciences*, *13*(1), 19. https://doi.org/10.3390/bs13010019

Jiang, J., & Liu, Y. G. (2019). Practice and innovation of China's Science and Technology Commissioners System: Taking Zhejiang Province as an example. *Scientific Management Research*, *37*(02), 89–92. https://doi.org/10.19445/j.cnki.15-1103/g3.2019.02.020

Kassem, H. S., Alotaibi, B. A., Muddassir, M., & Herab, A. (2021). Factors influencing farmers' satisfaction with the quality of agricultural extension services. *Evaluation and Program Planning*, *85*. https://doi.org/10.52997/jad.1.04.2018

Kishioka, T., Hashimoto, S., Nishi, M., Saito, O., & Kohsaka, R. (2017). Fostering cooperation between farmers and public and private actors to expand environmentally friendly rice cultivation: intermediary functions and farmers' perspectives. *International Journal of Agricultural Sustainability*, *15*(5), 593–612. https://doi.org/10.1080/14735903.2017.1374321

Lastra-Bravo X.B., Hubbard C., Garrod, G., & Tolón-Becerra, A. (2015). What drives farmers' participation in EU agri-environmental schemes? Results from a qualitative meta-analysis. *Environmental Science and Policy*, *54*, 1–9. https://doi.org/10.1016/j.envsci.2015.06.002

Li, L. Y., & Wang, Z. (2024). The 2024 National Conference on Empowering Rural Revitalization and Development by Science and Technology Commissioners was held in Beijing. *China Rural Network*. http://www.farmer.com.cn/2024/08/29/9993327.html. 2024-08-29

Magruder, J. R. (2018). An assessment of experimental evidence on agricultural technology adoption in developing countries. *Annual Review of Resource Economics*, *10*(1), 299–316. https://doi.org/10.1146/annurev-resource-100517-023202

Makate, C., & Makate, M. (2019). Interceding role of institutional extension services on the livelihood impacts of drought tolerant maize technology adoption in Zimbabwe. *Technology in Society*, *56*, 126–133. https://doi.org/10.1016/j.techsoc.2018.09.011

Mills, J., Gaskell, P., Ingram, J., & Chaplin, S. (2018). Understanding farmers' motivations for providing unsubsidised environmental benefits. *Land Use Policy*, *76*, 697–707. https://doi.org/10.1016/j.landusepol.2018.02.053

Moseley, A., & Thomann, E. (2021). A behavioral model of heuristics and biases in frontline policy implementation. *Policy & Politics*, *49*(1), 49–67. https://doi.org/10.1332/030557320X15967973532891

Movahedi, R., & Ghanbari, S. (2014). Investigating the relationship between university education and agricultural students' entrepreneurial spirit. *International Journal of Agricultural Science Research & Technology in Extension & Education Systems*, *7*(3), 23–29. https://journals.iau.ir/article_517351.html

Norton, G. W., & Alwang, J. (2020). Changes in agricultural extension and implications for farmer adoption of new practices. *Applied Economic Perspectives and Policy*, *42*(1), 8–20. https://doi.org/10.1002/aepp.13008

Prokopy, L. S., Floress, K., Arbuckle, J. G., Church, S. P., Eanes, F. R., Gao, Y., Gramig, B. M., Ranjan, P., & Singh, A. S. (2019). Adoption of agricultural conservation practices in the United States: Evidence from 35 years of quantitative literature. *Journal of Soil and Water Conservation*, *74*(5), 520–534. https://doi.org/10.2489/jswc.74.5.520

Ringling, K. M., & Marquart, L. F. (2020). Intersection of diet, health, and environment: Land grant universities' role in creating platforms for sustainable food systems. *Frontiers in Sustainable Food Systems*, *4*, 70. https://doi.org/10.3389/fsufs.2020.00070

Takahashi, K., Muraoka, R., & Otsuka, K. (2020). Technology adoption, impact, and extension in developing countries' agriculture: A review of the recent literature. *Agricultural Economics*, *51*(1), 31–45. https://doi.org/10.1111/agec.12539

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.

Thaler, R. H., & Sunstein, C. R. (2023). *Nudge: How to make better decisions about health, wealth and environment* (ultimate edition; Z. Jiang, trans.). CITIC Publishing House. (in Chinese)

Xiao, Z. Y., & Ye, J. T. (2020). The pulse and outlook of research on science and technology special agent system: An analysis based on CiteSpace. *Science Management Research*, *38*(01), 27–34. https://doi.org/10.19445/j.cnki.15-1103/g3.2020.01.005

Xu, S. W. (2013). Research and inspiration on the analysis and early warning work of agricultural products in the United States. *China Agricultural Information*, (22), 3–7. https://doi.org/10.3969/j.issn.1672-0423.2013.11.001

Zeng, Y. S., & Zhao, J. J. (2009). A breakthrough institutional innovation: Research report on China's System of Rural Science and Technology Commissioners. *Rural Science and Technology*, *6*, 60–63. (in Chinese)

Zhu, Z. Y., & Jin, J. B. (2023). Innovative agricultural science and technology extension mode: Analysis of Science and Technology Commissioners System from the perspective of scientific capital: Taking the practice of science and technology commissioners in the Nanping fungus and grass industry as an example. *Popular Science Research*, *18*(06), 60–69. https://doi.org/10.19293/j.cnki.1673-8357.2023.06.007