



GOVERNANCE OF DATA PLATFORM WITHIN A DATA PLATFORM ECOSYSTEM FRAMEWORK: EVIDENCE FROM JAPAN'S WAGRI DATA PLATFORM

Rungroge Kamondetdacha
Chulalongkorn University, Bangkok 10330 Thailand

Corresponding E-mail : Rungroge.K@chula.ac.th

Received Date April 19, 2025
Revised Date July 18, 2025
Accepted Date August 01, 2025

บทคัดย่อ

ภูมิทัศน์ของผู้มีส่วนได้เสียที่ซับซ้อนและการกำกับดูแลแพลตฟอร์มข้อมูลเป็นความท้าทายในการนำแพลตฟอร์มมาใช้เพื่อแบ่งปันและใช้ประโยชน์จากข้อมูล บทความนี้นำเสนอกรอบแนวคิดระบบนิเวศแพลตฟอร์มข้อมูลเพื่อศึกษาวิวัฒนาการการกำกับดูแลแพลตฟอร์มข้อมูลด้านการเกษตร รวมถึงกลยุทธ์การพัฒนาและดำเนินงาน โดยใช้กรณีศึกษาแพลตฟอร์มข้อมูล “วากรี” ของญี่ปุ่น ในช่วง พ.ศ. 2560-2567 ศึกษาด้วยวิธีวิจัยเอกสารและสัมภาษณ์ผู้มีส่วนได้เสีย ผลการศึกษาพบว่า วิวัฒนาการของระบบนิเวศแพลตฟอร์มข้อมูลประกอบด้วย 3 ส่วน ได้แก่ การเพิ่มขึ้นของจำนวนผู้เล่นและความสัมพันธ์ระหว่างกัน การเพิ่มขีดความสามารถด้านเทคโนโลยีของโครงสร้างพื้นฐานแพลตฟอร์มเทคโนโลยี และการมีโครงสร้างกำกับดูแลที่เข้มแข็งขึ้น ตลอดจนมีมาตรการกำกับดูแลข้อมูลที่คุ้มครองความเป็นเจ้าของข้อมูลและความปลอดภัยข้อมูลเพิ่มขึ้น รวมถึงมีการขยายความร่วมมือระหว่างผู้เล่นเพิ่มขึ้น สำหรับกลยุทธ์การพัฒนาและดำเนินงานแพลตฟอร์มข้อมูลอาศัยรูปแบบการประกอบธุรกิจ “ธุรกิจสู่ธุรกิจสู่ผู้บริโภค” ที่ควบคู่ไปกับความเป็นผู้นำของผู้เป็นเจ้าของและผู้ให้บริการแพลตฟอร์มข้อมูล โดยรูปแบบธุรกิจดังกล่าวมีความสำคัญมากต่อการดำเนินงานที่ประสบความสำเร็จและยั่งยืนของแพลตฟอร์ม ซึ่งแสดงให้เห็นถึงการเติบโตของแพลตฟอร์มข้อมูล “วากรี” ที่เป็นแพลตฟอร์มที่สามารถพึ่งพาตนเองได้จากรายได้การดำเนินงาน จึงเป็นรูปแบบการพัฒนาและดำเนินงานแพลตฟอร์มที่สามารถนำไปปรับใช้ได้

คำสำคัญ: การกำกับดูแลแพลตฟอร์มข้อมูล ระบบนิเวศแพลตฟอร์มข้อมูล การเกษตร

Abstract

The complex stakeholder landscape and governance of data platforms in agriculture, designed to facilitate data sharing and utilization among diverse stakeholders, often posed challenges. This research proposed a data platform ecosystem framework and also applied it to empirically investigate the evolution of the governance of Japan's WAGRI data platform and its development and operations strategies, covering the study of evolution period from 2017 to 2024. The research methodology employed a document review in conjunction with interviews of key stakeholders. The results revealed the evolution of the data platform ecosystem, which included: an increase in the number of actors and their relationships; an enhancement of technological capabilities of the platform infrastructure; and (3) the evolution of data platform governance, encompassing a strengthened governance structure, a refinement of data governance measures that protect data ownership and data security, and an expanded stakeholder collaboration. Furthermore, the platform's development and operations strategies were based on a “business-to-business-to-consumer” business model. This business model, coupled with a strong leadership of the data platform owner and provider, was crucial for the successful and sustainable operation of the platform as demonstrated by the growth of the “WAGRI” data platform, which had become a self-sustaining platform through its operational revenue. Therefore, the model can be adapted for development and operation of other data platforms.

Keywords: data platform governance, data platform ecosystem, agriculture

1. Introduction

The agricultural sector is undergoing a period of substantial transformation driven by the confluence of climate change, demographic shifts, and economic disparities (Fischer & Connor, 2018). To this end, Information and Communication Technologies (ICTs), and digital technologies present a range of opportunities for the agricultural community to address challenges and enhance farm productivity, while simultaneously promoting sustainability. Specifically, data-driven agriculture or smart farming leverages digital transformation in agriculture to achieve significant improvements in productivity, ensure the consistent production of high-quality agricultural products, and foster environmentally sustainable practices (Basso & Antle, 2020). Fundamental to this digital transformation are data platforms, developed to generate value through data sharing and data utilization, whose potential resides in their capacity to empower stakeholder engagement and interaction (Carletto, 2021).

To this end, governance plays a very important role for data platform owners to make key decisions about the roles and responsibilities of stakeholders, mechanisms to facilitate and promote stakeholder collaborations, and measures to ensure adherence to data procedural requirements (Borrero & Mariscal, 2022; Bronson & Knezevic, 2016; Rojo-Gimeno et al., 2019). Consequently, understanding and addressing the challenges of data platform governance is very paramount for realizing the full potential of the data platform and ensuring its sustainable and equitable development.

On the one hand, prior research has extensively examined the technical applications of data platforms (Kamilaris et al., 2017; Wolfert et al., 2017), but however, comparatively less attention has been directed towards the governance of data platforms (Borrero & Mariscal, 2022; Rojo-Gimeno et al., 2019). On the other hand, previous insights into data platform governance have been primarily informed by many case studies from the high-technology sector (Ghazawneh & Henfridsson, 2013; Hein et al., 2016).

Therefore, this research aims to address this gap in the understanding of data platform governance of the agricultural sector, consisting of a multiplicity of stakeholders with complex structural relationships, measures for fostering trusts and transparency in data exchange and utilization, concurrently supporting the creation of viable business models for sustainable operation of the platforms. More specifically, this research proposed a data platform ecosystem framework and applied it to empirically investigate the evolution of the governance of Japan's WAGRI data platform and its development and operations strategies, covering the study of the evolution period from 2017 to 2024. Japan's WAGRI Agricultural Data Collaboration platform demonstrated a recent success in developing and implementing an agricultural data platform, with its long-term strategies towards sustainability of the platform, whose experiences can be useful for agricultural data platforms in other countries.

2. Objectives

2.1 To analyze and elucidate the evolution of the governance of the data platform in agriculture, using a case study of Japan's WAGRI Agricultural Data Collaboration platform.

2.2 To identify strategies for developing and managing the data platform to ensure its long-term success and sustainability.

3. Study methods

This study employed a case study methodology. Following introducing a data platform ecosystem framework, it applied the framework to analyze the WAGRI data platform as a case study. The selection of Japan's WAGRI data platform as a case was both intrinsically and instrumentally motivated. Intrinsically, the WAGRI data platform case is empirically significant and of considerable interest due to its recent success in the development and implementation of an agricultural data platform. Instrumentally, the case of Japan provides a novel geographical perspective, complementing the well-documented cases in Europe (e.g., FarmMaps in the Netherlands, and Farmdata in Spain), Australia (Web APIs in Australia), and South America (e.g., AgroAPI in Brazil) (Borrero & Mariscal, 2022; Poppe et al., 2015; Romani et al., 2023; Wolfert et al., 2017). Table 1 illustrates selected data platforms in agriculture operating under different ruling governors in four regions.

Table 1 Data platforms in agriculture operating under different governing governors

Data platform	Region	Governing governor	Type of governing organization
WAGRI	Asia	National Agricultural Research Organisation (NARO)	Research Organization
FarmMaps	Europe	Wageningen University & Research	University
Farmdata	Europe	University of Huelva, Spain	University
Web APIs	Australia	Department of Primary Industries and Regional Development	Government
AgroAPI	South America	Brazilian Agricultural Research Corporation (Embrapa)	Research Organization

The research questions addressed in this study were as follows:

- 1) What were the components and key characteristics of the WAGRI Agricultural Data Collaboration platform ecosystem, and how did they evolve?
- 2) What were the key data platform governance mechanisms of the WAGRI Agricultural Data Collaboration platform, what were the roles of stakeholders in governing the platform, and how did they evolve?
- 3) What were the underlying strategies for developing and implementing the WAGRI Agricultural Data Collaboration platform?

3.1 Data collection

The data collection strategy employed in this study resembled that of historical studies, where direct observation of events was not feasible. The data collection and subsequent analysis involved an iterative process of examining data from multiple sources, with the author continuously refining understandings and interpretations. In this process, the compilation of factual information through secondary data collection was essential for developing comprehensive historical and contextual understandings, and interpretations of the research case.

This research utilized a diverse array of secondary data sources, including WAGRI-related press releases and announcements, archival data, conference, workshop, and special event data, public interviews, and online articles. The author prioritized the collection of all publicly accessible data related to the development of the WAGRI data platform, aiming for a comprehensive understanding while mitigating potential biases associated with extensive interviews. The secondary data collection and analysis were supplemented by primary data collection through semi-structured interviews with key stakeholders. These face-to-face interviews were conducted in late 2024 in Tsukuba, Japan, the location of the National Agricultural Research Organization (NARO) headquarters. The interviewees were the key persons involved in development and governance of the WAGRI data platform, including NARO's personnels at Research Center for Agricultural Information Technology, members of the WAGRI Council, ICT vendors, and agri-tech company owners representing users of the WAGRI data platform. Each of the interviews lasted approximately 50-90 minutes. The total number of interviewees was nine.

The interview topics and the scope of data collection from primary and secondary sources are detailed in Table 2.

Table 2 Topics and scope of data from interviews and secondary sources

Source of data	Topics and scope of data
Interviews	• Explanation of activities in key events in the WAGRI data platform development and implementation • Strategies of the WAGRI data platform ecosystem
WAGRI-related press releases and announcements, archival data, conference, workshop, and special events data, public interviews, online articles	• Description and development of key events in the WAGRI data platform development and implementation • Key stakeholders in the WAGRI data platform ecosystem and their characteristics • Roles of stakeholders, and policies, standards, processes and procedures of big data shared among the stakeholders in the WAGRI data platform ecosystem • Business model of the WAGRI data platform ecosystem • Development and implementation strategies of the WAGRI data platform ecosystem

This research adhered to the international standards for the protection of human subjects, and the research protocols were reviewed and approved by the Institutional Review Board (IRB) of the Office of the Research Ethics Review Committee for Research Involving Human Subjects, Chulalongkorn University. The research proposal underwent review by the Research Ethics Review Committee for Research Involving Human Subjects: The Second Allied Academic Group in Social Sciences, Humanities and Fine and Applied Arts, under an expedited review category. Approval was granted with reference number 521/67.

3.2 Data analysis

This research employed a historical approach. The starting point of the empirical analysis was in March 2017, the initiation of the WAGRI data platform. The analysis encompassed a seven-year period, spanning 2017 to 2024. Time-stamped data facilitated the chronological mapping of key events in the platform's development, from its inception to recent implementation within the WAGRI data platform ecosystem. The analysis of data was guided by the research objective, the research questions, and the conceptual framework derived from Section 4 Literature review, on data governance and data platform ecosystems (Adner, 2016; Jacobides et al., 2018; Kapoor, 2018; Parker & Van Alstyne, 2014; Parker et al., 2016; Yablonsky, 2020). The conceptual and analytical framework is depicted in Figure 1.



Figure 1 Conceptual and analytical framework of data platform ecosystem

The findings from the analyses were articulated as a developmental process, providing preliminary answers to the research questions. Subsequently, an explanation-building strategy was employed to develop a cogent understanding and explanation of the research questions. This resulted in the identification of ecosystem components and their characteristics, the respective roles of stakeholders, the governance mechanisms and business model of the WAGRI data platform, and the underlying strategies for developing and implementing the WAGRI data platform.

4. Literature review

This section reviews key theoretical concepts on data governance and data platform ecosystems, informing the conceptual and analytical framework of this research.

4.1 Data governance

Data governance constitutes an essential element in facilitating data value creation. According to Abraham et al. (2019, pp. 425-426), data governance is defined as “a cross-functional framework that manages data as a strategic enterprise asset by establishing clear decision-making rights and accountabilities, formalizing data policies, standards, and procedures, and ensuring their adherence.” Fundamentally, data governance sets up policies and responsibilities of what decisions must be made and who make the decisions regarding data. Abraham et al. (2019) synthesized various concepts into a conceptual framework for data governance, identifying three governance mechanisms: structural, procedural, and relational. The objectives and scopes of these mechanisms are summarized in Table 3.

Table 3 Objectives and scopes of governance mechanisms

Mechanisms	Objectives	Scopes
Structural	Determining reporting structure, governance bodies, and accountabilities	• Roles and responsibilities • Locations of decision-making authority
Procedural	Ensuring accuracy, security, effectiveness, and appropriateness of data usage	• Data strategy • Policies, standards, processes and procedures • Contractual agreements • Performance measurement • Compliance monitoring • Issue management
Relational	Facilitating collaboration between stakeholders	• Communication • Training • Coordination of decision making

Source: Summary from Abraham et al. (2019)

Among governance mechanisms, the identification of the data owner and their associated roles is paramount. Specifically, data ownership and accountability must be clearly delineated (Abraham et al., 2019). Furthermore, the allocation of decision-making authority is critical and should be determined in relation to the benefits of data governance (Abraham et al., 2019). Consequently, structural mechanisms can significantly impact the efficacy of data governance design.

Additionally, data governance exhibits a dynamic nature, undergoing periods of change as it necessitates improvement and adaptation to evolving data needs and regulatory requirements (Abraham et al., 2019). However, with limited exceptions (e.g., Otto, 2013; Tallon et al., 2013; Vilminko-Heikkinen & Pekkola, 2019), prior studies have not adequately elucidated how data governance may evolve over time (Abraham et al., 2019). Therefore, this research seeks to enhance the understanding of data platform governance and its dynamic nature by investigating the evolution of data governance mechanisms, using the case of Japan's WAGRI agricultural data platform.

4.2 Data platform ecosystem

Current research on platform ecosystems considers and emphasizes the organization of economic agents as ecosystem actors around a platform (Jacobides et al., 2018). Within such an ecosystem, interdependencies exist between the economic agents or ecosystem actors and the platform itself, necessitating the consideration of both economic and structural components of the platform ecosystem (Adner, 2016; Jacobides et al., 2018; Kapoor, 2018). This requires the establishment of policies, standards, processes, and procedures for data sharing among the actors, which constitute inherent governance mechanisms of the platform ecosystem. These mechanisms effectively enable and promote value creation from the platform by ecosystem actors (Jacobides et al., 2018; Yablonsky, 2020).

Parker and Van Alstyne (2014), and subsequent work by Parker et al. (2016) on platform ecosystems, identified four distinct categories of economic agents or actors and their respective roles within the platform ecosystem. Firstly, the platform owner or leader serves as the platform steward, possessing the authority to control intellectual property and govern the platform. This authority encompasses defining the platform's business strategy, managing the underlying technology, and establishing governance mechanisms for platform operations through rules and standards. Secondly, the platform provider acts as an intermediary, facilitating platform user interactions by enforcing access rules to shared resources and maintaining the underlying platform architecture. Thirdly, platform users create value from the platform, including novel

solutions or services, which other parties select and utilize to fulfill their needs. Fourthly, users of the platform's solutions and services, or customers, utilize offerings created by the platform users.

While these four categories of economic agents or ecosystem actors and their roles provide a valuable framework, they may be incomplete when applied specifically to "data" platform ecosystems. Specifically, another category of agents or actors can be the data provider to the platform. Therefore, adapting Parker and Van Alstyne (2014) and Parker et al. (2016), this research proposes five categories of economic agents or actors organizing and operating within the data platform ecosystem, summarized in Table 4.

Table 4 Economic agents or actors, and their roles within data platform ecosystem

Economic agents or actors within data platform ecosystem	Roles within data platform ecosystem
Owner of data platform	• Define the platform's business strategy • Control intellectual property • Manage underlying technology • Establish governance mechanism through the use of rules and standards
Provider of data platform	• Facilitate users' interactions with the platform • Enforce rules for accessing to shared resources • Maintain underlying platform architecture
Providers of data to data platform	• Provide data for creating values
Users of data platform	• Create values including new solutions or services
Users of solutions or services from values created from data platform	• Use or acquire new solutions or services

Source: Adapted from Parker and Van Alstyne (2014) and Parker et al. (2016)

Within a data platform ecosystem, the key technology platform infrastructure is digital infrastructure, a category of information technology artifacts. Tilson et al. (2010, p. 1) defined digital infrastructure as the basic information technologies and organizational structures, along with the related services and facilities necessary for an enterprise or industry to function. The necessity to control access and utilization of platform resources requires the incorporation of software tools and regulations that serve as an interface between the platform owner and users (Ghazawneh & Henfridsson, 2013; Tilson et al., 2010). Consequently, information technologies and software tools constitute the core technologies of the technology platform infrastructure within a data platform ecosystem.

A related concept of ecosystems is an innovation ecosystem. According to Granstrand and Holgersson (2020, p. 3), an innovation ecosystem is an evolving set of actors, activities, and artifacts, alongside institutions and relations, including complementary and substitute relations, that are crucial for the innovative performance of an actor or a population of actors.

A data platform ecosystem, while distinct, operates within a broader innovation context. It represents a specific type of innovation ecosystem where core platform technologies enable and facilitate the creation and exchange of data value among a diverse set of actors. Consequently, economic agents and their roles in the data platform ecosystem are analogous to the actors and activities of an innovation ecosystem, while platform technology infrastructure is comparable to artifacts. Furthermore, the governance of the data platform ecosystem is an integral part of the institutions and relations of the innovation ecosystem.

Moreover, both data platform ecosystems and broader innovation ecosystems are subject to continuous evolution, driven by technological advancements, evolving market demands, and the emergence of new actors and relationships. Therefore, conceptualizing the data platform ecosystem within the broader innovation ecosystem framework allows for a more comprehensive perspective on the dynamics of the data platform ecosystem. This research conceptualizes a data platform ecosystem within a broader innovation ecosystem framework, as a data platform ecosystem framework, depicted in Figure 2. This framework informed the study design and was operationalized in section 3, the study methods section, for analyzing the WAGRI data platform as a case study.

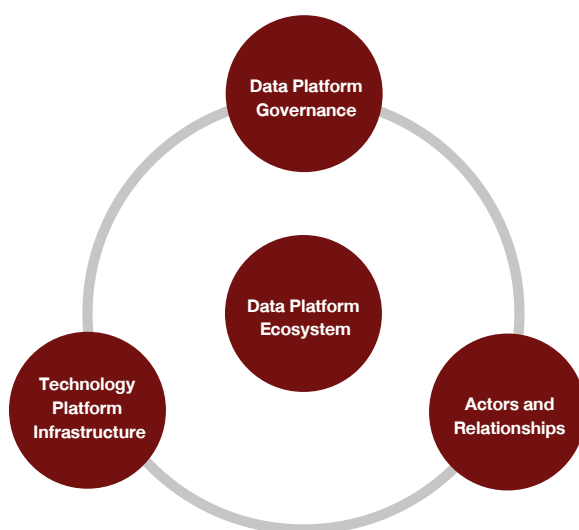


Figure 2 The data platform ecosystem framework

5. Results

5.1 The WAGRI data platform ecosystem: components and characteristics

The WAGRI data platform ecosystem had three main components: (1) actors and relationships; (2) technology platform infrastructure, and (3) data platform governance. This sub-section elaborates on each of the components.

5.1.1 Actors and relationships

The major actors engaging in the WAGRI data platform development and operation can be grouped into five categories: (1) owner of the WAGRI data platform; (2) provider of the WAGRI data platform; (3) providers of data to the WAGRI data platform; (4) users of the WAGRI data platform; and (5) users of solutions or services created from the WAGRI data platform. Table 5 summarizes actors within each category, and their key roles and responsibilities within the WAGRI data platform ecosystem.

Table 5 Actors and relationships within the WAGRI data platform ecosystem

Category of actors	Individuals and organizations	Roles & responsibilities and relationships
Owner of the WAGRI data platform	- SFC Research Institute, Keio University (March 2017–March 2019) - WAGRI Promotion Office, NARO (April 2019–present)	- Leading, and creating the stakeholder network of the WAGRI Agricultural Data Collaboration Platform, financed by the Cabinet's Cross-ministerial Strategic Innovation Promotion Program (SIP) I Program - Taking full responsibility of developing, managing, and promoting the stakeholder network (collaborating with other ministries and agencies) - Governing the WAGRI data platform, acting as the secretariat of the WAGRI Council
Provider of the WAGRI data platform	- SFC Research Institute, Keio University (March 2017–March 2019) - WAGRI Promotion Office, NARO (April 2019–present)	- Conducting pilot operation, and demonstrating the benefits of the WAGRI data platform - Managing full operation of the WAGRI data platform (users management and technical supports)

Category of actors	Individuals and organizations	Roles & responsibilities and relationships
Providers of data to the WAGRI data platform	- Public organizations (e.g. Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan Meteorological Agency (JMA), etc.) - Private companies (e.g. metrological companies, ICT vendors) - Research organizations and Universities (e.g. NARO, Keio University)	- Providing public data for free-of-charge - Being members of the WAGRI data platform (free of charge), the WAGRI Council (free of charge), and being representatives of the advisory board of the Council - Providing private data and systems for fees, to be paid by users of the platform - Being members of the WAGRI data platform (free of charge), the WAGRI Council (free of charge), and being representatives of the advisory board of the Council - Disseminating research results, and licensing systems to users of the platform - Being members of the WAGRI data platform (free of charge), the WAGRI Council (free of charge), and being representatives of the advisory board of the Council
Users of the WAGRI data platform	- Private companies (e.g. agricultural machinery manufactures, ICT vendors) - University and research organizations	- Using data and systems, provided by the WAGRI data platform, and separately contracted with other data providers, for creating services or solutions - Being members of the WAGRI data platform (fee paid), the WAGRI Council (free of charge), and being representatives of the advisory board of the Council - Using data for research and education - Being members of the WAGRI data platform (free of charge or discounted), the WAGRI Council (free of charge), and being representatives of the advisory board of the Council
Users of solutions or services created from the WAGRI data platform	- Private companies (e.g. agricultural producer companies) - Farmers	- Using services or solutions, provided by the users of the WAGRI data platform - Paying fees for using services or solutions, to the service providers - Using services or solutions, provided by the users of the WAGRI data platform - Paying fees for using services or solutions, to the service providers

From its initial Research and Development (R&D) phase beginning in 2017, the WAGRI data platform ecosystem cultivated relationships among key actors, initially structured as the Agricultural Data Collaboration Platform Consortium under the leadership of Keio University's SFC Research Institute (Uehara, 2019; Uehara & Shinjo, 2019). Following the platform's transfer of ownership and operational management to NARO in April 2019, a substantial increase in participating actors and stakeholders led to a significant expansion of this network (Shiomi, 2020; Shiomi & Ishihara, 2019; Shiomi & Saito, 2020). This growth culminated in WAGRI becoming Japan's largest big data consortium (Uehara, 2019). Despite this expansion, the structural relationships among the five actor categories remained relatively consistent, with NARO assuming the governing role previously held by the SFC Research Institute of Keio University (as detailed in Sub-section 5.1.3). Figure 3 illustrates these structural relationships within the WAGRI data platform ecosystem.

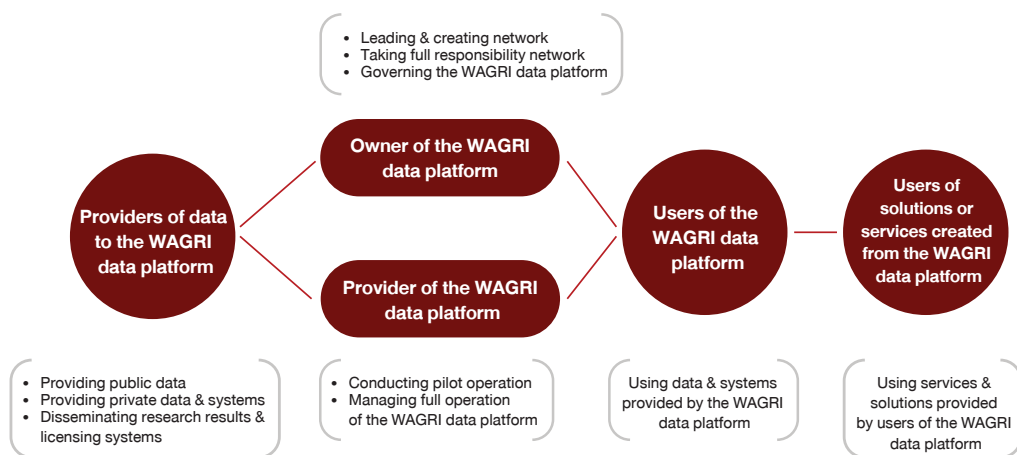


Figure 3 The roles and structural relationships among the actors of the WAGRI data platform ecosystem

5.1.2 Technology platform infrastructure

The WAGRI data platform's technology infrastructure was specifically designed and developed to support its core functionalities: data sharing, data provision, and data utilization. A foundational information technology infrastructure, including a subsequent AI supercomputer and Linked Database, formed the core of the WAGRI data platform (Kawamura, 2023; 2024; NARO, 2018). The platform utilizes Application Programming Interfaces (APIs) as the software tools to manage data input and output and to execute programs provided by the platform (Shiomi, 2020; Shiomi & Ishihara, 2019; Shiomi & Saito, 2020). The rapid expansion of

the technology platform infrastructure is largely attributable to research capabilities of NARO and the platform’s architecture, which allows for independent development of the platform itself and its associated APIs (Kawamura, 2023; Uehara & Shinjo, 2019).

The core technology infrastructure of the WAGRI data platform remained consistent from its R&D phase through its full operational deployment. However, technological advancements in speed, capacity, and security were implemented to accommodate the growing number of members or users and data categories, as demonstrated by the increasing number of available APIs (Kawamura, 2023; 2024; Uehara, 2019; Uehara & Shinjo, 2019). Table 6 below summarizes the technology platform infrastructure within the WAGRI data platform ecosystem.

Table 6 Technology platform infrastructure within the WAGRI data platform ecosystem

Technology platform infrastructure	Core technologies	Functions
Underlying information and digital technologies	- AI supercomputer and NARO Linked Database (DB) - Access token authentication, OpenID Connect	- Data communication and linkage (speed and capacity) - Data communication and linkage (security)
Software interface between the users and the platform operator	Web-based Application Programming Interface (API), using Graphical User Interface (GUI)	- Managing data input and output, and executing the programs, with simple scripts by the users - A growing number of APIs: From 60 APIs (2019) to 187 APIs (2024)

5.1.3 Data platform governance

The governance of the WAGRI data platform ecosystem was analyzed through a data governance framework comprising three interconnected mechanisms: structural, procedural, and relational (Abraham et al., 2019). The structural mechanism was examined by analyzing the governing bodies and their organizational structure. The procedural mechanism was investigated by exploring the established data governance measures. Finally, the relational mechanism was characterized by the collaborative interactions among stakeholders.

Each of these mechanisms was assessed across two distinct phases of the WAGRI data platform's development: (1) the Research and Development (R&D) phase, spanning from March 2017 to March 2019, under the guidance of the SFC Research Institute of Keio University; and (2) the full operational phase, commencing in April 2019 and continuing to the present, under the leadership of NARO (Kawamura, 2024; MAFF, 2020a; Uehara, 2019). This two-phase analysis revealed a strengthening of the governance structure, the further

development of established governance procedures, and an expansion of collaborative relationships among stakeholders. Table 7 provides a summary of data platform governance within the WAGRI data platform ecosystem.

Table 7 Data platform governance within the WAGRI data platform ecosystem

Data platform governance	Structure and measures	Objectives and scopes
Governance bodies and structure		
March 2017–March 2019	<i>SFC Research Institute, Keio University:</i> - Leading and creating a stakeholder network of the WAGRI Agricultural Data Collaboration Platform Consortium, financed by the Cabinet's SIP I Program	- Preparation of governance measures adopted from Cabinet Office and MAFF - Governance measures not formulated or developed fully
April 2019–present	<i>WAGRI Promotion Office, NARO:</i> - Taking full responsibility of developing, managing, and promoting a stakeholder network - Collaborating with other ministries and agencies, private companies, and universities and research organizations	- Establishment of governance measures regarding data ownerships, data sharing, data provision, and data utilization - Organization of governance measures to be implemented
Data governance measures		
March 2017–March 2019	<i>SFC Research Institute, Keio University:</i> - Cabinet Office's Standard Term of Use on Agricultural IT Service (2016) - MAFF's Data Contract Guidelines in the Agricultural Sector (2018)	- Specifying ownership of data by type of data - Raw data – only belonged to data provider - Processed data – depended on the data - Specifying ownership of data by type of data - Determining the type of data contract - Data provision - Data creation - Data sharing

Data platform governance	Structure and measures	Objectives and scopes
April 2019–present	<i>WAGRI Promotion Office, NARO:</i> - Basic policy on handling of research data (2019) (based on Cabinet Office (2019) Guideline for Establishing Data Policy at National Research and Development Agencies (2018)) - Data ownership guideline (2019) (based on MAFF's Data Contract Guidelines in the Agricultural Sector (2018)) - Research DB guidelines and Research data terms of use (2020) (based on Cabinet Office's Guidelines for the Development and Operation of Research Data Repositories (2019)) - Terms of use for data provision and data agreement (2020) (based on MAFF (2020b) Guidelines on Contracts Regarding Utilization of AI and Data in Agricultural Sector (2020))	- Handling of research data at NARO - Specifying ownership of data by type of data - Determining the type of data contract - Data provision - Data creation - Data sharing - Developing and operating research data repositories, supporting - Sharing of research data - Protecting data ownership - Enabling collaborative data sharing - Cultivating security for data sharing, data provision, and data utilization
Collaborative interactions among stakeholders		
March 2017–March 2019	<i>SFC Research Institute, Keio University:</i> - Leading and creating a stakeholder network of the WAGRI Agricultural Data Collaboration Platform Consortium, financed by the Cabinet's SIP I Program	- Collecting data from public organizations (e.g. MAFF, JMA, etc.) - Conducting pilot operation and practical tests with stakeholders in the network of the Agricultural Data Collaboration Platform Consortium
April 2019–present	<i>WAGRI Promotion Office, NARO:</i> - Taking full responsibility of developing, managing, and promoting a stakeholder network - Collaborating with other ministries and agencies, private companies, and universities and research organizations	- Governing the WAGRI data platform, acting as the secretariat of the WAGRI Council (560 WAGRI Council members as of October 2004) - Commercializing research results, data and systems to private companies through the platform - A growing number of private companies using the WAGRI data platform: From 45 companies (2020) to 110 companies (2024)

5.2 Development and operations strategies of the WAGRI data platform

The WAGRI data platform has evolved into a successful big-data platform in the agricultural sector, driven by strategic development and operational approaches encompassing technology, business, and governance. Technologically, NARO and its predecessor, the SFC Research Institute

of Keio University, implemented an IT architecture that facilitated independent development of NARO's internal platform data technology (i.e., AI supercomputer, Linked DB) and user-developed APIs. This allows WAGRI platform users to flexibly and rapidly develop and provide services and solutions utilizing the available data (Kawamura, 2023; 2024; MAFF, 2020a). Furthermore, the implementation of OpenID Connect and access token authentication ensures secure data sharing (Shiomi, 2020; Shiomi & Saito, 2020).

From a business perspective, NARO has implemented a Business-to-Business-to-Customer (BtoBtoC) business model that has effectively facilitated both data provision and utilization on the WAGRI data platform. This model was also refined through customized fee structures tailored to different user categories, contributing to the platform's ability to attract diverse users and driving increased utilization and data commercialization (Kawamura, 2024). By 2024, the WAGRI data platform had become one of the first near self-sustaining, revenue-generating data platforms in Japan (Kawamura, 2024; NARO, 2021).

6. Discussion

This research provided key insights into the evolution of a data platform in agriculture within a data platform ecosystem framework, using evidence from the WAGRI data platform as a case study. The results presented in Tables 5-7 of the two-period analysis, spanning from the R&D phase to full operation, revealed an evolution of the platform governance, including strengthening of the governance structure, further development of established governance measures, and an expansion of collaborative interactions among stakeholders. This finding offers valuable insights into the dynamic nature of data governance, an area that so far has received limited attention in previous research (Abraham et al., 2019; Borrero & Mariscal, 2022).

In terms of governance, the analysis of the development and operations strategies of the WAGRI data platform indicated that the consistent leadership of NARO, and previously the SFC Research Institute of Keio University, as both platform owner and provider, has been a defining characteristic throughout WAGRI's evolution from R&D to full operation. With guidance and financial support from the Cabinet Office, NARO and the SFC Research Institute effectively developed a collaborative network of stakeholders, robust data governance measures, and a strong governance structure. Particularly, NARO's data ownership guidelines and the terms of use, along with data agreements, have enabled collaborative data sharing while also ensuring security across all aspects of data sharing, provision, and utilization.

Furthermore, the strong leadership of the platform owner and its capabilities are critical to the successful development and implementation of the data platform. The platform owner must possess capabilities across technological, business, and governance domains. While prior studies of data platforms in other countries such as Farmdata in Spain, have suggested that farmers are more likely to participate in big-data platforms owned and governed by universities due to data security concerns (Borrero & Mariscal, 2022; Turland & Slade, 2020), this research demonstrates that NARO, as a public research organization, has effectively attracted participation from local stakeholders, including farmers, while maintaining a strong emphasis on data security.

7. Conclusion

This research analyzed the governance of the WAGRI Agricultural Data Collaboration Platform, a Japan's agricultural big data platform, and its evolution over time. The findings highlighted the integral role of the platform owner and the platform provider, NARO and its predecessor, the SFC Research Institute of Keio University, as stewards of the WAGRI data platform, establishing a collaborative stakeholder network and effectively governing the WAGRI data platform (Borrero & Mariscal, 2022; Harmel et al., 2021; Parker & Van Alstyne, 2014; Parker et al., 2016).

From a policy perspective, this research also underscores the importance of strategic development and implementation approaches for agricultural data platforms like WAGRI. Specifically, a clearly articulated business model, reflecting operational costs and local business innovation environment, is essential. For a contrasting example, Thailand's THAGRI agricultural data platform, announced in November 2021, has seen rather limited development and commercialization (NECTEC, 2022). The absence of a robust business model may be hindering the THAGRI platform's continued operation, despite its public sector backing. This remains a major challenge for Thailand aiming to achieve data-driven agriculture or smart farming.

8. Recommendations

8.1 Recommendation for future studies

This study examined a case study of Japan's WAGRI data platform in agriculture, which demonstrated key components influencing successful development and implementation of the platform. While it is appropriate to consider learning from Japan and applying it to Thailand, it still further requires an in-depth study to understand the current policy strategies and progresses, as well as obstacles facing Thailand in developing and implementing a big data platform in agriculture. To this end, the lessons from this case study of Japan will be properly applied to promote the utilization of the big data platform in agriculture in Thailand.

8.2 Policy recommendation for digital communications

In terms of policy recommendation for digital communications, local communication companies should strategically collaborate with other stakeholders in extending the utilization of big data in agriculture. A recent study by Srivetbodee and Igel (2021) has indicated that the partnership between a leading communication company in Thailand with National Electronic and Computer Technology Center (NECTEC) and a startup company, led to the utilization of weather and soil conditions data to build mobile applications for disseminating important data to local smart farmers. Other project partners also included Ministry of Agriculture and Cooperatives and Department of Agricultural Extension. However, the project partnership was mainly part of the company's creation and promotion of corporate social responsibility and its brand image, and so it was unclear about the future growth and sustainability.

Therefore, as highlighted in this case study of Japan's WAGRI data platform, a proper and clearly articulated business model for local communication companies in partnership with other stakeholders will be crucially required to successfully develop and implement the big data platform in agriculture.

Acknowledgements

This research was financially supported by the Sumitomo Foundation's FY 2023 Grant for Japan-Related Research Projects.

References

- Abraham, R., Schneider, J., & vom Brocke, J. (2019). Data governance: a conceptual framework, structured review, and research agenda. *International Journal of Information Management*, 49, 424-438. <https://doi.org/10.1016/j.ijinfomgt.2019.07.008>
- Adner, R. (2016). Ecosystem as Structure: An Actionable Construct for Strategy. *Journal of Management*, 43(1), 39-58. <https://doi.org/10.1177/0149206316678451>
- Basso, B., & Antle, J. (2020). Digital agriculture to design sustainable agricultural systems. *Nature Sustainability*, 3, 254-256. <https://doi.org/10.1038/s41893-020-0510-0>
- Borrero, J. D., & Mariscal, J. (2022). A Case Study of a Digital Data Platform for the Agricultural Sector: A Valuable Decision Support System for Small Farmers. *Agriculture*, 12(6), 767. <https://doi.org/10.3390/agriculture12060767>
- Bronson, K., & Knezevic, I. (2016). Big Data in food and agriculture. *Big Data & Society*, 3(1). <https://doi.org/10.1177/2053951716648174>
- Cabinet Office. (2019, March 29). *Guidelines for the Development and Operation of Research Data Repositories*. <https://www8.cao.go.jp/cstp/tyousakai/kokusaipen/guideline.pdf>
- Carletto, C. (2021). Better data, higher impact: Improving agricultural data systems for societal change. *European Review of Agricultural Economics*, 48(4), 719-740. <https://doi.org/10.1093/erae/jbab030>
- Fischer, R. A., & Connor, D. J. (2018). Issues for cropping and agricultural science in the next 20 years. *Field Crops Research*, 222, 121-142. <https://doi.org/10.1016/j.fcr.2018.03.008>
- Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal*, 23(2), 173-192. <https://doi.org/10.1111/j.1365-2575.2012.00406.x>
- Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: a conceptual review and a new definition. *Technovation*, 90-91, 102098. <https://doi.org/10.1016/j.technovation.2019.102098>
- Harmel, R. D., Kleinman, P., Eve, M., Ippolito, J. A., Beebout, S., Delgado, J., Vandenberg, B., & Buser, M. (2021). The Partnerships for Data Innovations (PDI): Facilitating data stewardship and catalyzing research engagement in the digital age. *Agricultural & Environmental Letters*, 6(4), e20055. <https://doi.org/10.1002/ael2.20055>
- Hein, A., Schrieck, M., Wiesche, M., & Krcmar, H. (2016, March 9-11). Multiple-case analysis on governance mechanisms of multi-sided platforms. *Telekommunikations- und Internetwirtschaft. MKWI 2016* (pp. 1-12). Paderborn, Germany. https://andreas-hein.info/portfolio/ScholarlyArticles/MKWI_2016_Paper_Camera_Ready_256.pdf
- Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, 39(8), 2255-2276. <https://doi.org/10.1002/smj.2904>

- Kamilaris, A., Kartakoullis, A., & Prenafeta-Boldú, F. X. (2017). A review on the practice of big data analysis in agriculture. *Computers and Electronics in Agriculture*, 143, 23–37. <https://doi.org/10.1016/j.compag.2017.09.037>
- Kapoor, R. (2018). Ecosystems: broadening the locus of value creation, *Journal of Organization Design*, 7(1), 12. <https://doi.org/10.1186/s41469-018-0035-4>
- Kawamura, T. (2023). Information Platforms for Smart Agriculture. In Q. Zhang (Ed.), *Encyclopedia of Digital Agricultural Technologies* (pp. 662-672). Springer. https://doi.org/10.1007/978-3-031-24861-0_184
- Kawamura, T. (2024, November 6). NARO Research DX for promoting Data-Driven Agriculture [Keynote address]. *14th International Conference of Asia-Pacific Federation for Information Technology in Agriculture. APFITA 2024*. Tsukuba, Japan.
- MAFF. (2020a, December 3). *Agricultural Data Collaboration Platform WAGRI*. https://www.maff.go.jp/e/policies/tech_res/smaagri/PDF/WAGRI_20250210.pdf
- MAFF. (2020b, March). *Contract Guidelines for AI and Data in the Agriculture Sector*. <https://www.maff.go.jp/j/kanbo/tizai/brand/keiyaku.html>
- NARO. (2018). *Establishment of a research center for integrating AI and big data infrastructure*. <https://www.naro.affrc.go.jp/english/topics/laboratory/naro/119620.html>
- NARO. (2021, January). *About the WAGRI Agricultural Data Collaboration Platform*. <https://kochi-iop.jp/iopwp/wp-content/uploads/2021/01/edbe19d762e74ff13cfdec4439660c32.pdf>
- NECTEC. (2022). *Thailand Agricultural Data Collaboration Platform (THAGRI)*. <https://www.thagri.in.th/>
- Otto, B. (2013). On the Evolution of Data Governance in Firms: The Case of Johnson & Johnson Consumer Products North America. In S. Sadiq (Ed.), *Handbook of Data Quality* (pp. 93–118). Springer. https://doi.org/10.1007/978-3-642-36257-6_5
- Parker, G., & Van Alstyne, M. (2014). Platform Strategy. In M. Augier, & D. Teece (Eds.), *The Palgrave Encyclopedia of Strategic Management* (pp. 1290–1298). Palgrave Macmillan. <https://doi.org/10.1057/978-1-349-94848-2>
- Parker, G., Van Alstyne, M. W., & Choudary, S. P. (2016). *Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You*. W. W. Norton & Company.
- Poppe, K., Wolfert, S., Verdouw, C., & Renwick, A. (2015). A European Perspective on the Economics of Big Data. *Farm Policy Journal*, 12(1), 11–19. https://www.researchgate.net/publication/278300518_A_European_Perspective_on_the_Economics_of_Big_Data
- Romani, L. A. S., Evangelista, S. R. M., Vacari, I., Apolinário, D. R. F., Vaz, G. J., Speranza, E. A., Barbosa, L. A. F., Drucker, D. P., & Massruhá, S. M. F. S. (2023). AgroAPI platform: An initiative to support digital solutions for agribusiness ecosystems. *Smart Agricultural Technology*, 5, 100247. <https://doi.org/10.1016/j.atech.2023.100247>

- Rojo-Gimeno, C., van der Voort, M., Niemi, J. K., Lauwers, L., Kristensen, A. R., & Wauters, E. (2019). Assessment of the value of information of precision livestock farming: A conceptual framework. *NJAS: Wageningen Journal of Life Sciences*, 90-91(1), 1-9. <https://doi.org/10.1016/j.njas.2019.100311>
- Shiomi, T. (2020). Agricultural Data Collaboration Platform WAGRI. *The Journal of the Institute of Electrical Installation Engineers of Japan*, 40(10), 642-645. <https://doi.org/10.14936/ieiej.40.642>
- Shiomi, T. & Ishihara, M. (2019). Full Operations of Agricultural Data Collaboration Platform WAGRI. *Journal of the Japan society of photogrammetry and remote sensing*, 58(5), 236-238. <https://doi.org/10.4287/jsprs.58.236>
- Shiomi, T., & Saito, T. (2020). Overview and System Operations of Agricultural Data Collaboration Platform WAGRI. *Journal of the Japanese Society of Agricultural Machinery and Food Engineers*, 82(3), 229-233. https://doi.org/10.11357/jsamfe.82.3_229
- Srivetbodee, S., & Igel, B. (2021). Digital Technology Adoption in Agriculture: Success Factors, Obstacles and Impact on Corporate Social Responsibility Performance in Thailand's Smart Farming Projects. *Thammasat Review*, 24(2), 149-170. <https://sc01.tci-thaijo.org/index.php/tureview/article/view/240106/163718>
- Tallon, P., Short, J., & Harkins, M. (2013). The Evolution of Information Governance at Intel. *MIS Quarterly Executive*, 12(4), 189-198. <https://aisel.aisnet.org/misqe/vol12/iss4/5>
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research Commentary—Digital Infrastructures: The Missing IS Research Agenda. *Information Systems Research*, 21(4), 748-759. <https://doi.org/10.1287/isre.1100.0318>
- Turland, M., & Slade, P. (2020). Farmers' willingness to participate in a big data platform. *Agribusiness*, 36(1), 20-36. <https://doi.org/10.1002/agr.21627>
- Uehara, H. (2019, August 22). *Information Service Platforms in Agriculture: Services and the architecture toward Smart Food Chain*. https://www.intelligentagri.com.tw/files/file_pool/1/0J231682167555447071/0821_05_Hiroshi%20Uehara%E8%AC%9B%E7%BE%A9.pdf
- Uehara, H., & Shinjo, A. (2019). WAGRI-the agricultural big data platform. In Sylvester, G. (Ed.), *E-agriculture in Action: Big Data for Agriculture* (pp. 73-83). FAO and ITU. <http://www.fao.org/3/ca5427en/ca5427en.pdf>
- Vilminko-Heikkinen, R., & Pekkola, S. (2019). Changes in roles, responsibilities and ownership in organizing master data management. *International Journal of Information Management*, 47, 76-87. <https://doi.org/10.1016/j.ijinfomgt.2018.12.017>
- Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). Big Data in Smart Farming-A Review. *Agricultural Systems*, 153, 69-80. <http://dx.doi.org/10.1016/j.agry.2017.01.023>
- Yablonsky, S. (2020). A multidimensional platform ecosystem framework. *Kybernetes*, 49(7), 2003-2035. <https://doi.org/10.1108/K-07-2019-0447>