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Interactive Infographic Dashboard of Urban Agriculture

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ABSTRACT

All countries worldwide are paying attention to sustainable models that are beneficial for managing the earth's resources. Urban sustainability is the United Nations' sustainable development goal. In the face of insufficient employment opportunities and population loss, it is reasonable to consider diverse urban agriculture (UA) scenarios to explore urban/rural sustainability. UA is an innovative service network that offers a diverse service portfolio, including business models, short supply chains, ecosystem services, and green tourism, which is helpful in creating not only an urban/rural marketing supply chain but also in increasing employment opportunities and improving urban/rural sustainability. Urban Agriculture Canvas (UAC) is the core of the Interactive Infographic Dashboard (IID), which is a planning framework for identifying various UA scenarios, including plain, waterfront, and mountain fringe. UAC contains multiple units that allow users to organize heterogeneous data and information and to disclose existing innovative services, including business models, short supply chains, ecosystem services, and green tourism. In this study, similarity serves as the method for identifying various agricultural product supply chains. The IID serves as an interface for presenting a co-occurrence network of UA scenarios while disclosing the existing innovative services and symbiotic relationships in the UA. The results show that 7 urban/rural cases filter three short supply chains, including organic food, ecological products, and local tourism, which are beneficial for the relocation of agricultural products to highly populated areas.

As shown above, UA is beneficial to maintaining food levels and increasing employment opportunities in urban and rural areas.

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INTRODUCTION

Urban agriculture (UA) is spread out due to the ever-increasing demand for fresh, affordable, and readily available products to meet the diverse requirements of urban areas. In the accordance with the studies, a symbiotic network between sustainable agriculture and rural/urban areas would be supported by UA (Smith et al., 2017). These studies point out that urban agriculture has different academic facets, referring to commercial urban, metropolitan agriculture (Heimlich, 1989), urban fringe agriculture (Bryant, 1997), and peri-urban agriculture (Zasada, 2011; Opitz et al., 2015; Mougeot, 2000). However, business models are the pivot for comprehending urban agriculture. Here, a varied combination of features is introduced into business models to comprehend UA. First, diversification, primary food producting, value differentiation, service provision, and innovative operations are identified by Liu (2015). Second, the five characteristics proposed by Van der Schans et al. (2010) are low cost, differentiation, diversification, commons, and experience. Third, Skar et al. (2020) proposed three characteristics: low-cost specialization, differentiation, and diversification. The various types of UA allow urban and rural areas to sustain food supplies within specific levels while integrating agricultural resources into the urban fringe zone. For example, Jansma and Wertheim-Heck (2022) provide an index portfolio, including the scale of operation, production, products, activities, supply, and users to analyze the diversity of peri-urban agriculture. As is listed, (1) garden agriculture (< 2-3 ha), (2) multipurpose agriculture (1-50 ha), and (3) conventional agriculture (2-100 ha+). The impact of developing short supply chains on UA is positive. Short supply chains come in many forms that allow UA to reconstruct the relationship between producers and consumers while providing a variety of business model scenarios. To continue doing so, Marsden et al. (2000) studied various short supply chains, such as certified organic food, ecological produce, green tourism, and farmers' markets. Short supply chains are critical partners in maintaining UA development. These pivotal partners deliver agricultural products to the zones with more people while affecting the local

supply chain and inducing various agricultural relocations (Aubry et al., 2013). UA is beneficial for alleviating ecosystem degradation. UA and green infrastructure are comparable in their ability to offer a wide scope of ecosystem services (Parker, 2005). Furthermore, urban, and peri-urban agriculture play a pivotal role in ecosystem services (provisioning, regulating, cultural, and supporting) (Evans et al., 2022), which are essential for the health, sustainability, and resilience of rural and urban environments (Fanfani et al., 2022). From the perspective above, urban agriculture makes an important contribution to the social-ecological system (Joshua, 2022), while being an important zone for realizing sustainable issues. UA put into effect the goal of economic, social, and ecological sustainability through the management of agricultural production sources, including agriculture, forestry, fishery, and animal husbandry (Theron, 2017). To do so, a large analysis of global data has found that urban agriculture has the potential to produce up to 10% of food crops, which is good news that UA is useful in contributing to sustainable development. In particular, the company can grow lettuce in hydroponic greenhouses in New York and Chicago and sell it in well-known shops in New York and the Midwest (Nel et al., 2021). Based on the above literature, some new insights into UA are as follows. UA is an innovative service network, offering a diverse service portfolio including business models, short supply chains, ecosystem services, and green tourism, while it is useful for supporting a symbiotic network between sustainable agriculture and rural and urban areas (Zhu et al., 2020; Clinton et al., 2018). However, some visualization challenges will be involved in comprehending the meaning of UA. To do so, this paper will explore this issue while data science and infographics are introduced in the next step. Facing waves of big data and data science (Papadopoulosa, 2021), more and more people are choosing to use infographics to deliver information while addressing the challenge of attracting attention. Infographics are another way of expressing information. The goals of infographics and data visualization are similar in that both present heterogeneous data in the form of diagrams (Rotolo et al., 2021). Infographics use diagrams as the primary information carrier, emphasizing the presentation of visual and graphic design skills (Tufte, 1983). Infographics are beneficial for people to understand the complex lot of information that is generated every day. Data visualization presents complex data in a simplified and easy-to-understand form based on charts, making it easier to identify patterns, trends, and correlations in data. The key to this insight is that the appropriate diagram is chosen to convey the information clearly according to the purpose of use (Bachechi et al., 2022). Dr. Andrew (2014) summarizes diversity charts for data visualization while classifying them into four purposes referring to comparison, distribution, composition, and relationship. From the above literature, the new insights and research highlights of UA are as follows. (1) Sustainability issues are attracting international attention. To this end, UA makes an important effort in ecosystem services while being the hub for addressing sustainability concerns (Skar et al., 2020). (2) UA is an innovative service network that offers a diverse service portfolio, including local tourism, community marketing, short supply chains, and business models. Meanwhile, the innovative service system will form synergies and symbiotic relationships to utilize local resources and create employment opportunities for the population. (3) UA offers diverse portfolio services to support the symbiotic network between sustainable agriculture and rural and urban areas. The short supply chain allows urban agriculture to reconstruct the relationship between producers and consumers, which will change the model of rural livelihoods. (4) UA is a symbiotic network with extensive heterogeneous data and information. However, some challenges will be involved in understanding the implications of heterogeneous data. Fortunately, data science and infographics will make it easier to identify patterns, trends, and correlations in heterogeneous data, while being beneficial for analyzing the future potential of UA (Rifat et al., 2022).

METHODOLOGY

UA can develop an innovative service and offer a diverse service portfolio, including local tourism, community marketing, short supply chains, and business models. Meanwhile, the innovative service can link agriculture with urban areas that will spread out synergies and symbiotic relationships to utilize local resources and create employment opportunities for the population. Heterogeneous data and information are major challenges for comprehending UA scenarios. Hence, this article disclosed an Interactive Infographic Dashboard (IID) forming a portfolio of diverse information about UA scenarios and short supply chain forms while revealing the potential of UA in the future. Accordingly, the foundation of IID is the Urban Agriculture Canvas (UAC), which is a portfolio framework to identify various UA scenarios. The UAC contains multiple unit blocks that allow users to organize heterogeneous data and information. To realize the above, the UAC was transferred into data models via Excel Power Pivot. At the same time, linkage and interaction functions between data models were generated in Tableau Public. The methods and processes are described as follows:

Urban Agriculture Canvas (UAC)

UAC is a portfolio interface that can be used to organize diverse data and information referring to

agricultural scenarios, landform scenarios, and innovative services (Figure 1) while identifying various UA scenarios. Considering the UA scenarios provided by Jan and Wertheim-Heck (2022), the information in peri-urban agriculture scenarios can be transformed into a UAC (Figure 2).

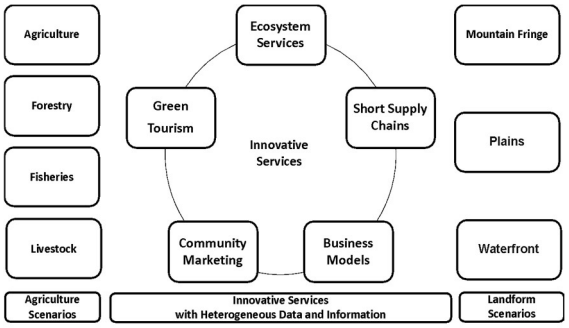

Figure 1 Urban Agriculture canvas

Establishing data models and relationships

UAC is a planning framework for structuring data models. According to the UAC, it can be used to collect UA data and establish data models. Excel Power Pivot is a data modeling technique that allows users to set up data models, relationships, and calculations based on databases.

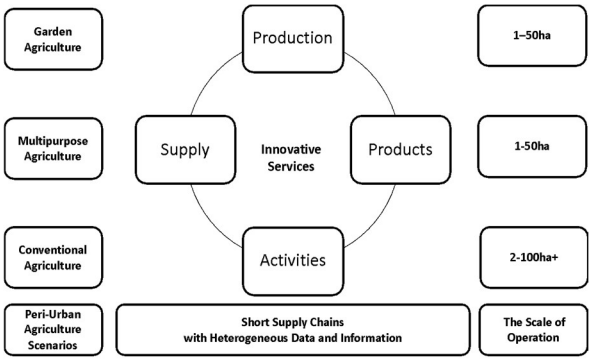

Figure 2 Per-Urban Agriculture canvas

Interactive Infographic Dashboard (IID)

Based on the planning framework of the UAC, we structured the data models and established the relationship between the data models. Next, the data models were introduced to Tableau Public to create an IID as described below. (1) The mission of Excel Power Pivot is to create data models and establish relationships between them based on the UAC. (2) Tableau Public is applied to build interactive graphs, maps, and instant dashboards. This refers to creating the data model based on the UAC while establishing the relationship between the data models and presenting the linkage effect of the dashboard. (3) The Calculated Fields in Tableau Public are used to manipulate data in the table. In the study, the Calculated Fields are introduced to create the infographics, including the chord or Sankey diagram.

Similarities in short supply chains:

UA is a symbiotic network that not only helps urban and rural areas create short supply chains but also increases employment opportunities while serving as an important driver toward urban and rural sustainability. Based on a vector basis, the similarity is used to identify three short supply chain cases referring to organic food, ecological products, and green tourism. Accordingly, this paper adopts the research of Salton and McG (2010), and the data of the short supply chains are expressed in vector form. The vector basis of short supply chains

$$SSC_i = (v_{i1}, v_{i2}, v_{i3}, \dots, v_{in}) \quad (1)$$

The reference vector basis of short supply chains

$$SSC_j = Max(v_{i1}, v_{i2}, v_{i3}, \dots, v_{in}) = (v_{j1}, v_{j2}, v_{j3}, \dots, v_{jn}) \quad (2)$$

Hence, the similarity in short supply chains is expressed as

$$\left(SSC_i, SSC_j\right) = \frac{\sum_{k=1}^{n} v_{ik}v_{jk}}{\sqrt{\sum_{k=1}^{n} v_{ik}^2}\sqrt{\sum_{k=1}^{n} v_{jk}^2}} \quad (3)$$

$$\sum_{k=1}^{n} v_{ik}v_{jk} = v_{i1}\times v_{j1} + v_{i2}\times w_{j2} + \dots + v_{in}\times v_{jn} \quad (4)$$

$$\sqrt{\sum_{k=1}^{n} v_{ik}^2}\sqrt{\sum_{k=1}^{n} v_{jk}^2} = \sqrt{(v_{i1} + v_{i2} + v_{i3} + \cdots + v_{in})} \times \sqrt{(v_{j1} + v_{j2} + v_{j3} + \cdots + v_{jn})} \quad (5)$$

Where scales are v_{ik}, v_{jk}.

Case Study

Employment opportunities and population loss are spreading out in urban and rural areas. These situations highlight where sustainable development issues are ignored in urban and rural areas. Urban Agriculture (UA) offers a diverse service portfolio, including business models, short supply chains, ecosystem services, and green tourism, while serving as an important activator for improving urban and rural sustainability. This study collected data from 7 urban and rural cases (Figure 3). The information refers to land area, population, and geographic pattern (Table 1). The case study process is described below:

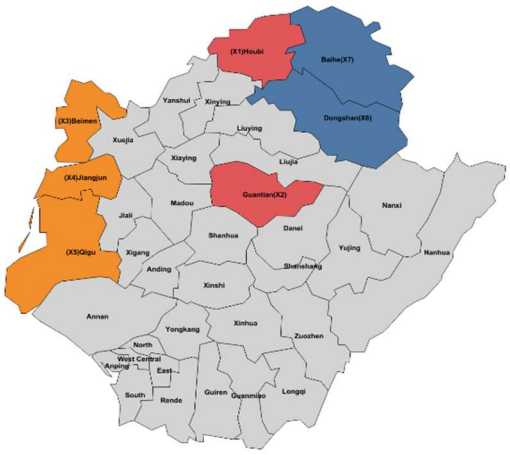

Figure3 Urban Agriculture Cases (Map Generated by Tableau Public)

Table 1 Data from 7 urban/rural cases

Case	Land Area	Population			Landform Patterns
	Hectare	Total	Male	Female	
X_1	7221.89	23213	12047	11166	Plains
X_2	7079.53	21268	10829	10439	
X_3	44100.3	10973	5525	5448	Waterfront
X_4	4197.96	19588	9980	9608	
X_5	11014.92	22611	11732	10879	
X_6	12491.78	20658	10966	9692	Mountain Fringe
X_7	12640.40	27965	14611	13354	

Urban Agriculture Canvas (UAC)

In Figure 4, there are seven urban cases. These urban and rural areas are located on mountain fringes, plains, and waterfronts, respectively. Based on the above methodology, UAC is a diverse information portfolio of agriculture scenarios, innovative services, and landform scenarios. Innovative services refer to short supply chains consisting of one-grade producing, two-grade processing, and three-grade selling.

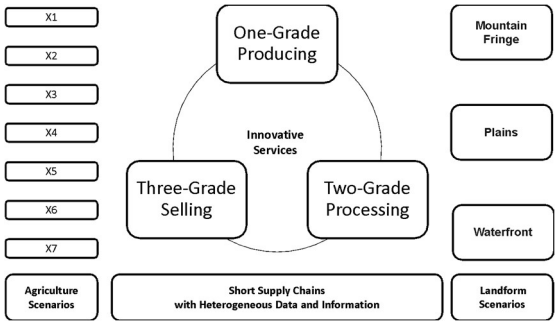

Figure4 Urban Agriculture Canvas

Date collection

UA is a service provision that includes a large amount of heterogeneous data and information. Short supply chains allow UA to reconstruct the relationship between producers and consumers, which will change urban and rural livelihoods and form an important driving force toward urban and rural sustainability. Accordingly, based on the UAC, heterogeneous data and information are collected in Table 2.

Infographics Development

The data in Table 4 consists of producing, UA scenarios, and short supply chains. Based on this information, the short supply chains between urban and agricultural areas in the literature [5] will be visualized by infographics. To do so, the data in Table 4 is introduced into Tableau Public to create infographics containing the portfolio information of production, geographic patterns, and scenarios, which are used to visualize short supply chains referring to organic food, ecological products, and green tourism (Figure 5).

Dashboard Deployment

Tableau public allows users to deploy the infographics in dashboards while establishing interactions between infographics. To do so, the interactive dashboard would provide the portfolio information of UA scenarios, production, processing, and short supply chains between agriculture and urban. (Figure 6). Finally, the dashboard would be published on Tableau Public Server and shared with community members.

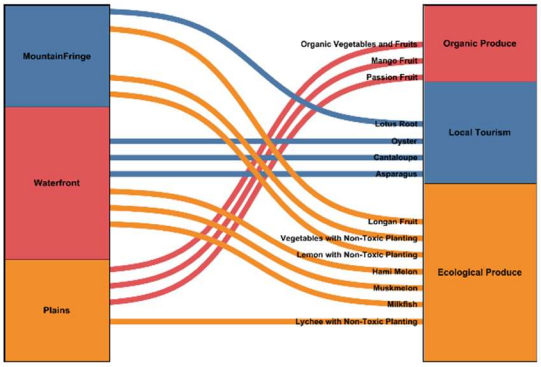

Figure 5 Transport Profile of Agricultural Products

Co-occurrence Networks of Short Supply Chains

Short supply chains serve as the transport path between the agricultural products and more population fields, meanwhile, these can induce various kinds of agricultural relocation, which is contributing to the development of agricultural production. Table 5, where short supply chains consist of one-grade producing, two-grade processing, and three-grade selling. The seven cases in Table5 would be introduced to Tableau Public to express the co-occurrence networks of short supply chains.

Calculating the similarity for Short Supply Chains

In the urban case (X_1, X_2,…, X_n), from Equations (1) and (2), various short supply chain data are expressed in vector form below: Vector basis of short supply chains is written as

$$SSC_i = (X_{i1}, X_{i2}, X_{i3}, \dots, X_{in}) \quad (6)$$

The reference vector basis is expressed as below

$$SSC_j = MAX(X_{i1}, X_{i2}, X_{i3}, \dots, X_{in}) = (X_{j1}, X_{j2}, X_{j3}, \dots, X_{jn}) \quad (7)$$

Hence, the similarity in various short supply chain data is expressed as

$$\left(SSC_i, SSC_j\right) = \frac{\sum_{k=1}^{n} X_{ik}X_{jk}}{\sqrt{\sum_{k=1}^{n} X_{ik}^2}\sqrt{\sum_{k=1}^{n} X_{jk}^2}} \quad (8)$$

$$\sum_{k=1}^{n} X_{ik}X_{jk} = X_{i1}\times X_{j1} + X_{i2}\times X_{j2} + \dots + X_{in}\times X_{jn} \quad (9)$$

$$\sqrt{\sum_{k=1}^{n} X_{ik}^2}\sqrt{\sum_{k=1}^{n} X_{jk}^2} = \sqrt{(X_{i1} + X_{i2} + X_{i3} + \cdots + X_{in})} \times \sqrt{(X_{j1} + X_{j2} + X_{j3} + \cdots + X_{jn})} \quad (10)$$

Where scales are X_{ik}, X_{jk}. From Equations (6)-(10), the similarity in the various short supply chains is written in Table3

Table2 Data Collected based on Urban Agriculture Canvas (UAC)

Geographic Patterns	Case	One-Grade Producing	Two-Grade Processing	Three-Grade Selling					
				Purchase through Social Media			Purchase through Usual Marketing		
				Facebook	LINE APP	Online Website	Telephone	Email	On Site
Plains	X_1	Lychee with Non-Toxic Planting	–	+	–	–	+	+	–
	X_2	Passion Fruit	–	+	–		–		
		Mango Fruit	Dried Mango Fruit	+	–		+	–	
		Organic Vegetables and Fruits	Kale Powder	+	+	+	–	–	+
			Rice Noodles						
Waterfront	X_3	Milkfish	Essence Soup	+	–	+	–		
		Muskmelon	Muskmelon Raw Milk Roll	+	–	+	–		
		Hami Melon	–	+	–	+	–		
	X_4	Asparagus	–	+	–	–	+	–	
		Cantaloupe	–	+	+	–	+	–	
	X_5	Oyster	–	+	+	–	+	+	–
Mountain Fringe	X_6	Lemon with Non-Toxic Planting	–	+	+	–	+	–	
		Vegetables with Non-Toxic Planting	Vegetables and Fruit Dehydrate	+	+	+	+	–	
			Jam						
			Cookies						
			Toast						
			Rice Egg Crisp						
		Longan Fruit	Dried Longan Fruit	+	+	–	+	+	–
			Longan Fruit Honey						
			Longan Flower Tea						
	X_7	Lotus Root	Lotus Seed	+	+	–	+	–	
			Lotus Root Powder						

Table3 Similarity in various short supply chains

Urban	One-Grade Producing	Two-Grade Processing	Purchase through Social Media	Purchase through Usual Marketing	Cosine Similarity
X_1	1	0	1	2	0.621
X_2	3	3	5	2	0.926
X_3	3	2	6	0	0.779
X_4	2	0	3	2	0.694
X_5	1	0	2	2	0.686
X_6	3	8	5	4	0.997
X_7	1	2	2	1	0.99

Table 4 Matching data between urban and agriculture

NO	Case	Producing	Landform Scenarios	Short Supply Chains
1	X_1	Lychee with Non-Toxic Planting	Plains	Ecological Produce
2	X_2	Passion Fruit		Organic Produce
3		Mango Fruit		
4		Organic Vegetables and Fruits		
5	X_3	Milkfish	Waterfront	Ecological Produce
6		Muskmelon		
7		Hami Melon		
8	X_4	Asparagus		Local Tourism
9		Cantaloupe		
10	X_5	Oyster		
11	X_6	Lemon with Non-Toxic Planting	Mountain Fringe	Ecological Produce
12		Vegetables with Non-Toxic Planting		
13		Longan Fruit		
14	X_7	Lotus Root		Local Tourism

RESPONSE RESULTS AND DISCUSSIONS

The information in this study was collected from Facebook, agricultural products, and marketing. The information is organized in various forms, including one-grade producing, two-grade processing, and three-grade selling, including Facebook, LINE APP, online websites, telephone, email, and on-site. Then, the discussions will involve similarity and the co-occurrence network in short supply chains.

Similarity in Short Supply Chains

In Table 3, short supply chains appear in many different forms, allowing UA to reconstruct the relationship between producers and consumers while providing diverse business scenarios, as described below (Table 4 and Figure 5). (1) Organic Vegetables and Fruits (X_2): Mango fruit and organic vegetables and fruits are produced in area X_2, where short supply chains are the activity portfolio of one-grade producing, two-grade processing, and three-grade selling. However, passion fruits dominate in area X_2, where the short supply chains are the activity portfolio of one-grade producing and three-grade selling. (2) Local Tourism (X_4, X_5, X_7): Asparagus and Hami melon are planted in area X_4, and oysters are grown in area X_5, where both short supply chains are the activity portfolio of one-grade producing, and three-grade selling. Lotus roots are produced in area X_7, where the short supply chains are the activity portfolio of one-grade producing and three-grade selling. (3) Ecological Produce (X1, X_3, X_6): In region X_1, the information on the two-grade processing activities of lychee is very weak. So far, the short supply chain information only involved one-grade and third-grade industrial activities. Milkfish and muskmelon are produced in area X_3, where the activity portfolio is one-grade producing, two-grade processing, and three-grade selling. Hami melons are planted in area X_3 is

the activity portfolio of one-grade producing and two-grade processing. The non-toxic vegetables and longan fruits are planted in region X_6, where the short supply chain activities are the portfolio of one-grade producing, two-grade processing, and three-grade selling. The information on the non-toxic lemon is only involved in one-grade and three-grade industrial activities.

Short Supply Chain of Co-occurrence Networks with Various Landforms

UA is a symbiotic network that provides diversified short supply chains and sales methods, promoting the relocation of various agricultural products toward areas with many people and integrating agricultural resources into urban fringe areas. To do so, short supply chains will appear in the form of a co-occurrence network (Table 5 and Figure 6) to maintain a specific level of food in urban and rural areas. Accordingly, the interactive dashboard (Figure 6) serves as the interface to discuss the co-occurrence network of short supply chains and to explore landform scenarios, including plains, waterfront, and mountain fringe. (1) Plains zone of co-occurrence network (X_1, X_2): Where the co-occurrence network includes one-grade production consisting of lychee with non-toxic planting, passion fruit, mango fruit, and organic vegetables and fruits. Two-grade processing is dried mango fruit, kale powder, and rice noodles (Figure 7). (2) Waterfront zone of co-occurrence network (X_3, X_4, X_5): where the co-occurrence network includes one-grade production referring to milkfish, muskmelon, Hami melon, asparagus, cantaloupe, and oysters. Two-grade processing is essence soup, and muskmelon raw milk roll (Figure 8). (3) Mountain Fringe zone of co-occurrence network (X_6, X_7): where the co-occurrence network includes one-grade production referring to the portfolio of lemons with non-toxic planting, vegetables with non-toxic planting, longan fruit, and lotus root. Two-grade processing includes dehydrated vegetables and fruits, jam, cookies, toast, rice egg crisp, dried longan fruit, longan fruit honey, longan flower tea, lotus seed, and lotus root powder (Figure 9).

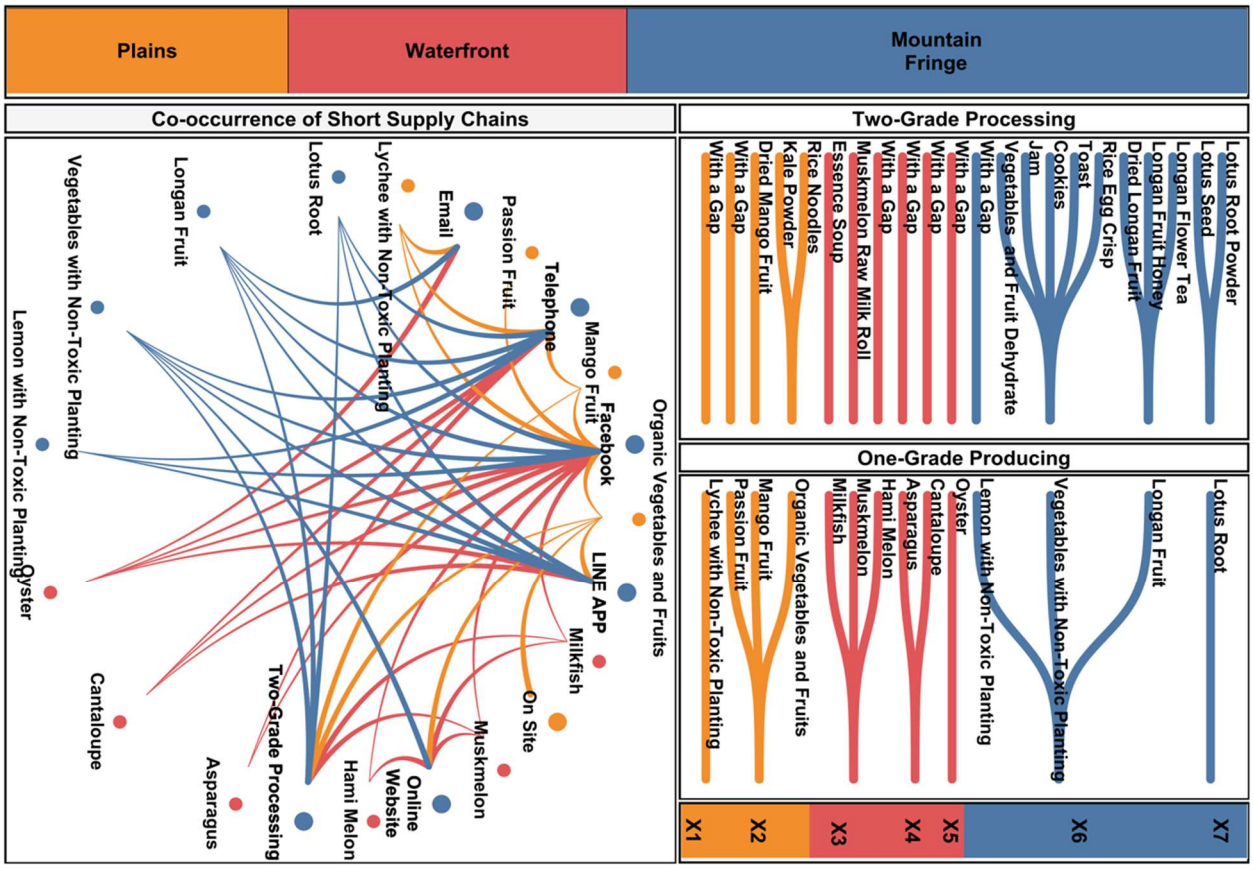

Figure 6 Dashboard Deployment

Table5 Short supply chains portfolio of seven cases

Case	One-Grade Producing	Two-Grade Processing	Three-Grade Selling					
			Facebook	LINE APP	Online Website	Telephone	Email	On Site
X_1	Lychee with Non-Toxic Plant	0	1	0	0	1	1	0
X_2	Passion Fruit	0	1	0	0	0	0	0
	Mango Fruit	1	1	0	0	1	0	0
	Organic Vegetables and Fruits	1	1	1	1	0	0	1
X_3	Milkfish	1	1	0	1	0	0	0
	Muskmelon	1	1	0	1	0	0	0
	Hami Melon	0	1	0	1	0	0	0
X_4	Asparagus	0	1	0	0	1	0	0
	Cantaloupe	0	1	1	0	1	0	0
X_5	Oyster	0	1	1	0	1	1	0
X_6	Lemon with Non-Toxic Plant	0	1	1	0	1	0	0
	Vegetables with Non-Toxic Plant	1	1	1	1	1	0	0
	Longan Fruit	1	1	1	0	1	1	0
X_7	Lotus Root	1	1	1	0	1	0	0

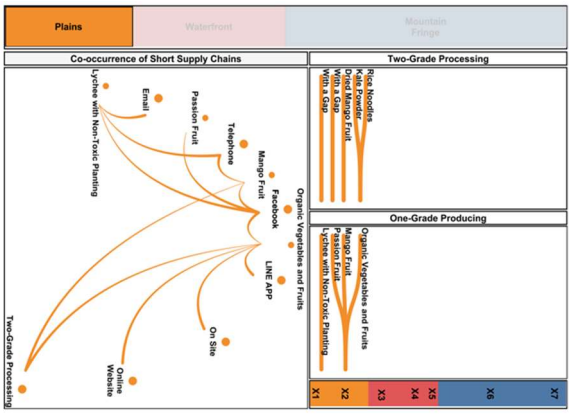

Figure7 Plain Zone of Co-occurrence Networks

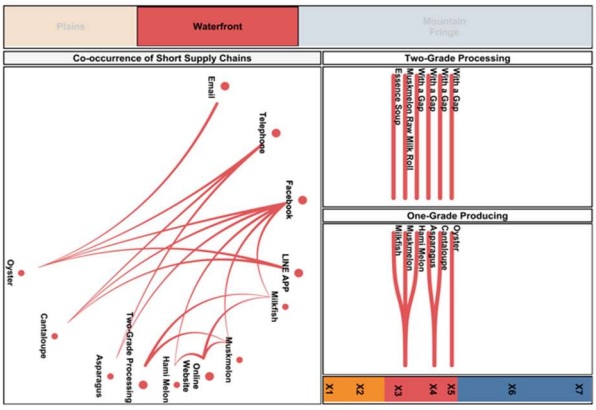

Figure8 Waterfront zone of Co-occurrence networks

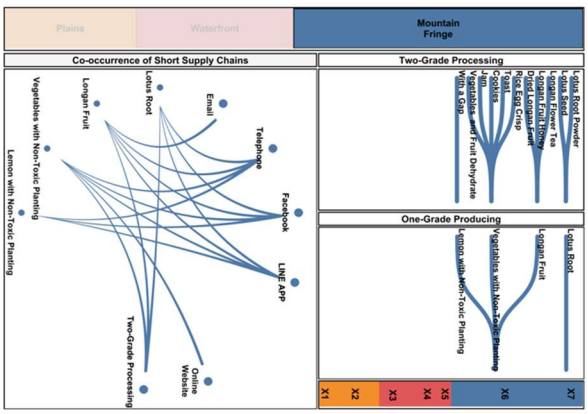

Figure9 Mountain Fringe Zone of Co-occurrence Networks

CONCLUSIONS

UA is an innovative service that offers diverse portfolio services, including business models, short supply chains, ecosystem services, and green tourism. UA allows urban and rural zones not only to create agricultural supply chains but also to increase employment opportunities while moving toward urban and rural sustainability. The major challenge in understanding UA involves heterogeneous data and diverse information. To do so, an interactive infographic dashboard displays a portfolio interface of UA scenarios and short supply chains while providing

a method for comprehending UA. UAC is a planning framework for organizing various UA scenarios. UAC includes multiple unit blocks allowing users to organize heterogeneous data and information referring to landform patterns, agriculture scenarios, and short supply chains. The similarity is used to identify short supply chain forms, including organic food, ecological products, and local tourism. The IID serves as an infographic interface for visualizing UA scenarios by displaying the co-occurrence networks of plains, waterfront, and mountains fringe while helping understand the existing innovative service system and symbiotic networks of urban agriculture.

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REFERENCES

Alberti, M. A., Blanco, I., Vox, G., Scarascia-Mugnozza, G., Schettini, E., Silva, L. P., "The challenge of urban food production and sustainable water use: current situation and future perspectives of the urban agriculture in Brazil and Italy," *Sustainable Cities and Society*, Vol.22, 103961 (2022).

Andrew V Abela, Paul J Radich, "Encyclopedia of Slide Layouts: Inspiration for Visual Communication," Soproveitto Press (2014).

Aubry, C., Kebir, L., Shortening food supply chains: A means for maintaining agriculture close to urban areas? The case of the French metropolitan area of Paris," *Food Policy*, Vol.41, 85–93 (2013).

Bachechi, C., Po, L., Rollo, F.,"Big Data Analytics and Visualization in Traffic Monitoring," *Big Data Research*, Vol.27, 100292 (2022).

Bryant, C. R., Russwurm, L.J., McLellan, A. G., "The City's Countryside: Land and Its Management in the Rural- urban Fringe", Longman, London (1982).

Clinton, N., Stuhlmacher, M., Miles, A., Aragon, N.U., Wagner, M., Georgescu, M., Herwig, C., Gong, P., "A Global Geospatial Ecosystem Services Estimate of Urban Agriculture," *Earth's Future*, Vol.6, 40-60 (2018).

Evans, D.L., Falag´an, N., Hardman,C.A., Kourmpetli, S., Liu, L., Mead, B.R., Davies, J.A. C., "Ecosystem service delivery by urban agriculture and green infrastructure – a systematic review," *Ecosystem service*, Vol.54, 101405 (2022).

Fanfani, D., Du˘zí, B., Mancino, M., Rovai, M., "Multiple evaluation of urban and peri-urban agriculture and its relation to spatial planning: The case of Prato territory (Italy)," *Sustainable Cities and Society*, Vol.79, 103636 (2022).

Heimlich, R. E., "Metropolitan Agriculture: Farming in the City's Shadow," *Journal of the American Planning Association*, Vol.26, 457-466 (2007).

Jansma, J.E., Wertheim-Heck, S.C.O. "Feeding the city: A social practice perspective on planning for agriculture in peri- urban Oosterwold, Almere, the Netherlands," *Land Use Policy*, Vol.117, 106104 (2022).

Joshua P. Newell, Alec Foster, Mariel Borgman, Sara Meerow, "Ecosystem services of urban agriculture and prospects for scaling up production: A study of Detroit," *Cities*, Vol.125, 103664 (2022).

Liu, S., "Business Characteristics and Business Model Classification in Urban Agriculture," Master Thesis, Wageningen University, 2015.

Marsden, T., Banks, J., Bristow, G., "Food supply chain approaches: exploring their role in rural development," *Sociologia Ruralis*, Vol.40 424–438(2000).

Mougeot, L. J., "Urban Agriculture: Definition, Presence, Potentials and Risks, and Policy Challenges," International Workshop on Growing Cities Growing Food: Urban Agriculture on the Policy Agenda, La Habana Cuba, October 11–15 (1999).

Nel, R., Mearns, K. F., Jordaan, M., Goethals, P., "Towards understanding the role of islandness in shaping socio-ecological systems on SIDS: The socio-ecological islandscape concept," *Ecological Informatics*, Vol.62, 101264 (2021).

Opitz, I., Berges, R., Piorr A., Krikser T., "Contributing to food security in urban areas: differences between urban agriculture and peri-urban agriculture in the Global North," *Agriculture and Human Values*, Vol.33, 341-358 (2016).

Parker, G., "Sustainable Food? Teikei, co-operatives and food citizenship in Japan and in the UK," University of Reading (2005).

Papadopoulosa, T., Balta, M.E., "Climate Change and big data analytics: Challenges and opportunities," *International Journal of Information Management*, Vol.63, 102448 (2021).

Rifat, S.A. A., Liu,W., "Predicting future urban growth scenarios and potential urban flood exposure using Artificial Neural Network-Markov Chain model in Miami Metropolitan Area," *Land Use Policy*, Vol.114, 105994 (2022).

Rotolo, S.M., Jain, S., Dhaon, S., Dokhanchi, J. K., Kalata, E., Shah, T., Mordell, L. J., Clayman, M. L., Kenefake, A., Zimmermann, L.J.,

Bloomgarden, E., Arora,V.M., "A coordinated strategy to develop and distribute infographics addressing COVID-19 vaccine hesitancy and misinformation," *Journal of the American Pharmacists Association*, Vol.62, 224-231(2021).

Salton, G., McGill, M., "Introduction to Modern Information Retrieval," McGraw-Hill, New York (2010).

Schans, J.W. van der, "Urban Agriculture in the Netherlands," *Urban Agriculture magazine*, Vol.24, 40-42 (2010).

Skar, S. L. G., Pineda-Martos, R., Timpe, A., Pölling, B., Bohn, K., Külvik, M., Delgado, C., Pedras, C. M.G., Paço, T. A., Ćujić, M., Tzortzakis N., Chrysargyris, A., Peticila, A., Alencikiene, G., Monsees, Junge, H. R., "Urban agriculture as a keystone contribution towards securing sustainable and healthy development for cities in the future," *Blue-Green Systems*, Vol.2, 1–27 (2020).

Smith, G., Nandwani, D., Kankarla, V., "Facilitating resilient rural-to-urban sustainable agriculture and rural communities," *International Journal of Sustainable Development & World Ecology*, Vol.24, 485-501(2017).

Theron, O., Duru, M., Roger-Estrade, J., Richar, G., "A new analytical framework of farming system and agriculture model diversities. A review," *Agronomy for Sustainable Development*, Vol.37, 21 (2017)

Tufte, Edward R, "The Visual Display of Quantitative Information," *Graphics Press* (1983).

Xun, Y. and Ren, G., "Smart Garden Planning and Design Based on the Agricultural Internet of Things," *Computational Intelligence and Neuroscience*, 8522751, 11(2022).

Yan, D., Liu, L., Liu, X., Zhang, M., "Global Trends in Urban Agriculture Research: A Pathway toward Urban Resilience and Sustainability," *Land*, Vol.11,117(2022).

Zasada, I., "Multifunctional peri-urban agriculture-A review of societal demands and the provision of goods and services by farming," *Land Use Policy*, Vol.28, 639-648 (2011).

Zhu, S., Sun, G., Jiang, Q., Zha, M., Liang, R., "A survey on automatic infographics and visualization recommendations," *Visual Informatics*, Vol.4, 24–40(2020).

城市農業的互動信息圖像儀表板

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摘要

世界各國都在關注有利於管理地球資源之永續模式。城市永續性是聯合國永續發展目標。面對就業機會不足和人口流失，基於現有城市農業情景來探索城鄉永續性是合理的。城市農業（UA）是創新服務網絡，提供商業模式、短供應鏈、生態系統服務和綠色旅遊在內的多元化服務組合，不僅有助於農村建立營銷供應鏈，而且可以增加就業機會，同時是提高城鄉永續性之重要推動力。城市農業畫布(UAC)是規劃互動信息圖像儀表板(IID) 之基礎，用於識別各種城市農業情景的包括平原、海濱和山區邊緣。UAC 包含多個單元，允許用戶組織異構數據和信息，並揭露現有之創新服務，包括商業模式、短供應鏈、生態系統服務和綠色旅遊。本研究中，相似度作為識別各種農產品供應鏈之方法。IID 作為呈現 UA 場景共現網絡之介面，同時揭示 UA 中現有之創新服務和共生關係。結果表明，7 個城鄉案例過濾出有機食品、生態產品、地方旅遊三種短供應鏈，係利於農產品向人口密集地區轉移。如上所述，UA 有利於維持城鄉糧食水平和增加就業機會。