

# GIES Case Study on Fengxian Apple of the Ancient Yellow River (Dashahe)

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**Abstract:** Feng county of Xuzhou prefecture is located in the northwest of Jiangsu province, at the junction of four provinces: Jiangsu, Shandong, Henan, and Anhui. It is a part of the Yellow River alluvial plain with a flat terrain and crisscrossing rivers. The rapid development of apple in the historical course of Yellow River in Feng county has important implications for the economic and tourism development of Feng county. The apple case dataset in the historical course of Yellow River area of Feng county includes: (1) spatial distribution range of apple production area in the historical course of Yellow River area of Feng county; (2) soil pH and chemical elements of sampling points in apple production area in the historical course of the Yellow River area of Feng county; (3) land use and vegetation index (NDVI) data of Feng county; (4) climate data of Feng county from 2012 to 2022; (5) surface water detection data of apple production area in the historical course of Yellow River area of Feng county. The dataset is archived in .xlsx, .shp, .tif, .jpg, .txt and .docx formats with a data size of 63.9 MB (compressed to 47.8 MB), consisting of 59 data files.

**Keywords:** Feng county; historical course of Yellow River; apple; geographic environment; Case 16

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**Dataset Availability Statement:**

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: <https://doi.org/10.3974/geodb.2023.05.08.V1> or <https://cstr.escience.org.cn/CSTR:20146.11.2023.05.08.V1>.

**1 Introduction**

Feng county of Xuzhou prefecture, with an area of 127,000 ha is located in the northwest of Jiangsu province, at the junction of four provinces: Jiangsu, Shandong, Henan, and Anhui. It borders Jinxiang and Yutai counties in Shandong province to the north, Dangshan and Xiaoxian counties in Anhui province to the south, Shanxian county in Shandong province to the west, and Pei county and Tongshan district in Xuzhou city to the east<sup>[1]</sup>. Feng county is located in the centre of the Huaihai Economic Zone and on the south-eastern edge of the North China Plain, connecting north and south and east and west. The Xuji expressway runs through the entire county, connecting the Beijing-Fuzhou line, the Beijing-Shanghai line, and the Lianyungang-Horgos line. The Fuxin River in the county leads to Weishan Lake and connects with the Beijing-Hangzhou Canal. Feng county is located 100 km away from Xuzhou Guanyin International Airport and 80 km away from Jining Qufu Airport.

Feng county is culturally prosperous, resource-rich, and has great development potential. It belongs to the Yellow River alluvial plain, with flat terrain. The Dashahe in the county is a natural river that has been transformed into a reservoir after introducing water from the Yangtze River. Feng county has four certified green food products and three certified organic food products, making it a green and high-quality agricultural product base in Jiangsu province and the largest contiguous apple production base in the province<sup>[2]</sup>. All the apples in the county have been recognized as standard production bases of national green food raw materials.

**2 Metadata of the Dataset**

The metadata information of the Dataset of geographical indications environment & sustainability (GIES) in Fengxian apple in the ancient Yellow River (Dashahe)<sup>[3]</sup> is shown in Table 1.

**Table 1** Metadata summary of the Dataset of geographical indications environment & sustainability (GIES) in Fengxian apple in the ancient Yellow River (Dashahe)

Items	Description
Dataset full name	Dataset of geographical indications environment & sustainability (GIES) in Fengxian apple in the ancient Yellow River (Dashahe)
Dataset short name	FengxianAppleCase16
Authors	Tan, M. H. 0000-0002-4945-7744, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, tanmh@igsnrr.ac.cn Mao, C. X., Agriculture and Rural Bureau of Feng County, fxljmcx@163.com Xu, X. L., Xuzhou Fruit Tree Research Institute, xzfxxl@126.com Gao, F. Y., Xuzhou Fruit Tree Research Institute, gfyfx@163.com Meng, L. S., Agricultural Technology Extension Center of Feng County, ccc15862191959@126.com Wang, X., Feng County Agro-water Group, 523606117@qq.com Li, J. Y., Xuzhou Ningxing Food Co., Ltd., fxljiayun89207365@126.com Chen, Y. X., Xuzhou Jiushun Food Co., Ltd., 724493571@qq.com Liang, H., Xuzhou Linjiapuzi Co., Ltd., baozhuang5858@126.com Tao, J., Xuzhou Andeli Fruit and Vegetable Juice Co., Ltd., taojian@northandre.com Li, D. H., Agricultural and Rural Office of Dashahe Town, Feng County, 1136838781@163.com Zhai, G. K., Agricultural and Rural Office of Dashahe Town, Feng County, dshnjtgzx@163.com Li, C., Agricultural and Rural Office of Songlou Town, Feng County, lnjzx163.com Li, Y. G., Agricultural and Rural Office of Liangzhai Town, Feng County, fxlznjlyg@163.com

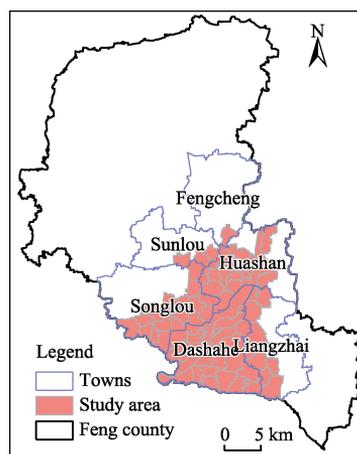
(To be continued on the next page)

(Continued)

Items	Description
Authors	Wu, T. G., Agricultural and Rural Office of Huashan Town, Feng County, 215983859@qq.com Wang, Z. X., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, wangzx@igsnr.ac.cn Wang, S. H., Nanjing Agricultural University, wsh3xg@njau.edu.cn Yan, Z. Y., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, yanzy.18s@igsnr.ac.cn Xu, X. F., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, xuxf.17s@igsnr.ac.cn Han, J. T., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, 627472520@qq.com
Geographical area	Feng county, Jiangsu province; geo-location: 106°33'55.8"E–107°39'42.1"E, 37°4'49.7"N–38°9'44.6"N
Data year	2022
Data format	.xlsx, .shp, .tif, .jpg, .txt, .docx
Data size	63.9 MB (Compressed to 47.8 MB)
Data files	The dataset includes six main types: (1) geographic location data of Feng county, Xuzhou, including county, township, and village boundaries; (2) soil pH and chemical element data of Huashan town, Songlou town, and Liangzhai town in Feng county; (3) NDVI data of Feng county; (4) surface water detection data of Songlou town, Liangzhai town, and other places in Feng county; (5) land use data of Feng county; (6) climate data from 2012 to 2022 of Feng county
Data publisher	Global Change Research Data Publishing & Repository, <a href="http://www.geodoi.ac.cn">http://www.geodoi.ac.cn</a>
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	<b>Data</b> from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the <i>Digital Journal of Global Change Data Repository</i> ), and publications (in the <i>Journal of Global Change Data &amp; Discovery</i> ). <b>Data</b> sharing policy includes: (1) <b>Data</b> are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use <b>Data</b> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <b>Data</b> subject to written permission from the GCdataPR Editorial Office and the issuance of a <b>Data</b> redistribution license; and (4) If <b>Data</b> are used to compile new datasets, the 'ten per cent principal' should be followed such that <b>Data</b> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset <sup>[4]</sup>
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

### 3 The Case Area

The research area is located in the southern part of Feng county (Figure 1), including 4 towns and 2 communities: Dashaha town, Liangzhai town, Huashan town, Songlou town, Sunlou road, and Fengcheng communities. The plantation area includes 62 administrative villages, one state-owned public welfare Fengxian Forest Farm, and one state-owned Dashaha Forest Farm in Feng county, with an area of approximately 440,100 mu ( $\approx 29,340$  ha). The population is 180,000, with approximately 63,000 households engaged in plantation. In 2021, the per capita income was 23,700 Yuan. The terrain of this area is mainly plain, with the Dashaha running through the middle, and the irrigation and drainage conditions are good.



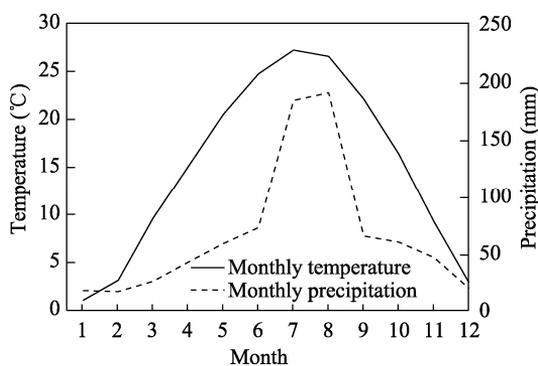
**Figure 1** The geo-location of the study area

### 4 Geographic Data and Development Methods

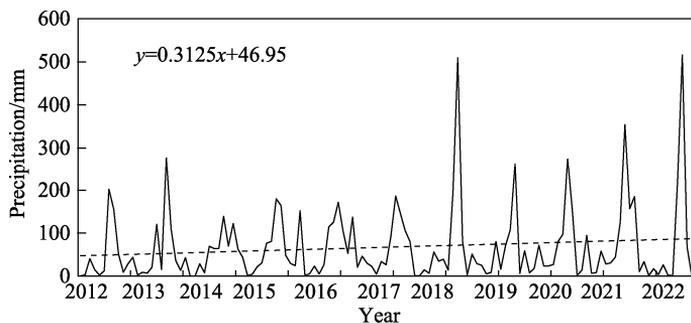
The geographic data of this case includes landform, geomorphology, meteorology, hydrology, soil, land use, and so on.

## 4.1 Landform and Climate

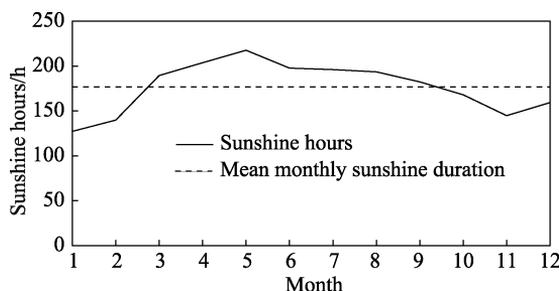
Feng county is located in the middle of the North China Plain and the Yellow River flood plain. The terrain is flat. Feng county is located in a warm temperate semi-humid monsoon climate zone, with distinct four seasons, sufficient sunlight, and rainy and hot seasons (Figure 2). The annual average temperature is around 15 °C, the average annual rainfall is about 630.4 mm, and the frost-free period is about 210 days. There was no significant change in temperature in the study area from 2012 to 2022, and precipitation showed an upward trend, with an increasing in the past three years (Figure 3). Sunshine duration is relatively long, with a monthly average of nearly 177 hours, and the strongest months are concentrated from April to May (Figure 4).



**Figure 2** Map of monthly mean temperature and monthly mean precipitation from 2012 to 2022



**Figure 3** Map of precipitation changes in the study area from 2012 to 2022



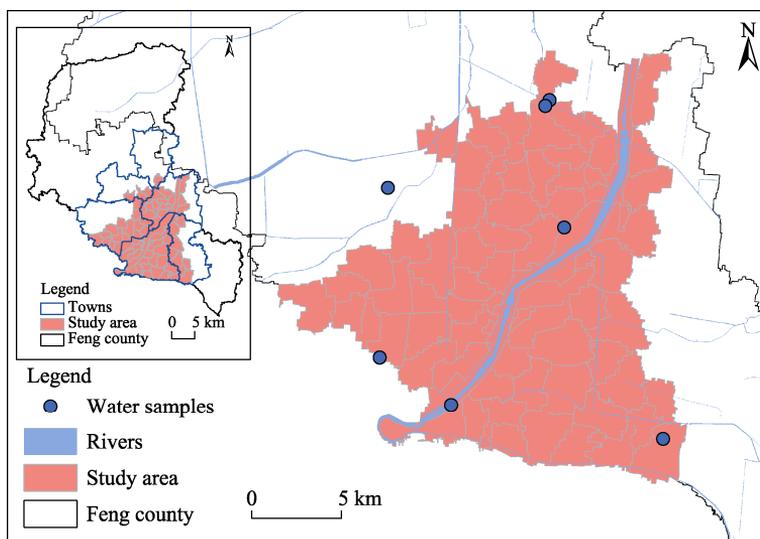
**Figure 4** Map of changes in monthly mean sunshine hours in the study area from 2012 to 2022

## 4.2 Water Resource

Feng county has a large amount of rainfall in July and August, so ensuring suitable soil moisture and smooth drainage and irrigation is an important condition for apple production.

At present, the flood control and waterlogging standards for major rivers in the apple production area, such as the Old Yellow River and the Dashaha, have basically met the standards. The drainage standard for the Old Yellow River channel is once in 10 years, and the flood control standard is once in years; the drainage standard for the Dashaha is once every 10 years, and the flood control standard is once in 20 years.

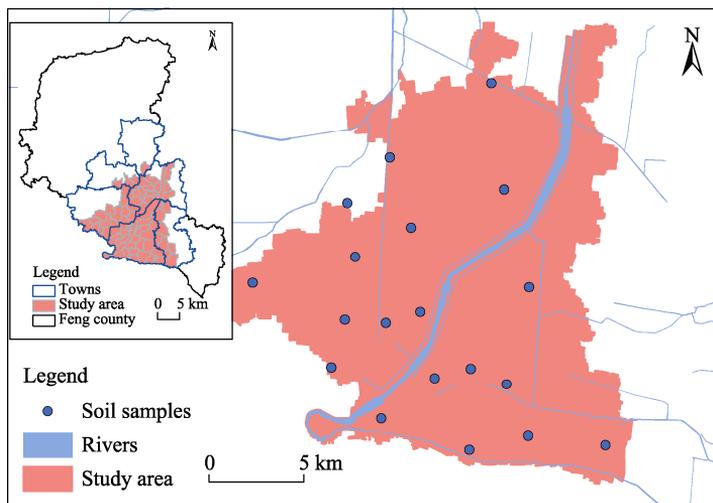
Water quality is crucial to ensuring the quality of the apples. This county comprehensively implements the “river chief system” in counties, towns, and villages, with a centralized drinking water source area reaching 100% of the standard. The water quality of the national and provincial test sections is stable and meets the standard, and has been approved as a “provincial-level water ecological civilization city”. Twelve town-level sewage treatment plants in the county have been put into operation, with a centralized urban sewage treatment rate of 92.51%. There are 7 surface water sampling points in this study, located in Dachengzhuang village in Huashan town, Guanzhuang village in Songlong town, Taolou village in Huashan town, and Xinyaoliwang village of Liangzhai town within the study area. The water quality meets the standards.



**Figure 5** Map of surface water sampling sites

### 4.3 Soil Texture

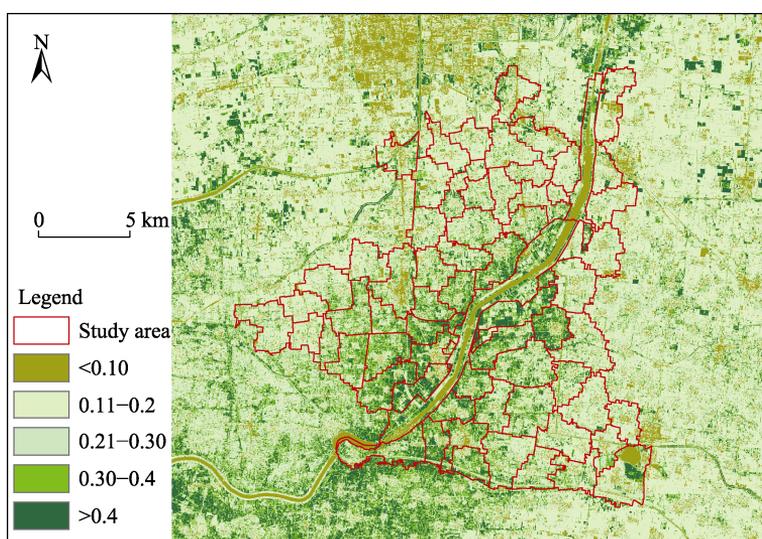
The soil in Feng county is developed from yellow loess deposits, with a generally deep soil layer, loose texture, and high air permeability. The topsoil is about 30 cm of sandy soil, which is conducive to root growth and development, and suitable for the growth of various deciduous fruit trees. The mineral content of the soil has an important influence on apple quality characteristics and fruit mineral element content<sup>[5]</sup>. According to the test results of 19 soil samples (Figure 6), the content of elements such as chromium, cadmium, copper, zinc, lead, mercury, and arsenic are all below the national standard. Compared with the second soil survey in 1982, due to the implementation of technologies and projects such as balanced fertilization and fertile soil engineering, the nutrient content of Feng county soil has been significantly improved<sup>[6]</sup>, but there is still room for improvement and enhancement in terms of fertilization methods and timing<sup>[7]</sup>. In addition, the average pH of the soil in this area is 8.13, which belongs to alkaline soil, similar to existing research results<sup>[6,8]</sup>.



**Figure 6** Map of the soil test points

#### 4.4 Vegetation Conditions

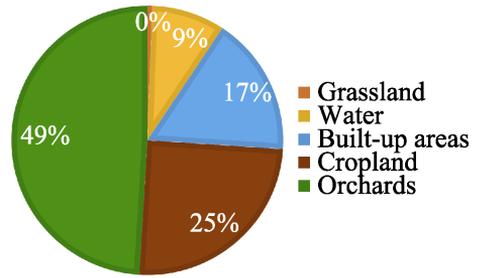
The ecological environment of Feng county is characterized by lush forests and clear water, with relatively good vegetation conditions throughout the region, and a relatively balanced distribution of vegetation indices (Figure 7). The forest cover rate exceeds 33.8%, ranking first among county-level administrative units in Jiangsu province. A 50 km tourism belt has been developed along the Dashaha and ancient Yellow River, integrating wetland parks, orchards, and ecotourism agriculture, mainly based on tourism and ecological industries. Currently, Feng county has received various honors, such as the United Nations Ecological Demonstration Zone, the National Advanced County in Plain Afforestation, the National Green Agriculture Demonstration County, and Provincial Eco-County, etc.



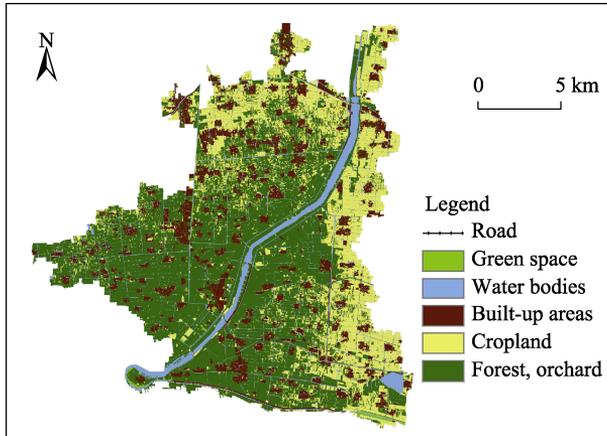
**Figure 7** Map of vegetation index (NDVI) in apple growing areas of Feng county in 2021

### 4.5 Land Use Types

The land use types in Feng county apple production areas are relatively simple (Figure 8, 9), mainly consisting of orchards and adjustable orchards, accounting for about 50%, followed by cropland and construction land, accounting for about 20% and 17%, respectively. Cropland is mainly distributed in the north and south-east of the apple production areas; the distribution of construction land is relatively uniform, mainly consisting of rural residential areas.



**Figure 8** Land use structure in apple production areas



**Figure 9** Map of land use in apple production areas

## 5 Product Attribute Data and Identification Standards

### 5.1 Apple Varieties in the Ancient Yellow River

Feng county has a history of over 50 years in fruit tree production, and has now become a base county for fruit production in Jiangsu province. It is the largest contiguous orchard in Jiangsu province and one of the top ten counties in fruit production in China. It is known as the “hometown of apples in China” and is called as the “fruit sea” and “fruit capital”. In 2012, it was awarded the only national-level export fruit demonstration zone in Jiangsu province. Through scientific research and development, introduction of trial planting, and selection of new variety, a number of apple varieties suitable for the local area have been selected, such as Yanfu 3, Yanfu 6, Qinyang, Changfu 2, Hongqian Fuji, Sufu, etc. (Figure 10); these varieties have a large production area and have achieved good economic benefits.



**Figure 10** Varieties of apples

## 5.2 Apple Varieties in the Old Yellow River

Following testing, Feng county apples exhibit exceptional characteristics, including brittleness, chewiness, high moisture content, thin skin, and low fruit hardness. Additionally, these apples possess a sugar-to-acid ratio ranging from 30 to 40, resulting in a balance of acidity and sweetness, along with a high vitamin C content.

**Table 2** Statistics of fruit texture

Area	Weight (g)	Moisture content (%)	Fruit hardness (N)	Peel hardness (N)	Pericarp thickness (mm)
Feng county Red Fuji	360.0±9.80	84.39±9.03	7.8±0.26	12.3±0.37	0.12±0.10

**Table 3** Statistics of related parameters

Area	Soluble solids (%)	Titrateable acidity (%)	Sugar acid ratio	Vitamin C (mg/100 g)
Feng county Red Fuji	15.4±0.25	0.39±0.02	39.48±1.73	2.27±0.26

## 5.3 Relevant Standards for Apple Management

Feng county apples have received approval for various local standards within Jiangsu province, including the following: Red Fuji apple (DB32/T 206—2007), Non-pollution Red Fuji apple production technical specification (DB32/T 526—2007), Export golden supreme apple production technical specification (DB32/T 1168—2007), Dwarfing rootstock M9T337 apple cultivation technical specification (DB32/T 3885—2020), and Detoxification dwarfing rootstock apple seedling breeding technical specification (DB32/T 3901—2020). Moreover, the Feng county apple Fuji series grade standard (DB3203/T 011—2017) has been locally recognized in Xuzhou city. These approvals serve as vital assurances for promoting the standardized production of Feng county apples and maintaining apple quality. Presently, following an assessment by the Chinese Green Food Development Center, Feng county apples confirm to the Grade A of the green food standard and have received official recognition as Grade A of the green food products, allowing for the display of the green food logo.

## 6 Social Development and Government, Market, and Research Management

Currently, there are approximately 320,000 mu ( $\approx 21,333.33$  ha) of fruit tree plantations in Feng county, yielding over 400,000 tons of fruit each year. In recent years, Feng county has vigorously undertaken the Fruit Industry Revitalization Project, enhancing technological and policy support, establishing a comprehensive apple industry supply chain, and advancing the modernization of the apple industry.

### 6.1 Research and Development of Programs

Since 2019, the finance departments of Xuzhou and Feng county have allocated annual budgets to create a dedicated fund for the development of the fruit industry, with a specific allocation for scientific and technological research and development. In cooperation with Nanjing Agricultural University and Jiangsu Academy of Agricultural Sciences, the county government has established the Feng County Fruit Industry Research Institute.

### 6.2 Standardized Management

Feng county's apples are registered as a geographical indication product and have achieved compliance with various standards, including the Grade A of the green food standard. These accomplishments constitute substantial intellectual property assets for the residents of Feng county and are the outcomes of sustained dedication by Feng county government, its

populace, and various sectors of society. Institutions such as the Xuzhou Fruit Tree Station, Xuzhou Fruit Tree Research Institute, Feng County Forestry Technical Guidance Station, and Jiangsu Dashahe Group have been actively engaged in developing standardized technology systems for cultivating dwarf apple trees (Table 4).

**Table 4** Standardized production technical specifications for apples in the Ancient Yellow River of Feng county

No.	Name of standard and technical specification	Type of standard and technical specification
1	Red Fuji apple (DB32/T 206—2007)	Local Standard (Jiangsu)
2	Non-pollution Red Fuji Apple Production Technical Specification (DB32/T 526—2007)	Local Standard (Jiangsu)
3	Export Golden Supreme Apple Production Technical Specification (DB32/T 1168—2007)	Local Standard (Jiangsu)
4	Dwarfing Rootstock Apple Cultivation Technical Specification (DB32/T 3885—2020)	Local Standard (Jiangsu)
5	Detoxification Dwarfing Rootstock Apple Seedling Breeding Technical Specification (DB32/T 3901—2020)	Local Standard (Jiangsu)
6	Fengxian apple Fuji series grade standard (DB3203/T 011—2017)	Local Standard (Xuzhou)
7	Integrated Management Technical Specification for Water and Fertilizer in Apple (DB32/T4415—2022)	Local Standard (Jiangsu)
8	Technical Specification for Mechanized Operations of Wide-row and Close-planting Apple Trees (DB3203/T 1018—2022)	Local Standard (Xuzhou)
9	Chemical Blossom and Fruit Thinning Technical Specification for Fuji Apple (DB32/T 4135—2021)	Local Standard (Jiangsu)
10	Technical Specification for Dwarfing Fuji Apple Trees in High-density Planting (DB32/T 3438—2018)	Local Standard (Jiangsu)
11	Apple Standard Orchard Construction Specification (DB32/T 2733—2015)	Local Standard (Jiangsu)
12	Technical Regulations for Apple Orchard Bagging Cultivation (DB32/T 1102—2007)	Local Standard (Jiangsu)

### 6.3 The Apple Product Value Chain

With the support of apple products, various initiatives were launched, including Nongshui Group E-commerce Logistics Park, Dashahe Town E-commerce Industrial Park, Songlou Town E-commerce Industrial Park, and so on<sup>[9]</sup>. There are more than 1,500 e-commerce enterprises operating within the county. In 2021, online sales surpassed 750 million Yuan, representing over 35% of the total sales volume, resulting in a significant of the apple product industry chain.

The Feng county government and local enterprises prioritize technology research, development, and investment. Together, they have established the “Feng County Fruit Technology Promotion Station” with Northwest A&F University, initiated a fruit testing center, and a training center, and developed a 500-mu ( $\approx 33.33$  ha) comprehensive experimental fruit tree demonstration base. They have intensified research and development efforts for new apple varieties and technologies, and have also engaged in research and development related to apple storage, sorting, packaging, and processing technologies.

## 7 Summary and Follow up Research

“The historical evolution of Yellow River apples in Feng county” possesses a distinctive and invaluable eco-geographic environment and product heritage within Jiangsu province. Apples from this region are distinguished by their substantial size, exquisite texture, vibrant color, crisp sweetness, excellent shelf life, and have consistently earned recognition as “national high-quality fruits”. To ensure the future high-quality development of Feng county apples, efforts can focus on the following areas: (1) Enhancing efforts for ecological environmental protection to maintain and enhance soil and water quality in the region, fostering a superior ecological environment for apple development. (2) Further enhancing standardized apple production management to safeguard the consistency in apple quality and grades. (3) Enhancing integration across primary, secondary, and tertiary industries,

expanding the apple production supply chain, augmenting the value within the apple industry chain, developing apple picking and tourist attractions, stabilizing apple juice and slice processing, and expanding the influence of the Feng County Apple Festival. (4) In recent years, the rapid expansion of e-commerce channels for Feng county apples suggests the need for leveraging these channels to cultivate a distinct brand, reduce sales costs, and bolster farmers' income in the future.

### **Author Contributions**

Tan, M. H. and Wang, Z. X. conducted the overall design of this case and hosted a field seminar on the case in January 2023. Mao, C. X., Xu, X. L., Gao, F. Y., Meng, L. S., Wang, X., Li, J. Y., Chen, Y. X., Liang, H., Tao, J., Li, D., Zhai, G. K., Li, C., Li, Y. G., and Wu, T. G. participated in the case study and field investigation, and provided statistical data, soil measurements, and enterprise management data. Wang, Z. X. and Wang, S. H. provided guidance for the case study and developed vegetation index data. Yan, Z. Y. designed the framework for dataset development and participated in the writing of the paper. Xu, X. F. handled and mapped water and plant data. Han, J. T. completed the translation of the English paper.

### **Acknowledgements**

Lu, F., deputy secretary of Feng County Party Committee and member of the Standing Committee of Feng County Party Committee; Chang, J. B., secretary and director of the Party Committee of Feng County Bureau of Agriculture and Rural Affairs; Dai, X. M., secretary of the Party Committee of Dashaha town, Feng county; Wang, S. H., chairman and general manager of Feng County Nongshui Group; and Liu, C., professor at the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, provided assistance in the field investigation of the case. The authors express profound gratitude.

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