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GIES Case Dataset on Rice Permanent Farmland in Lanjia Village, Jilin Province of China

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Abstract: The quality of agricultural products are naturally related to their geographic origin. The close connection between agricultural products, geographic characteristics and their regional terroir (production location, including natural and human factors) is the driving force for producers to maintain the integrity of related natural resources and support the sustainable development of the environment. The products of this case study on ecological environment protection and the sustainable development of permanent basic farmland for rice cultivation in Lanjia village, Panshi city, Jilin province, were planted in the basin of Lanjia village reservoir in Panshi. The water area of the reservoir was 8.86 hectares, and the paddy field area was 61 hectares. The case study area is located in the transitional zone from the Changbai Mountains to the Songnen Plain. It belongs to a hilly and semi-mountainous area and is formed by clean water sources such as ice and snow water and natural precipitation. The water quality is better than that of the urban drinking water, and the soil type is paddy soil in black soil area. The currently planted rice varieties are mid-late maturity varieties. The dataset were archived in .shp, .tif, .xlsx, .docx and .jpg formats and were composed of 79 data files, including study area, physical geographic data, and characteristics of rice, management data, photos and images. The data size was 85.3 MB.

Keywords: Lanjia village; rice; permanent basic farmland; geographical indication; cases 3

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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.2021.06.01.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2021.06.01.V1.

1 Introduction

With the development of the social economy and the improvement of living standards, people's

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demands for a higher quality of life have also risen. High-quality agricultural products have become one of the important needs of people's lives. "High-quality geographical products" (geographical indications, geographical characteristics and traditional geographical products) emerge as the times require[1–3]. Lanjia village is located in the south of Niuxin town, Panshi city, Jilin province. It is located in the transition zone from the Changbai Mountains to the Songnen Plain, belonging to hilly and semi-mountainous areas. Affected by geographical location and atmospheric circulation, the climatic conditions are suitable to agriculture. At the same time, clean water sources such as snow-ice water and precipitation are naturally present, and the ecological environment of the whole basin is pollution free[4,5]. Lanjia village is a traditional agricultural village with no large-scale enterprises or factories surrounding it. The soil and water quality of the area are good. The permanent basic farmland in Lanjia village depends on the high-quality water source of Lanjia reservoir, which breeds high-quality rice products with regional characteristics. In order to promote the development of quality geographical products and sustainable environment, the geo-eco system protection and sustainable development cases of permanent basic farmland for rice cultivation in Lanjia village, Panshi, Jilin province, were launched to provide scientific and technological support for the environmental protection and sustainable development.

2 Metadata of the Dataset

Table 1 shows the name, author, geographical region, data time, dataset composition, data publishing and sharing service platform, data sharing policy and other information of the ecogeographic environmental protection and sustainable development of permanent basic farmland for rice cultivation in Lanjia village, Panshi, Jilin province (case study dataset of permanent basic farmland for rice cultivation in Lanjia village, Panshi city) [6].

3 Case Dataset and Development Method

The dataset was archived in .shp, .tif, .xlsx, .docx and .jpg formats and was composed of five data files, including study area, physical geographic data, and characteristics of seed, management data, photos and images. The data size was 85.3 MB.

3.1 Development of Physical Geographic Data

3.1.1 Scope of the Case Study Area

The case study area belongs to Lanjia village, Niuxin town, Panshi city, Jilin city, Jilin province. Panshi city is located in the south-central part of Jilin province to the south of Jilin city. Niuxin town is located in the south of Panshi city. The coordinates range from 42°26′N to 42°55′N and 126°06′36″E–126°26′47″E. There are 17 administrative villages under Niuxin town; Lanjia village is one of them[8]. The urban–rural classification code of Lanjia village is 220; the district code is 220284105211; and the postal code is 132000. Lanjia village and the four natural villages (tunnels) of Lanjiaxincun, Quanyangoutun and Dongchatiaogoutun jointly form the Lanjia Village Committee. The case study area is located in the range of paddy fields upstream and downstream of Lanjia reservoir on the east side of Lanjiaxincun. The water area of the reservoir is 8.86 hectares, and the paddy field area is 61 hectares (Figure 1).

3.1.2 Meteorological Characteristics of the Case Study Area

Affected by its geographical location and atmospheric circulation, Panshi city has a temperate continental monsoon climate with four distinct seasons: drought and strong winds in spring; the summer is hot and rainy; the autumn is cool and sunny with higher temperatures in the daytime and lower temperatures at night, with a large temperature difference between day and night; the winter is long and cold[8]. Based on the meteorological data of the city from 2000 to 2019 (Figure 2), the annual average temperature was 4.6 °C, and the annual accumulated temperature was 2,700–2,850 °C. The annual average precipitation was 699.6 mm, and the rainfall was mainly concentrated in June through to August. Affected by the terrain, the temperature in the south was slightly lower than that in the west, and the precipitation was slightly higher than that in the west. The annual sunshine time was 2,491.2 hours. The annual average frost-free period was 125 days. The annual minimum temperature was –42.6 °C.

Table 1 Metadata summary of the Panshi rice Lanjia village case dataset on permanent basic farmland protection and sustainable development

Items	Description
Dataset full name	Panshi rice Lanjia village case dataset on permanent basic farmland protection and sustainable development
Dataset short name	LanjiaVillageRiceCase03
Authors	Fu, J. Y., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, fujy@igsnrr.ac.cn Du, X. L., College of Plant Science, Jilin University, duxinglin2004@163.com Zheng, Q. S., Nanjing Agricultural University, qszheng@njau.edu.cn Qiao, Y. B., Agricultural and Rural Bureau of Panshi city, pssnyj@163.com Yan, S., Lanjia Rice Planting Cooperative in Panshi city, 429009306@qq.com Zhu, X. G., Beijing TianhangHuachuang Technology Co., Ltd., 18510867688@163.com Gu, Y. B., Lanjia Rice-growing cooperative, Panshi city Fu, Y. J., Lanjia Rice-growing cooperative, Panshi city
Geographical area	Upstream and downstream paddy fields of Lanjia reservoir, Lanjia village, Niuxin town, Panshi city, Jilin province, with an area of approximately 61 hectares
Year	2000–2021
Data format	.shp, .tif, .xlsx, .docx, .jpg
Data size	85.3 MB (After compression)
Data files	5 data files (study area, physical geographic data, characteristics of seed, management data, photos and images)
Foundations	Chinese Academy of Sciences (XDA28060400, XDA19040501), Youth Innovation Promotion Association (2018068)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[7]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

The highest annual temperature was 36.1 °C. The annual mean number of thunderstorm days was 35.4 days. The growing season of rice in the case study area was from May to October, in which the average temperature of the planting months was 15.30 °C. Sunshine duration was 7.37 h. The surface temperature was 17.85 °C. The relative humidity was 58.06 %, with a low amount of evaporation of 1.06 mm. The average wind speed was 2.72 m/s. The average annual temperature in harvest months was 6.74 °C. The sunshine duration was 6.28 h. The surface temperature was 7.98 °C. The relative humidity was 68.39 %, and the evaporation was 2.82 mm. The average wind speed was 1.80 m/s.

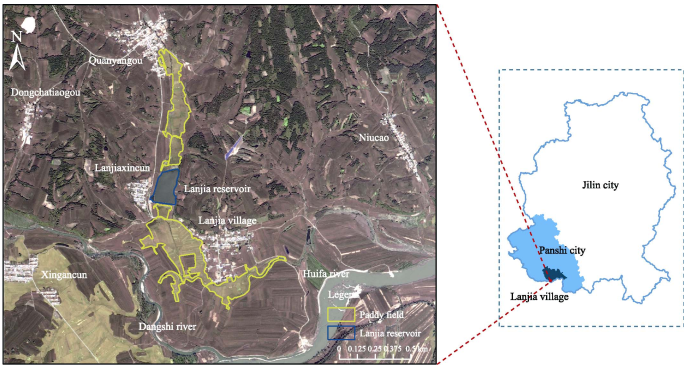

Figure 1 Location and scope of the case study area (Satellite image data source: land observation satellite data service platform of China Resources Satellite Application Center (CRSSAT), ZMS-3 satellite image[1])

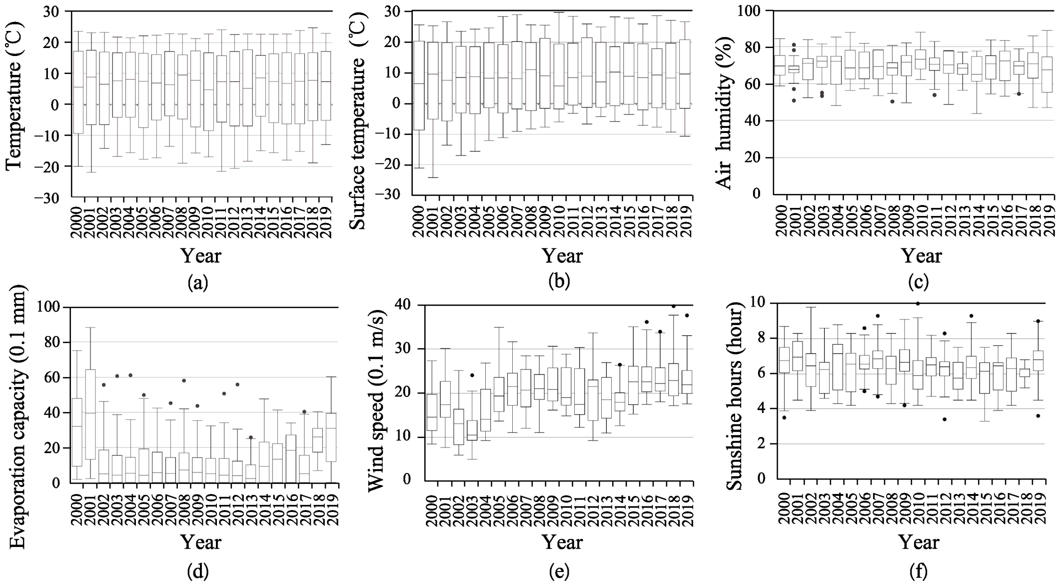

Figure 2 Meteorological data for case study area from 2000 to 2019 (Data source: monitoring data of Jilin Panshi station, National Meteorological Science Data Center[2], station code: 54263)

3.1.3 Digital Elevation Model (DEM) and Physical and Chemical Analysis of the Soil

Panshi city is located in the western foothills of Changbai Mountain, which is a hilly and semi-mountainous area. The Laoyeling of the Hadaling Mountains of Changbai Mountain spans east to west within the territory, forming a roof-like topography with high central and northeastern parts, becoming lower in the north–south parts (Figure 3). The highest elevation of the city is 1,049 m, the lowest elevation is 230 m, and the relative elevation difference is 819 m[8]. The main landforms in Panshi are a low mountainous area, a hilly area, a river valley plain and karst landforms. The low mountainous area covers an area of 1,730.72 km^2, accounting for 43.66% of the total area of the city. The hilly area is 1,308 km^2, accounting for 32.98% of the total area of the city. Most of the hills are formed by structural denudation, and most of them are round in shape, with a few having a “steamed bread” shape, hill shape

[1] Date sources: http://www.cresda.com/CN/.

[2] Date sources: http://data.cma.cn/data/cdcdetail/dataCode/SURF_CLI_CHN_MUL_DAY_V3.0.html.

or flat top shape. The relative height is 50–200 m, and the slope is 10°–45°. Niuxin town, where the case study area is located, is located in the hilly area of Panshi city, with a minimum elevation of 237 m and a maximum of 384 m (Figure 4). The planting area is surrounded by low hills and hilly areas, where precipitation is collected, and the geographical location is conducive to the natural growth of rice.

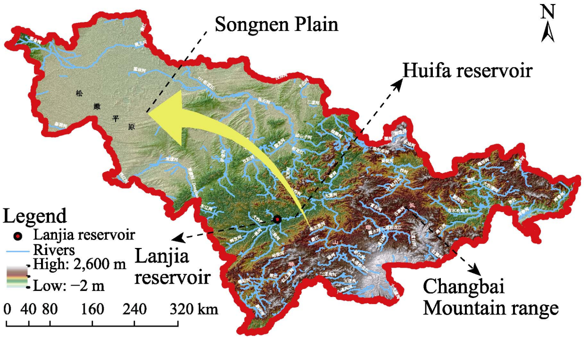

Figure 3 Natural geographical features of the case study area

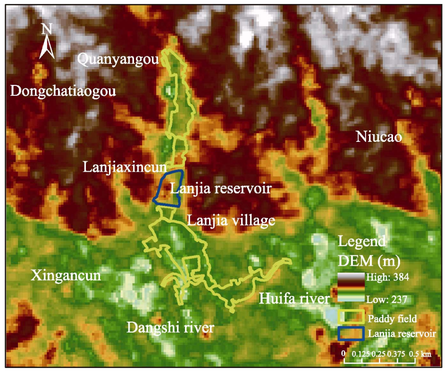

Figure 4 DEM of case study area

Panshi city is located in the mountainous area of Changbai Mountain–Liaodong hilly in the black soil area of Northeast China. The climate is mild and humid in this area, with an annual precipitation of 600–1,000 mm. The cultivated land area of black soil in the area is 1.29 million ha, and the slope cultivated land accounts for 68%, of which the gentle slope cultivated land above 2° to 6° accounts for half, respectively[9]. The black soil types are mainly meadow soil and dark brown soil in the case area. In the early days of liberation, the model workers of Panshi improved the soil by mixing loess with black soil to increase income. After long-term soil improvement, the black soil in the case area has high organic matter content, good properties and high fertility. It is an important part of the grain production bases in China.

The authors collected surface soil samples from field ridges, paddy fields and arable land in the case study area. The nitrogen content percentage (N%), carbon content percentage (C%), carbon–nitrogen ratio (C/N) (Table 2) and element contents (Table 3) in the collected soil samples were tested by the Physical and Chemical Analysis Center of the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences (with CMA certification). Among the 12 soil samples tested for 3 types of soil, the nitrogen (N) content was about 0.28% to 0.32%, the content of carbon (C) was in the range of 2.74% to 3.23%, and the ratio of C to N was in the range of 8.63 to 10.74. Among them, the content of N in the ridge soil was relatively high in the three soil samples, while the content of C was the lowest in the three soil samples. The low content of C makes the ratio of C to N in the ridge soil the lowest of the three soil samples. In the three soil samples, the content of N in the paddy field was in the middle position, and the content of C was relatively high in the three soil samples. The final ratio of C to N was also the highest in the three soil samples. The content of N in the mountain soil near the cultivated land was the lowest among the three soil samples, while the content of C and the ratio of C to N were intermediate.

Table 2 Soil carbon and nitrogen content in the case study area

Soil type	Sample number	N%	C%	C/N
Surface soil of ridge	1-1	0.320,7	2.768,3	8.633,3
Surface soil of ridge	1-2	0.311,6	2.741,1	8.797,9
Surface soil of ridge	1-3	0.298,3	2.748,0	9.213,0
Surface soil of paddy field	2-1	0.293,1	3.137,1	10.703,1
Surface soil of paddy field	2-2	0.291,3	3.127,9	10.738,0
Surface soil of paddy field	2-3	0.292,6	3.143,3	10.742,9
Surface soil of paddy field	3-1	0.298,7	3.235,2	10.832,3
Surface soil of paddy field	3-2	0.300,0	3.225,6	10.753,5
Surface soil of paddy field	3-3	0.298,5	3.231,0	10.825,8
Mountain soil near arable land	4-1	0.276,3	2.948,0	10.668,9
Mountain soil near arable land	4-2	0.277,9	2.932,8	10.555,4
Mountain soil near arable land	4-3	0.275,6	2.927,7	10.622,0

Table 3 Soil element contents in the case study area

Heavy metal types	Surface soil of ridge	Surface soil of paddy field 1	Surface soil of paddy field 2	Mountain soil near arable land
Al (mg/kg)	49,535.00	71,815.00	47,590.00	53,810.00
Ba (mg/kg)	517.05	498.85	490.90	506.70
Ca (mg/kg)	3,834.00	5,486.00	3,237.00	5,358.00
Co (mg/kg)	20.78	19.93	19.09	19.59
Cu (mg/kg)	32.15	28.50	26.47	16.78
Fe (mg/kg)	34,380.00	34,085.00	32,220.00	24,600.00
K (mg/kg)	23,280.00	20,930.00	20,180.00	19,660.00
La (mg/kg)	22.35	32.73	29.22	30.04
Li (mg/kg)	32.40	34.45	35.82	27.91
Mg (mg/kg)	6,700.50	7,254.50	6,901.00	6,039.00
Mn (mg/kg)	833.85	443.25	517.60	680.20
Na (mg/kg)	11,780.00	10,840.00	10,280.00	12,560.00
Ni (mg/kg)	41.42	41.17	34.86	30.38
P (mg/kg)	851.95	725.85	659.40	554.20
Sc (mg/kg)	5.91	10.25	7.19	7.95
Sr (mg/kg)	64.26	102.45	64.15	114.80
Ti (mg/kg)	4,385.00	4,802.00	4,592.00	4,766.00
V (mg/kg)	87.61	85.37	84.26	74.62
Zn (mg/kg)	84.43	75.06	82.18	68.39

3.1.4 Analysis of Water Resources and Quality

There are three primary small reservoirs, six secondly small reservoirs and 64 ponds in Niuxin town where the case study area is located. Among them, the Dangshi River joins eight streams and flows through Xinglong, Niuxin, Desheng, Chaoyang and other villages before flowing into Huifa river [8]. Huifa river is the largest tributary in the upper reaches of Songhua River, and it is also one of the important water sources in the rice planting area (Figure 5).

Huifa river originates from the eastern and western foothills of Jinmenling, Longgang mountain, Qingyuan city, Liaoning province, and the upstream is formed by the confluence of Liuhe river and Yitong river, which flows into Panshi city in the southwest of Lanjia village. Huifa river flows through Panshi city, with a length of 49 km and a drainage area of 2,309.94 km^2. The banks of Huifa river mostly hills, with low mountains and valleys. There are 39 rivers flowing into Huifa river in Panshi city, including 10 first-class rivers, 21 second-class rivers and 8 third-class rivers. Its runoff accounts for 26% of the total inflow of the Fengman reservoir. The water volume varies greatly with season, and can differ by 1,000 times between flood and drought conditions. As the natural ecology in the case study area is well protected, the water of Huifa river is clear, and fish and shrimp are abundant. After the river ice melts every year, a large number of wild ducks, wild geese and white eagles are attracted (Figure 6).

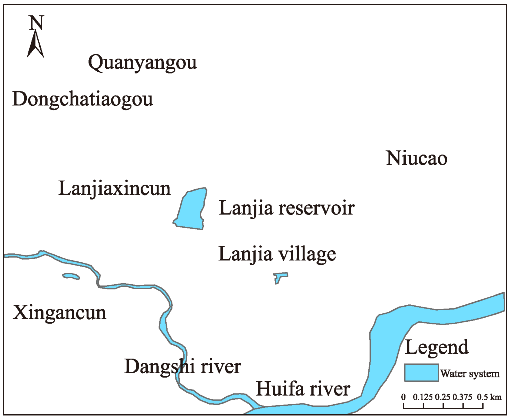

Figure 5 Water system in case study area

Figure 6 Lanjia village section of Huifa river (by Fu, J. Y. on December 1, 2020)

As the main water source of the rice-growing area, Lanjia reservoir covers an area of 8.86 hectares. The reservoir is located in a traditional agricultural village with no pollution in the whole basin and no factories around it. Three water samples from Lanjia reservoir was used to generate the water quality test (Table 4). We analyzed 25 elements and ions such as Al, As and B in the index water. By comparing the test data of the reservoir water samples with the urban drinking water supply and the sanitation standards of domestic drinking water, it was found that all the indicators of the water quality test in Lanjia reservoir were higher than those of the urban drinking water supply.

3.1.5 Analysis of Land Use Type

According to land use types in the case study area, the vegetation coverage of paddy fields, dry (rain-fed arable) land, forest land and water bodies around Lanjia village and the spatial distribution of land use types in the villages where villagers live are obtained from the interpretation of ZY-3 satellite images of China Resources Satellite Center (Figure 7). The paddy field consists of two plots of the upper and lower reaches of Lanjia reservoir with a total area of 61 hectares. Dry land was the dominant land-use type, with a total area of 908.68 hectares. Forestland covers only 292.68 hectares, second only to dry land. The water bodies are mainly Lanjia reservoir, Huifa river, Shuishi river and Lanjia village pool. Lanjia reservoir is the main irrigation water source for the paddy fields in the case study area, with a total area of about 8.86 hectares. The villages in the case study area include four natural villages (tuns) that make up the Lanjia Village Committee.

The largest area is Quanyangou to the north of the paddy fields in the case study area, with a total area of 21.96 hectares; the second largest is Lanjia village in the south of the case study area with a total area of 16.93 hectares; Lanjiaxincun on the west side of Lanjia reservoir has a total area of 4.76 hectares; Dongchatiaogou, which is far from Lanjia reservoir and the paddy fields in the case study area, has an area of 4.72 hectares.

3.2 Rice Product Characteristics

3.2.1 Rice Varieties

The Jihong 6 is a rice variety planted in the case study area in 2020. It is a mid-to-late maturity variety. The seedling time is May 20–26, the heading time is mid-to-late July, the filling time is mid-August, and the harvesting time is around October 10th. The grain length of the rice product is 4 mm, the aspect ratio is about 1.7, and the yield can reach 7,000–7,500 kg/ha[10].

Table 4 Major water chemicals of Lanjia reservoir

Elements	Sample 1	Sample 2	Sample 3	Standard for urban drinking water supply	Sanitary standards for drinking water
Al (mg/L)	0.149,4	0.157,6	0.134,4	0.2	–
As (mg/L)	0.007,5	0.008,5	0.008	0.01	0.05
B (mg/L)	0.018,1	0.018,2	0.018	0.5	–
Ba (mg/L)	0.058,8	0.059,6	0.060,6	0.7	–
Ca (mg/L)	51.97	53.82	53.61	–	–
Cd (mg/L)	0	0	0	0.003	0.01
Co (mg/L)	0.000,1	0	0.000,3	–	–
Cr (mg/L)	0.001	0.001	0.001	0.05	0.05
Cu (mg/L)	0.002,1	0.002,4	0.002,7	1	1
Fe (mg/L)	0.103,7	0.121,6	0.116,6	0.3	0.3
K (mg/L)	7.564	7.64	7.628	–	–
Li (mg/L)	0	0	0	–	–
Mg (mg/L)	15.6	15.84	15.85	–	–
Mn (mg/L)	0.065,6	0.067,7	0.076,8	0.1	0.1
Mo (mg/L)	0.000,5	0.000,8	0.002,7	0.07	–
Na (mg/L)	17	17.55	17.38	200	–
Ni (mg/L)	0.000,6	0.000,6	0.001,2	0.02	–
P (mg/L)	0.233,6	0.215,3	0.222,1	–	–
Pb (mg/L)	0	0	0	0.01	0.05
Se (mg/L)	0.005,8	0.005,1	0.006,3	0.01	0.01
SiO_2 (mg/L)	9.016	9.131	8.987	–	–
SO_4^{2-}= (mg/L)	55.32	55.38	55.61	250	
Sr (mg/L)	0.307,9	0.315,7	0.322,5	–	–
V (mg/L)	0.013,5	0.013,7	0.019,4	–	–
Zn (mg/L)	0.002,8	0.003,1	0.003,5	1	1

The Jida japonica rice 518 (*Jida indica* 518) is another rice variety planned to be replanted in the case study area (Figure 8). It is a mid–late maturing variety, with a plant height of about 109 cm and a thousand-grain weight of about 23 grams. This variety is sown in early April and transplanted in mid-May. The Jida Japonica 518 rice produced in November 2021 are shown in Figure 9. Water management adopts the irrigation method of a shallow tillering stage, a deep booting stage and a shallow grain filling stage[11].

3.2.2 Rice Quality

The core analysis data of the case study product include the Lanjia village rice quality appraisal data tested by Nanjing Agricultural University (Table 5) and the Lanjia village rice element content test data tested by the Physical and Chemical Analysis Center of the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (with CMA certification) (Table 6). According to the rice quality identification dataof Lanjia village, the chalky grain rates of the three rice samples were 9.5%, 8% and 12.5%, respectively. With reference to the national quality rice standards, the chalky grain rates of the first-class high-quality rice were below 10%, level 2 is 11%–20%; that is, Lanjia village rice samples 1 and 2 met the national first-level, high-quality rice standard, and Lanjia village rice sample 3 met the national second-level rice standard. From the Lanjia village rice glue consistency test (the gum consistency is a colloidal characteristic of rice starch, an important indicator for evaluating high-quality rice; the greater the gel consistency, the softer the rice and the better the quality), it can be seen that the glue consistency of the Lanjia village rice product samples can reach 100 mm, which is the highest value among 54

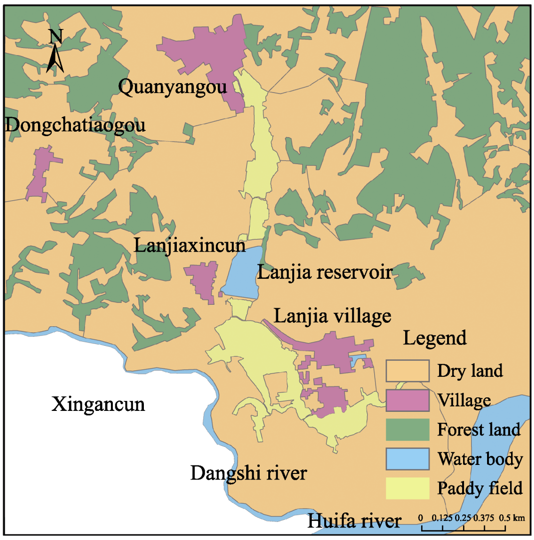

Figure 7 Map of land use in the rice planting area of Lanjia village

Figure 8 Rice (*Indica Jida* 518)

Figure 9 Rice product (*Indica Jida* 518)

rice samples in the same batch. From the heavy metal detection data of Lanjia village rice products (Table 7), the 15 monitoring indicators used in the Lanjia village rice samples show no element exceeds the standard, and the products are generally of high quality.

Table 5 Quality, carbon and nitrogen content of rice in Lanjia village (Jihong 6)

Identification data of rice quality in Lanjia village			
	Chalkiness rate (%)	Chalkiness (%)	Gel consistency (mm)
Rise sample 1	9.5	1.5	100
Rise sample 2	8	1.3	100
Rise sample 3	12.5	2	100

Table 6 Content and ratio of C and N element of rice in Lanjia village (Jihong 6)

Test data of element content of rice in Lanjia village				
	Number	N%	C%	C/N
Rice sample 4	Big1	1.147,7	40.609,7	35.383,8
Rice sample 4	Big2	1.084,5	40.714,5	37.542,0
Rice sample 4	Big3	1.069,4	40.637,0	38.000,9
Rice sample 5	Sma1	1.065,0	38.768,0	36.402,4
Rice sample 5	Sma2	1.062,8	38.748,8	36.460,1
Rice sample 5	Sma3	1.053,4	38.853,8	36.883,7

In addition, the quality test results of the Jida Japonica rice 518 rice variety planted in the case study area in 2021 showed that the brown rice rate of the Jida Japonica rice 518 variety was 84.2%, the polished rice rate was 77%, the wholly polished rice rate was 71.4%, the aspect ratio was 1.6, the grain length was 4.5 mm, the chalky rate was 6%, the chalkiness was 1.5%, the gel consistency was 81 mm, the alkali elimination value was 7.0, the amylose content was 16.2% and the protein content was 6.65% (Table 6). This variety has also reached the national first-class quality rice standard[3].

Table 7 Trace elements of rice products in Lanjia village (*Jihong* 6)

Elements	Rice sample 4	Rice sample 5	Elements	Rice sample 4	Rice sample 5
Al (mg/kg)	20.07	10.47	Mn (mg/kg)	22.10	20.74
B (mg/kg)	6.07	4.57	Mo (mg/kg)	0.37	0.34
Ba (mg/kg)	0.36	0.30	P (mg/kg)	854.00	829.50
Ca (mg/kg)	81.41	74.52	Sr (mg/kg)	0.15	0.12
Cu (mg/kg)	3.17	3.11	Ti (mg/kg)	3.50	3.95
Fe (mg/kg)	60.78	34.25	V(mg/kg)	0.06	0.07
K (mg/kg)	781.69	737.17	Zn (mg/kg)	15.25	14.75
Mg (mg/kg)	242.76	224.52			

3.3 Business and Management

Lanjia village is located in the south of Panshi city, south of Niuxin town, 15 km from the town government, with Hulong village in the east, Huinan county in the south, Baoshan township in the west and Chaoyang village in the north[4]. There are 4 natural villages, 7 villager groups, 396 households and 1,665 people in Lanjia village. There are only 2 members under 35 years old. Lanjia village has one American ginseng park, one orchard and more than 100 cattle raised by retail investors. The total arable land area of Lanjia village is 897 hectares, of which the paddy field area is 61 hectares. The basic rural productive system in Lanjia village is household contract, indicating that each family is responsible only to their own product management. In 2020, there was no collective revenue in Lanjia village, the average per capita income of the farmer is 16,500 Yuan.

3.3.1 Profound Scientific and Technological Cooperation

To revitalize villages in Panshi city and to spur the local economy, the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (ISGNRR-CAS), and Panshi city have conducted some investigations and carried out in-depth cooperation.

(1) On December 1st, 2020, Prof. Liu, C. from IGSNRR-CAS visited Lanjia village and discussed with the leader and villagers about organizing them together and taking advantage of Lanjia village's geographical resources to reinforce the integration of science and technology and promote the brand of products (Figure 10).

(2) On March 11th, 2021, the leaders of Panshi city as well as other city staff held a symposium with researchers IGSNRR-CAS. The two parties signed a framework agreement on science and technology cooperation (Figure 11).

(3) On March 15th, 2021, IGSNRR-CAS, Jilin University, Beijing Tian Hang Hua Chuang Technology Co., Ltd., as well as researchers from other involved parties, participated in a

[3] Date sources: Grain and Product Quality Supervision, Inspection and Testing Center of the Ministry of Agriculture and Rural Affairs (Harbin).

[4] Date sources: https://baike.sogou.com/v234077.htm?fromTitle=%E7%89% 9B%E5%BF%83% E9%95%87.

seminar on the case of permanent rice farmland in Lanjia village, Panshi, and initiated the construction of a field inspection station for the real-time monitoring system of rice growth in Lanjia village.

(4) On May 20th, 2021, Prof. Jiang, D. and associate Prof. Fu, J. Y. from IGSNRR -CAS investigated Lanjia village during the rice transplanting season.

(5) On July 19th, 2021, Deputy Director Feng, Z. M., Director Wang, Z. B., and Fu, J. Y. of IGSNRR-CAS, visited Panshi to investigate the rice cultivation in Lanjia village.

In the meantime, the Lanjia Rice Planting Professional Cooperative in Panshi city set up the director, the representative, the executive supervisor, and the shareholder of the cooperative to ensure the management of the cooperative would be conducted scientifically and reasonably.

3.3.2 Setting up the Cooperative

On March 26th, 2021, The Lanjia Rice Planting Cooperative was established, indicating that the primary way to do business in this village has shifted from individual to collective management. The cooperative is mainly engaged in the production, processing, and sales of local products, including: grain and bean planting; production, sales, processing, transportation, storage and other related services of agricultural products; primary processing of edible agricultural products; sales of grains; sales of beans and potatoes.

Figure 10 In December 2020, Prof. Liu, C. conducted field research on the geographical environment of Lanjia reservoir

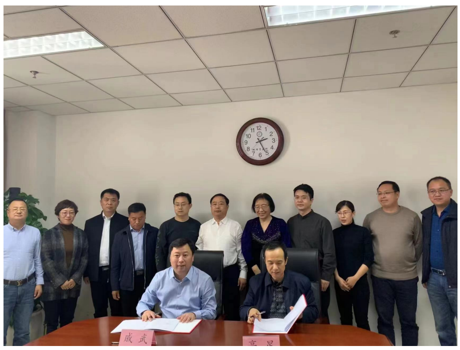

Figure 11 In March 2021, the leader of Panshi city and his entourage held a symposium with the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences. The two parties signed a framework agreement on science and technology cooperation

3.3.3 Trademark Registration

In January 2021, the trademark of Lanjia village rice was approved by the State Administration for Industry and Commerce (Figure 12).

兰家村

Figure12 Trademark of Lanjia village rice

3.3.4 Building the Real-time Monitoring Station and Traceability System

Lanjia village has built an automatic observatory for rice habitat in March 2021 to better trace the growth environment and process of rice (Figure 13). The observatory is a low-power IoT (Internet of Things) sensing system with functions including real-time photographed landscape (Figure 14), air temperature (Figure 15), air humidity (Figure 16), air quality (Figure 17), wind speed, and wind direction, etc.

Figure 13 The ground-based observatory was completed in March 2021

Figure 14 Real-time landscape images observed by the ground-based observatory in September 2021

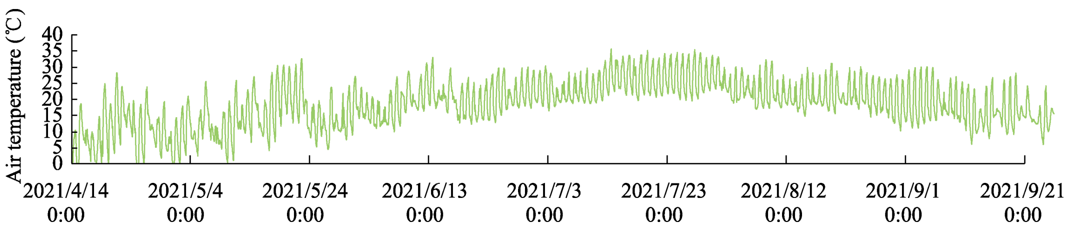

Figure 15 Real-time ecological environment data observed by the ground-based observatory from April 2021 to December 2021 (Temperature)

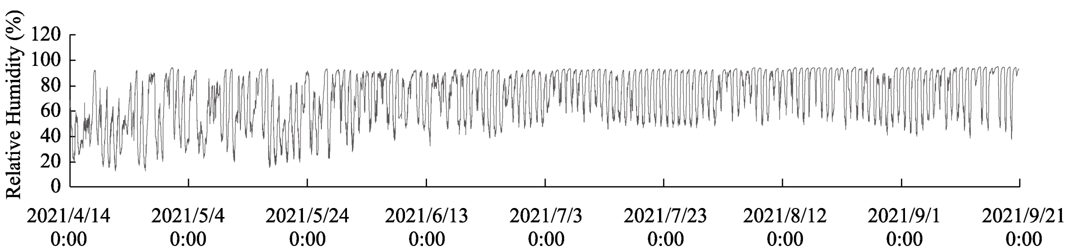

Figure 16 Real-time ecological environment data observed by the ground-based observatory from April 2021 to December 2021 (Humidity)

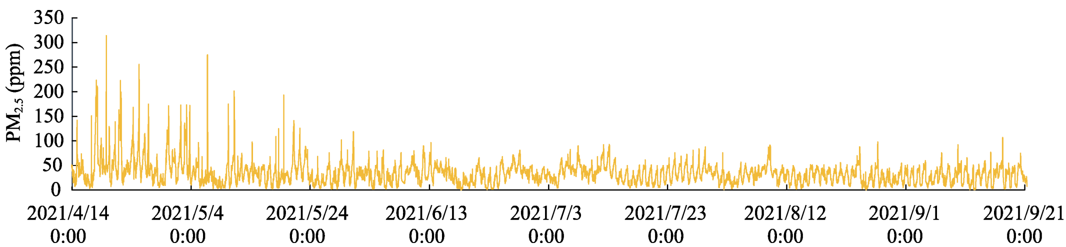

Figure 17 Real-time air quality data observed by the ground-based observatory from April 2021 to December 2021 ($PM_{2.5}$)

3.3.5 Normalization of Rice Planting Management

Panshi City Lanjia Rice Planting Community Cooperative has established the Cooperation

Rules[5]. Rice production is carried out in a pollution-free place of origin, adhere to planting management standard. Full-time personnel are equipped to handle the management all year round, and agricultural technicians are fully equipped to carry out production technical training and field management and production technical guidance. Rice production archives are established, and the whole process of organic rice production is recorded as required for reference. The main technical and management measures are as follows.

(1) The environmental and technical conditions of the producing area, including the indexes and concentration limits of farmland water, soil, and air, must meet the production requirements of organic rice; the soil should have good water and fertilizer retention ability.

(2) According to the local accumulated temperature, irrigation and other ecological conditions and market requirements, the varieties with suitable maturity, high quality and yield, strong disease and stress resistance, which have been approved and popularized, should be selected for variety breeding and treatment; before soaking, the seeds should be dried on sunny day for 1–2 days and turned over 3–4 times a day; the selected seeds should be soaked in 1% lime water at room temperature for 3 days.

(3) Cultivating strong seedlings, tilling the land, preparing the land, soaking the seeds and accelerating germination, sowing, seedbed management, weeding and pest control should be carried out in accordance with the relevant regulations.

(4) Field management is carried out using mechanical land preparation; the height should not be different from 10 cm before high-quality decomposable farm manure is raked into the field; the distance of planting holes should be 3 cm × 10 cm, with 3–5 plants in each hole and about 33 holes per square meter. After transplanting and before turning green, the seedlings should be irrigated with 2/3 of the water and then nursed and protected. A total of 3 cm shallow water should be irrigated at the effective tillering stage to increase temperature and promote tillering. Drainage and sunning in the field should be undertaken 3 to 5 days before the middle stage of effective tillering. Cracks can appear on the pool's surface when the field is sun-dried, white roots can be seen on the ground, and the leaves can be pale in color. After sun-drying for 5–7 days, the normal water layer should be restored. Before the booting and earring, 4–6 cm of running water should be irrigated. Irrigate with water to a depth of 15–20 cm to protect the fetus when encountering low temperature. During the heading and flowering period, irrigate 5–7 cm of live water, and intermittently irrigate during filling to wax maturity, in a dry–dry–wet–wet pattern, keeping it mainly wet. Drainage starts at the beginning of yellow maturity, and depressions can be properly advanced. Drainage leaking places can be properly discharged later.

(5) Organic fertilizer and a special fertilizer for rice were used for top dressing. Physical method was used to control weeds and insects. Enhancing crop resistance, cultivating the ecological balance of paddy fields, scientific and reasonable balanced fertilization technology and making full use of natural enemies to control insect pests were used as the primary means of pest control, coupled with limited use of pesticides permitted under the organic standard GB/T 19630—2019.

(6) Harvesting takes place when rice maturity reaches to 90% (around October 10th), and

[5] Documented management documents: Cooperation Rules of Panshi Lanjia rice planting professional cooperative; the cooperation framework agreement on high-quality geographical products; the science and technology cooperation framework agreement between the Institute of Geographic Sciences and Nature Resources Research, Chinese Academy of Sciences and the People's Government of Panshi.

threshing is carried out at the same time.

3.4 History of Rice Cultivation

Rice has been planted in the Northeast China since more than 1,300 years ago[12], as early as the Tang Dynasty, and the rice of Lucheng was well known in ancient China. The "General History of Northeast China" records that the capital of the Bohai Kingdom, Zhongjing Xiande Mansion, and the six prefectures Lu, Xian, Tie, Tang, Rong and Xing were all within the territory of Jilin province [13]. The rice of Lucheng at that time is the rice of Jilin today. In the Qing Dynasty, the excellent quality of Jilin rice was more widely recognized, and emperors from Nurhachi to Xianfeng designated Jilin rice as tribute rice. In 1682, when Emperor Kangxi visited Jilin, he ate Jilin rice and felt that the rice was fragrant and smooth, the taste was very good, and he was very happy. In the middle of the 19th century, with the lifting of the Qing government's ban on Changbai Mountain, rice began to be planted in the Yanbian area. At that time, the Yanbian area subsequently became a township famous for its rice in Northeast China, and it also has opened the modern Northeast rice cultivation for more than 100 years. Rice cultivation quickly expanded to Jilin province and the entire northeast.

When P. R. China was founded in 1949, the area of paddy field has reached 5,458 ha. After that, the Panshi Government stipulated that "The agricultural tax will be exempted for reclamation of dry fields for 3 years or paddy fields for 5 years, and the agricultural tax will not be changed for conversion of dry fields to paddy fields for 3 years; At the same time, water conservancy loans are issued to encourage the construction of water conservancy and expand the area of paddy fields.". In 1954, a water conservancy construction climax was set off, and the area of paddy fields had reached 7,956 ha by 1955. The water conservancy was promoted again in Panshi, and the area of paddy fields soared to 20,681 ha. After the 1960s, the achievements of water conservancy construction began to be consolidated in Panshi, the quality and standards of water conservancy projects were improved, and area of paddy field has been steadily expanded. At the same time, they began to develop paddy fields and strip fields, remove the ridge of fields and merge the small pools into large ones. By the end of 1975, there were 7,866 ha of quality paddy fields and strip fields in Panshi. By 1990, 15,000 ha of paddy fields and strip fields had been built, accounting for 51.5% of the total paddy fields. In 1991, Panshi rice was mainly planted with Tongyu 35 and Tongyu 36, with a sowing area of 16,629 ha and a yield of 117,159 tons. In 1999, the sown area of rice increased to 18,095 ha and the output was 182,955 tons[14].

4 Discussion and Conclusion

Lanjia village, Panshi city, Jilin province, is located in the transitional zone from the Changbai Mountains to the Songnen Plain. It is a hilly and semi-mountainous area. Affected by geographical location and atmospheric circulation, it has favorable climatic conditions. The main water source of the case study product planting area is Lanjia reservoir, which is located in the low-lying area where snow and ice water, natural precipitation and other clean water sources occur naturally. The ecological environment of the whole basin is superior and pollution-free. The unique geographical environment has given birth to high-quality rice products with regional characteristics in Lanjia village, Panshi, Jilin. Panshi municipality take rural revitalization and technological integration very seriously. The grounded scientific research of the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, adopted open scientific methods and communication methods that combine science, technology, and engineering. This research provides guidance to transform the village business from individual management to collective management, help the villagers with pollution-free crops cultivation, set up a real-time monitoring IoT system for the ecological environment of crop fields, aid in trademark registration, promotes the brand meeting the market demand, develop the local agriculture that benefits the villagers, and blaze a trail for all the scientists that are dedicated to "write scientific papers in the land". The scientific thought, techniques, and organization in the case of permanent basic farmland for rice cultivation in Lanjia village, Panshi city have made a replicable example that accumulates valuable knowledge and experience for the exploration of development patterns suited for Panshi city as well as the rural revitalization.

Author Contributions

Fu, J. Y. made an overall design for the development of the data set, and wrote data paper; Du, X. L. and Zheng, Q. S contributed to rice data and related technologies; Qiao,Y. B., Yan S., Zhu, X. G. provided and dealt with the key real-time monitoring data and the detection data of rice quality and soil elements; Gu, Y. B. and Fu, Y. J. collected key data including the ecological circumstances and rice planting management of the case area.

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Conflicts of Interest

The authors declare no conflicts of interest.

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