Investigating Effectiveness of Water Supply on Civil Complaints and Customer Satisfaction: Implication on CRM (focus on Nonsan city)

By

KIM, Taehoon

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC MANAGEMENT

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Committee in charge:

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Abstract

Water supply is a basic factor for the lives of the people and the development of the national economy. Therefore, management of water supply plays a key role for customer satisfaction. In the case of Korea, local governments manage water facilities to supply tap water to the people. So local governments are the local water supply companies that manage each administrative district. However, as local governments are responsible for supplying tap water, the level of tap water service varies depending on the financial independence of individual local governments, the availability of water supply professionals, and low fees.

The main business objectives of local water supply companies are safe water supply and water quality management. However, other services, such as staff attitude and efforts to meet diverse customer needs, are lacking. K-water conducts an annual customer satisfaction survey to measure customer satisfaction with local water supplies. However, it is difficult to grasp the ever-changing needs of customers with only annual customer satisfaction surveys.

This study will examine whether various complaints raised by local water supply customers (such as service improvement, inconvenience resolution, and policy proposals) can be used to improve the quality of service in the overall local water supply business. In this study, focuse on the water supply business in Nonsan, 1) Whether an increase or decrease in the number of customer complaints of a particular type has a positive or negative effect on customer satisfaction, 2) Whether the long or short time taken to process complaints has a positive or negative effect on customer satisfaction, 3) Whether the difference in the water usage environment, such as the difference in water usage by Eup, Myeon, and Dong in the city, affects customer satisfaction, By studying this, we would like to investigate the effect of customer complaints on customer satisfaction. In order to conduct this study, the civil complaint data submitted by customers of the Nonsan Regional Water Center of the K-water

for five years from 2014 to 2018 were intensively analyzed.

The results of verifying the above three hypotheses are as follows. 1) The increase or decrease in the number of specific civil complaints, such as water quality and water supply facilities, has a positive correlation with customer satisfaction. On the contrary, customer satisfaction has a negative correlation with specific civil complaint items such as reissue of bills and requesting changes in customer information. 2) As a result of analyzing the effect of the time taken to process complaints on customer satisfaction, In 2018, when customer satisfaction fell sharply, it was confirmed that the number of complaints processed within one minute decreased, and the number of complaints processed by more than 20 minutes increased.

3) As a result of analyzing the effect of the difference in water usage environment on customer satisfaction by eup, myeon, and dong, there is no significant difference between villages that use a lot of water and villages that use less water. Therefore, it was confirmed that regional characteristics did not significantly affect customer satisfaction.

Unlike the private sector, public services can be monopolized. Therefore, customer satisfaction in the public service sector seemed unimportant. However, customers' needs for public services become diversified. The role of customer satisfaction should be addressed importantly in the public service sector. In the past, sufficient water supply was the most important thing in tap water policy. However, there is a growing demand from customers for improving the quality of tap water services. It is necessary to immediately respond to customer complaints related to tap water by creating a system that can proactively respond to customer demands. It is necessary to increase customer satisfaction by identifying which items customers are most sensitive to among various customer complaints (charges, water supply, water quality, etc.), and to create a tap water management system that can quickly address customers' needs.

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I. Introduction

Water supply is one of the most basic factors for the people's lives and economic development. Water supply is generally divided into local water supply, multi-regional Water Supply and village water supply. Local water supply refers to a facility in which local governments supply tap water to local residents and commercial facilities in the region. Since local water supply is managed by administrative district, 161 local governments in Korea are water operators in each region. However, since each local government manages facilities for water supply, the level of water service varies depending on the water supply environment, such as whether the local government has water supply experts, financial conditions, and high and low water rates by region. In particular, most local governments invest their finances in expanding the area that supplies tap water by installing water supply facilities. Therefore, there was little investment in repairing existing water facilities and improving services.

K-water, Korea's only water management agency, was entrusted with a local water supply operation project by local governments to solve these problems. Starting with the Nonsan Local Water Supply Project in 2004, K-water was entrusted with the local water supply project by 23 local governments by 2019. After K-water was entrusted with the local water supply project, the revenue water ratio and water supply rate increased significantly, and customer satisfaction also increased. Water supply business organizations such as local governments are focusing on supplying tap water stably, and invest resources in maintaining clean water quality.

K-water conducts a customer satisfaction survey every year to improve customer satisfaction with local water supply. However, customer needs are constantly changing, so the annual customer satisfaction survey is insufficient to improve customer satisfaction. In order to increase customer satisfaction, it is necessary to identify the changing needs of customers in real time and reflect them in water business operation.

Local water supply customers file civil complaints to improve services, resolve

inconveniences, and propose water supply policies. Customers' complaints reflect various needs of customers. The information contained in the customer's complaints can be used to establish and operate a local water supply business plan and improve service quality. In particular, in the case of local water supply projects, more than 10,000 various customer complaints are accumulated every year. This customer complaint data can be used more effectively to improve the quality of water supply services. By using the results of the annual customer satisfaction survey conducted by the K-water, it is possible to analyze whether the increase or decrease of specific customer complaints has an effect on increasing or lowering customer satisfaction. From this point of view, this study attempts to find a way to improve customer satisfaction by analyzing customer complaints. In this study, the following research questions are applied: 1) Based on the water supply project in Nonsan city, determine whether the increase or decrease in the number of specific types of complaints among complaints filed by customers affects the increase or decrease in customer satisfaction rate, 2) Whether the longer or shorter time taken to settle complaints has a positive or negative impact on customer satisfaction rate, 3) Based on the each village of Nonsan, whether the difference in water use environment such as water supply affects customer satisfaction, try to understand the extent to which customer complaints affect customer satisfaction. To this end, complaints received at the K-water Nonsan Regional Waterworks Center for five years from 2014 to 2018 were categorized and classified, Calculate the correlation between the increase or decrease of the number of complaints of each type by year and the customer satisfaction score for that year, based on the fact that the average water supply is high and the average water supply is low, the average customer satisfaction level of the two types of township is significant.

II. Literature Review

2.1. Review on Civil Complaints

Various studies also exist in the field of civil complaints. Kim, Ha, and Lee (2020) attempted to analyze the relationship between residential environment satisfaction and complaints about inconvenience in living, Ahn and Moon (2011) conducted a study on measures to improve customer satisfaction and service quality in public services. Yeom and Lee (2009) conducted a study on ways to improve customer satisfaction in civil administration services. Kim, Lee, Yoo, and Kim (2018) studied how to derive civic requirements by analyzing text on civil complaints through text mining techniques research for civil complaint analysis. Cai and Geng-Qing (2018) analyzed the service response factors affecting customer loyalty through the impact of compliance on customer status and loyalty study.

2.2. Review on Local Water Management

Numerous studies have been conducted on local water supply projects. Park (2008) analyzed the factors influencing customer satisfaction in Inje-gun through research on customer satisfaction evaluation and influencing factors of local government water supply services. Kang (2019) quantified K-water's entrusted operation performance through the improvement of local water supply rates and operation advancement direction, Park (2018) studied domestic water supply policy and operation performance evaluation, and Go (2017) studied efficiency comparison analysis according to local water operation. Denantes and Donoso (2021) research factors influencing customer satisfaction with water service quality in Chile. Delpla, Legay, Proulx and Rodriguez (2020) investigate Assessment of the factors modifying the links between satisfaction and water consumption behavior. According to the survey, citizens' perception of the water supply project would be affected by the quality of tap water services. Ewuzie, Nnaemeka, Stephen and Nwankpa (2021) research the appraisal of data collection, analysis, and reporting adopted for water quality assessment in Nigeria.

2.3. Theological background of Customer Satisfaction (CS) and Customer Relationship Management (CRM)

2.3.1. Definition of Customer Relationship Management

CS and CRM have been discussed and studied at the corporate marketing level. Lee (2001) defined CRM (Customer Relationship Management) as a customer-related process and activity that uses customer information to maintain, expand, and improve customer relationships to improve customer satisfaction and loyalty. In addition, Lee (2001) argued that the demand for CRM has increased due to the power shift from company to customer due to the digitalization and Internet revolution. Lee and Heo (2005) argued that a systematic system and employee training are important to improve customer satisfaction and loyalty by providing customized benefits and differential information to actively utilize brand assets.

2.3.2. Characteristics of Customer Relationship Management

Choi and Lee (2001) said that there are six characteristics of CRM: First, CRM is customer-oriented, so it provides appropriate benefits such as products and services necessary for customers, as well as differentiated compensation, and focuses on customer-centric management, Second, CRM is a long-term and dynamic way of managing relationships throughout the customer's life, Third, CRM should form and develop interactive relationships based on mutual benefits and trust between customers and companies, Fourth, CRM promotes return on investment (ROI) and differential target marketing through efficient utilization of information technology-based scientific environments, Fifth, CRM continues integrated and consistent interactive communication through direct contact with customers, Sixth, CRM defined that it does not simply focus on marketing, but requires the integration of all processes of the company.

III. The status of Water Supply Management

3.1. Water Supply Management by K-Water

About 120 years have passed since the domestic water supply was supplied. Prior to the 2000s, the water supply policy was centered on the development of water supply to expand the water supply rate. However, since the 2000s, the concept of integrated resource management has been introduced beyond water resource development based on supply facilities. In the late 1990s, the importance of demand management emerged due to drought across the country, and the water supply policy was changed to reduce water leakage and improve the efficiency of water supply management. As a result, local governments have been criticizing the limitations of how to manage the water supply project. In other words, local governments are criticized for their small size (difficulty in achieving scale economy), lack of expertise in water supply workers, overlapping water supply facilities (wide area) Waste of budget due to excessive investment, and inefficiency in facility operation, etc. Accordingly, Article 23 of the Waterworks Act and Article 36 of the Enforcement Decree have allowed local governments to entrust water facilities to professional organizations since 2001 in order to eliminate the size of local waterworks projects and imbalance. In addition, K-water commissioned and managed local water supply facilities of 23 local governments for the first time in Nonsan-city in 2004. K-water's business type is that facility ownership is taken by local governments and operation management rights are taken by K-water, and it is in charge of operating and improving existing local water supply facilities, increasing the flow rate, and improving overall water service. Investment is required to improve local water supply facilities during consignment operation, and it is implemented in a structure that recovers costs over a long period of time (20 to 30 years) after K-water pays the initial investment costs.

Sortation	Han river basin		Geum river basin		Yeongsan/Seomjin River basin	Nakdong River basin	
	Gyeonggi (4)	Chungbuk (1)	Chungnam (4)	Jeonbuk (1)	Jeonnam (5	Gyeongbuk (4)	Gyeongnam (4)

Local government	Dongducheon, Yangju, Paju, Gwangju	Danyang	Nonsan, Seosan Geumsan, Cheonan (Ind)	Jeongeup	Naju, Hampyeong, Wando, Jindo, Jangheung	Yecheon, Goryeong, Bonghwa, Cheongsong	Sacheon, Geoje, Goseong, Tongyeong

(Table 1) Status of K-water's consignment of local water supply projects (K-water, 2018)

Local waterworks directly operated by local governments have been pointed out as problems such as excessive overlapping investment, inequality in quantity and water quality between regions, differences in rates, and low running rates and lack of expertise due to circular positions of public officials. (Park & Jeong 2010). As a result, the government has introduced a new method of operation that transcends the direct production and supply of local governments in the field of water supply. In 2001, the Waterworks Act was revised to implement a privatization policy to foster fisheries companies and a private consignment policy through the establishment of water-related organizations. K-water, a water management agency, has commissioned local waterworks projects, and has achieved various results. The main results were a 24.2 percent increase in water flow and 16 points increase in customer satisfaction.

Sortation	Start of operation	Water flow rate (%)				customer satisfaction			water supply population		
		Goal	Before	After	Result	Before	After	Result	Before	After	Result
Total			60.1	84.3	24.2	66.29	82.29	16.00	1,757,195	2,500,159	742,964
Nonsan	'04.03.12	80.0	54.9	85.9	31	56.9	81.65	24.75	77,678	102,622	24,944
Jeongeup	'05.04.01	80.0	53.7	81.9	28.2	64.1	81.34	17.24	112,503	112,039	△464
Sacheon	'05.12.01	80.0	39.6	80.0	40.4	68.3	84.42	16.12	96,127	111,460	15,333
Yecheon	'05.11.01	80.0	49.9	81.4	31.5	68.9	84.22	15.32	25,287	49,517	24,230
Seosan	'06.05.24	80.0	65.3	85.9	20.6	64.5	83.14	18.64	85,780	173,538	87,758
Goryeong	'06.12.01	80.0	48.0	80.6	32.6	65.9	83.64	17.74	21,673	33,209	11,536
Geumsan	'07.01.01	80.0	49.9	79.1	29.2	63.1	82.39	19.29	33,054	43,728	10,674
Dongducheon	'07.01.01	80.0	60.7	90.0	29.3	65.8	80.89	15.09	84,762	96,745	11,983
Geoje	'08.02.01	80.0	59.9	79.5	19.6	57.6	81.61	24.01	190,004	249,802	59,798
Yangju	'08.08.01	88.0	84.9	88.7	3.8	63.8	80.31	16.51	157,475	225,328	67,853
Naju	'08.07.21	80.0	66.5	85.7	19.2	65.6	81.29	15.69	49,160	97,607	48,447
Danyang	'08.07.01	80.0	53.1	81.0	27.9	63.8	80.58	16.78	20,396	22,558	2,162
Paju	'09.07.01	88.0	84.3	88.5	4.2	69.7	78.45	8.75	272,073	461,474	189,401

Hampyeong	'09.06.05	80.0	42.7	80.5	37.8	63.4	83.08	19.68	14,344	31,232	16,888
Gwangju	'09.11.02	88.0	83.2	86.1	2.9	58.1	78.78	20.68	212,800	353,631	140,831
Tongyeong	'10.09.01	80.0	40.9	80.6	39.7	72.3	82.12	9.82	130,015	134,068	4,053
Goseong	'10.09.01	80.0	47.9	79.8	31.9	72.4	83.66	11.26	36,864	43,002	6,138
Wando	'13.03.01	80.0	34.0	80.6	46.6	70.9	83.31	12.41	42,472	51,408	8,936
Jindo	'13.02.13	80.0	47.5	80.8	33.3	79.2	85.08	5.88	33,054	31,915	△1,139
Jangheung	'13.05.31	80.0	57.6	82.9	25.3	76.1	83.99	7.89	24,703	34,106	9,403
Bonghwa	'14.07.01	80.0	53.4	80.7	27.3	61.8	85.69	23.89	18,888	22,340	3,452
Cheongsong	‘17.09.01	80.0	35.8	57.2	21.4	77.0	80.91	3.91	18,083	18,830	747
Cheonan(Ind)	‘06.07.01	-	-	97.6	-	-	-	-	-	-	-

(Table 2) Results of K-water's entrusted operation of local waterworks projects(K-water, 2018)

3.2. Nonsan local Water supply project Customer Complaint Data

About 10,000 civil service data are accumulated annually in the Nonsan Regional Waterworks Project, and each civil service data includes a management number, civil service information (name, contact information, address, etc.), civil service details, and action results. The contents of civil complaints are divided into 11 major categories and 63 middle categories according to the type of civil complaint. The major classification items consist of items such as rates, meter reading, meter, and customer related to rate notification, as well as items such as water supply, leakage, water quality, and water supply facilities related to water supply and tap water quality. The middle classification item is a sub-concept of the major classification item and consists of detailed civil petition elements constituting each major classification item. (ex. Major classification fee → Items such as middle classification fee inquiry, leak reduction, arrears, refund, etc.) When analyzing the correlation between each civil complaint element and customer satisfaction, the major and middle categories of each civil complaint element are the criteria for calculating the increase or decrease in the number of civil complaints by year.

complaint reception			content of complaint			content of complaint			
control number	Name	application date	Name	contact information	Address	major classification	middle classification	application method	Contents

consecutive numbers	-	yyyy-mm-dd hh:mm		Phone number	-	63 types	11types	10types	amorphous form

complaint-producing area			outcome of treatment			meter-reader	agent
township	measuring instrument number	Location	Person in charge	matters to be dealt with	completion date		
area name	4 digits	Address	Name or contact code	amorphous form	yyyy-mm-dd hh:mm:ss	Name	Name of the company

(Table 3) Configuration of civil application data fields (K-water, 2018)

3.3 Overview of Local Water Supply Customer Satisfaction Survey

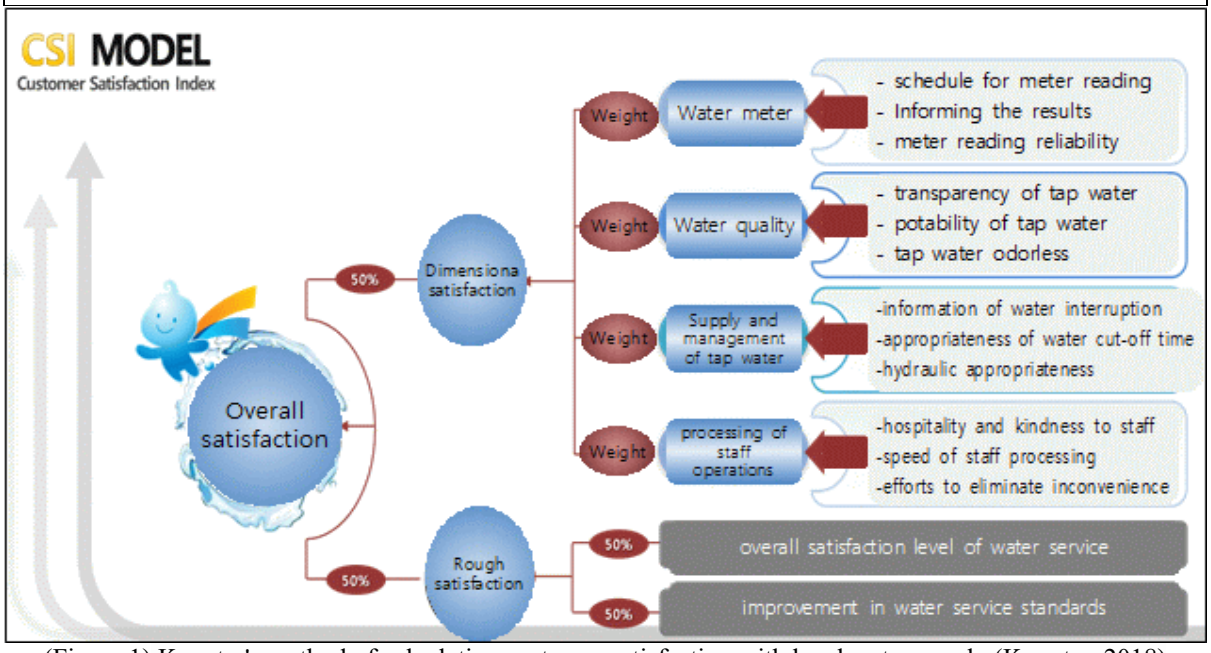
For customer-centered management, K-water conducts a customer satisfaction survey by business field, region, and age group every year for the entire local water supply business site to understand customer satisfaction for each business field and region. The results of the customer satisfaction survey are calculated by summing the satisfaction (dimensional satisfaction) and overall satisfaction by weight by job field. The satisfaction survey method borrowed the Public-service Customer Assessment Index (PCSI) method for public enterprises and quasi-governmental institutions. This model consists of a leading factor model, a performance model, and a satisfaction model, and a customer satisfaction score is calculated based on the satisfaction model (K-water, 2018). The satisfaction model is weighted by overall satisfaction, individual satisfaction, and importance of individual components to calculate the overall satisfaction score (K-water, 2018).

▪Customer satisfaction index (CSI) = ∑ Weighted satisfaction

▪ Weighted satisfaction = The relative importance of each item (Weight) × Weight

▪ satisfaction = The average satisfaction level of each item

- Overall satisfaction: The sum of the satisfaction index for each dimension and the weighted satisfaction using the correlation coefficient of the dimension
- Dimensional satisfaction: The sum of weighted satisfaction using a correlation coefficient to item satisfaction constituting customer satisfaction
- Dimensional importance: the degree of relative influence of each dimension that affects overall satisfaction
- Item satisfaction: The value obtained by converting the 5-point scale of an evaluation item to 100 points
- Item Importance: Degree of relative influence of each dimension detail item affecting dimension satisfaction



(Figure 1) K-water's method of calculating customer satisfaction with local water supply (K-water, 2018)

3.4 Customer satisfaction survey results of Nonsan Local Waterworks Project

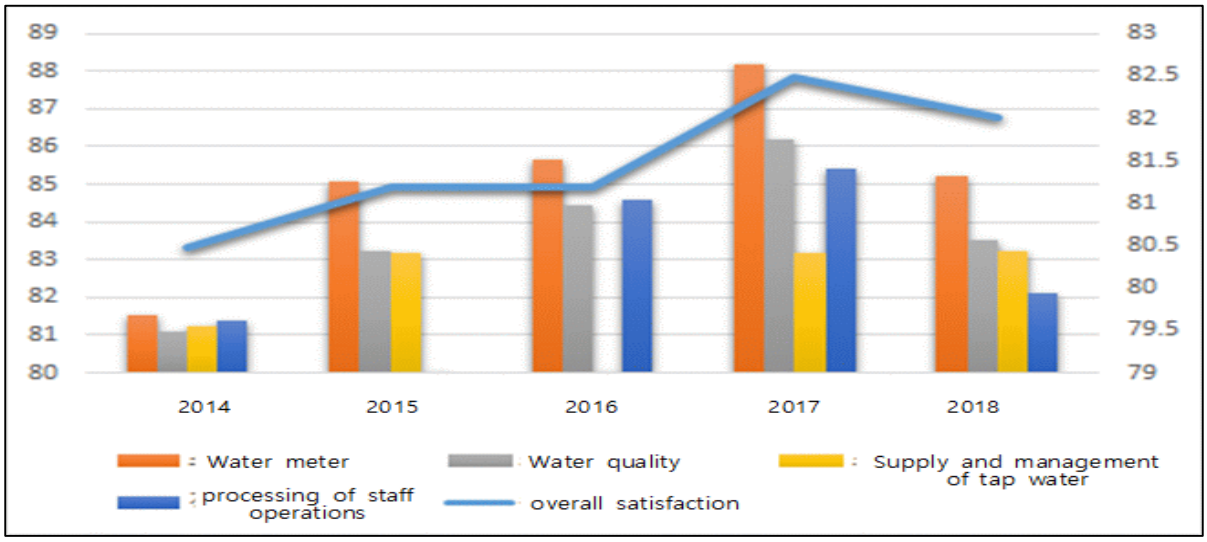
Nonsan City's overall satisfaction and dimensional satisfaction scores for local waterworks projects commissioned by K-water are continuing to rise and fall at low levels, but they are gradually increasing. In particular, the satisfaction level in water meter reading and staff treatment is relatively high, while the satisfaction level in water quality and tap water supply management is relatively low. By year, it recorded the highest overall satisfaction level in 2017, and in 2018, the satisfaction level dropped slightly from the previous year.

Sortation	Average	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

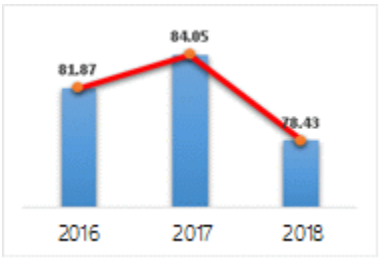
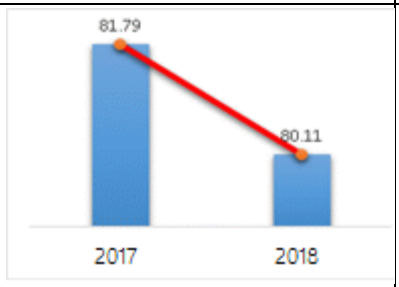
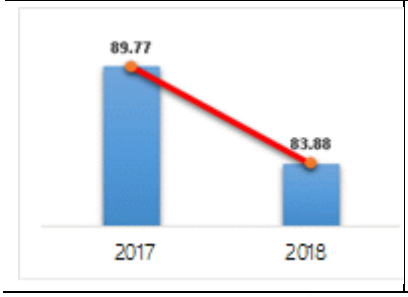
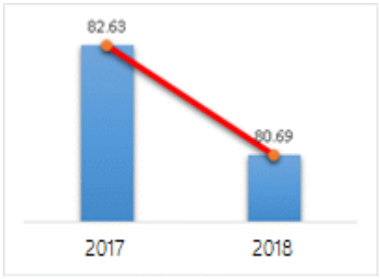
Overall satisfaction		79.86	75.03	76.80	79.01	79.91	80.55	80.47	81.18	81.18	82.49	82.01
Dimensional satisfaction	Water meter	82.97	73.93	80.61	85.25	82.03	82.22	81.51	85.07	85.65	88.20	85.24
	Water quality	80.98	75.80	75.48	80.51	81.54	77.97	81.08	83.24	84.46	86.2	83.54
	Managing the supply of water	80.58	76.65	79.23	82.07	81.00	79.13	81.24	83.18	76.87	83.17	83.21
	processing of staff operations	83.21	85.10	78.48	83.88	84.92	87.58	81.36	78.68	84.61	85.39	82.1

(Table 4) Nonsan Regional Waterworks Customer Satisfaction Survey Results (K-water, 2018)

(Figure 2) Customer satisfaction survey results for each item (K-water, 2018)



The current status of increase or decrease in satisfaction with local water supply projects by township (eup, myeon, and dong) in Nonsan is as follows.

Ganggyeong-eup	Gwangseok-myen	Noseong-myeon
		
Sangwol-myeon	**Yeonsan-myeon**	**Eunjin-myeon**
		

(Figure 3) Customer satisfaction by township (eup, myeon, dong) (K-water)

Sortation	2014	2015	2016	2017	2018	Trend
Gayagokmyeon	78.17	80.82	-	80.13	85.21	ascent
Ganggyeong-eup	78.89	80.58	81.87	84.05	78.43	decline
Gangsan-dong	-	-	79.62	82.86	-	-
Gwanchok-dong	-	-	78.98	79.9	-	-
Gwangseokmyeon	79.73	81.86	-	81.79	80.11	decline
Naedong	-	-	80.64	81.29	-	-
Noseongmyeon	79.73	81.86	-	83.52	77.88	decline
Daegyo-dong	-	-	84	90.75	-	-
Deokji-dong	-	-	83.11	82.82	-	-
Donghwa-dong	-	-	76.81	78.61	-	-
Banwol-dong	-	-	85.08	77.98	-	-
Bujeokmyeon	80.32	80.95	-	82.14	81.34	-
Buchang-dong	81.6	80.35	81.58	75.54	82.63	ascent
Sangwol-myeon	79.73	81.86	-	89.77	83.88	decline
Seongdong-myeon	79.73	81.86	-	84.95	84.19	-
Yangchon-myeon	78.17	80.82	-	74.64	78.98	-
Yeonmu-eup	80.45	80.74	80.58	83.64	85.26	ascent
Yeonsan-myeon	78.17	80.82	-	82.63	80.69	decline
Eunjin-myeon	80.97	82.17	-	88.8	83.1	decline
Jisan-dong	-	-	79.42	78.92	-	-
Chaeun-myeon	80.97	82.17	-	81.75	82.63	-
Chiam-dong	81.67	81.69	77.4	77.14	81.3	ascent
Hwaji-dong	81.67	-	83.07	81.83	-	-

(Table 5) Detailed Satisfaction Status by township (eup, myeon, dong) (K-water)

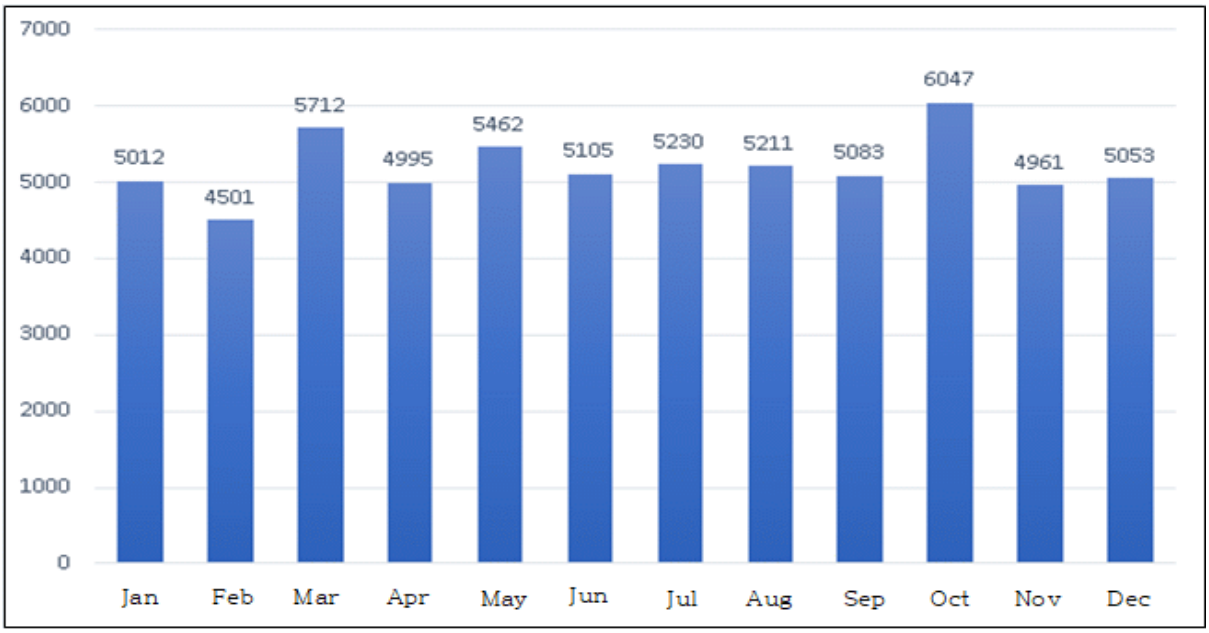
3.5 Status of the total number of complaints

The number of complaints related to water supply in Nonsan Province is increasing with the increase in the number of users of water supply in Nonsan City. While the total number of complaints decreased exceptionally in 2017, it is necessary to confirm whether there is an inverse relationship between the total number of complaints and the total satisfaction level in 2017, given the extremely high level of overall satisfaction in 2017.

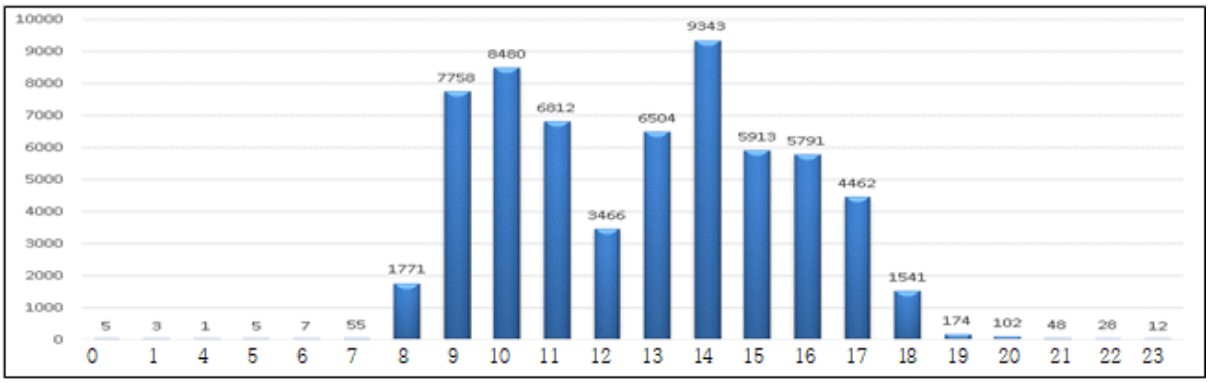
Sortation	Total	2014	2015	2016	2017	2018
The number of complaints	62,372	10,009	11,114	13,447	12,374	15,428

(Table 6) The number of complaints by year (K-water)

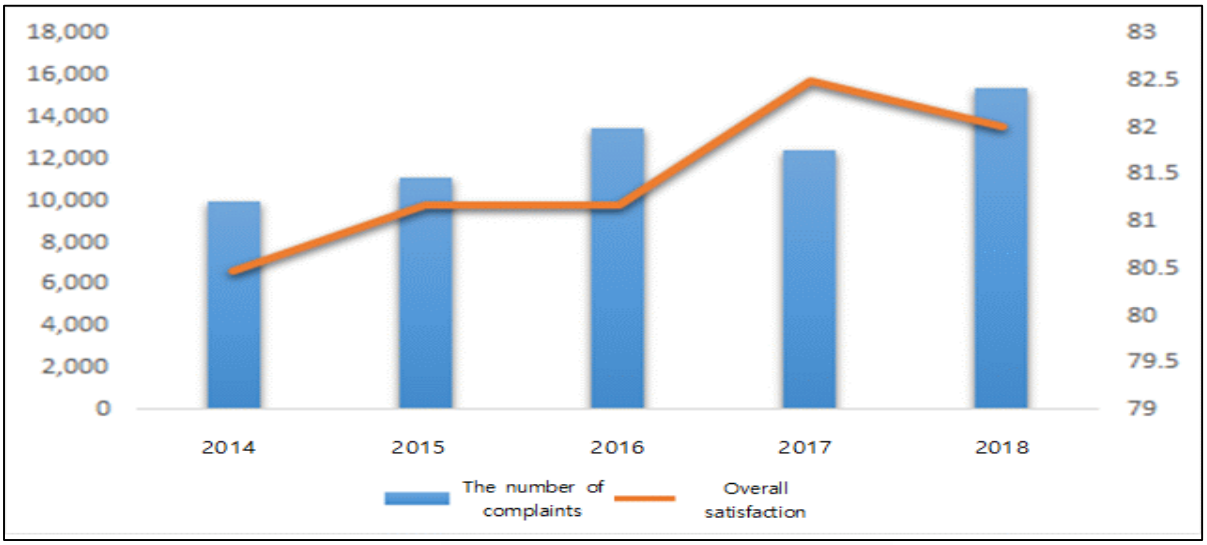
According to the basic statistics of Nonsan's waterworks project, the number of monthly complaints occurred in March and October, and the number of complaints decreased sharply on weekends, Mondays and Tuesdays, and 10 a.m. and 2 p.m. on weekdays.



(Figure 4) The number of complaints and by year (K-water)



(Figure 5) Number of complaints by time zone (K-water)



(Figure 6) Monthly number of complaints (K-water)

3.6 The number of complaints by major and middle classification

As a result of classifying complaints according to the major classification, charge complaints account for 44% of the total.

Type number	11 types
Average number of applications	5670
Standard deviation of the number of applications	7786
Top 3 categories	Fee (27801), water supply (7450), water quality (6673)
Bottom 3 categories	Water supply facilities (1036), other complaints (52), village water supply (39)

(Table 7) Civil complaints according to the major classification (K-water)

As a result of classifying complaints according to the middle classification, inquiries related to fees account for 23% of the total.

Type number	63 types
Average number of applications	990
Standard deviation of the number of applications	2246
Top 3 categories	Fee (27801), water supply (7450), water quality (6673)
Bottom 3 categories	Inquiries about fees (14105), automatic payment (9595), water quality inspection (6194)

(Table 8) Civil complaints according to the middle classification (K-water)

IV. Hypotheses Development

4.1. Establishment of hypothesis

Based on the data and customer satisfaction of Nonsan district water supply business over the past five years, it is necessary to investigate the possibility of a specific correlation between customer satisfaction and civil application. Customer complaints and satisfaction may be correlated. In particular, considering that customer satisfaction increased as the number of complaints decreased in 2017, it is believed that checking how the increase or decrease of all or specific complaints affects customer satisfaction in the future can help manage customer satisfaction. Accordingly, three hypotheses were established as follows on the premise that there will be factors that have a positive or negative effect on customer satisfaction among customer complaint data.

1. Among the civil complaint classification items (Major classification 11 types, middle classification 63 types), effects of specific civil complaint items is positively/negatively related to customer satisfaction.
2. If the civil complaint processing time is decreased, it will have a positive effect on customer satisfaction, while if the civil complaint processing time is long, it will have a negative effect.

3. There is a significant difference in customer satisfaction among regions with large and small average water supply by region (township : eup, myeon, mong).

In order to verify the hypothesis, it is necessary to analyze the correlation between the civil complaint factor data and customer satisfaction in each hypothesis to check whether there is civil complaint data that is the same as or opposite to customer satisfaction.

4.2. Relationship between Customer complaints and satisfaction

For the research, civil petition data such as phone calls, visits, and e-mails for five years from 2014 to 2018 collected from the K-water Nonsan Regional Waterworks Center were intensively analyzed. Complaint data are generated when the complainant of Nonsan Waterworks Center registers the relevant information in K-water's local waterworks management system, connects it to the complaint management system, and downloads it in Excel form. In addition, the correlation between the number of customer complaints per year and the customer satisfaction score over the same period was calculated for the purpose of correlation. Among the 11 major classification of complaints, complaints related to customer satisfaction are water quality (water quality inspection, color water, etc.), other complaints, meter reading (movement adjustment, etc.) and water supply facilities.

Sortation	Water quality	Other complaints	Meter reading	Inform	Water supply facilities	Water supply	Fee	Village water supply	Measuring instrument	Person in need	Leakage
Correlation	0.78	0.75	0.66	-0.61	0.57	0.52	0.52	0.48	0.43	0.41	0.33

(Table 9) The results of correlation analysis between customer satisfaction scores and major classification complaints (K-water, 2018)

Among the major civil complaints, water quality items have the highest positive (+) correlation, indicating that in the case of complaints requesting water quality tests, local water supply operators visit each household and receive water quality tests at the request of consumers, the

higher the overall satisfaction. In addition, it can be seen that the more requests for service such as settlement of directors and faxing of fee notices among other complaints, the higher customer satisfaction. On the other hand, in the case of charge notification complaints, it can be seen that customer satisfaction tends to decrease as more complaints request reissue due to omission or loss of bills. As a result of analyzing the correlation of middle classification between 63 items (63) and customer satisfaction, complaints with a positive (+) correlation were changing water supply status (0.938), household movement settlement (0.877), and complaints with negative (-) correlation with customer satisfaction were non-bankbook deposit (-0.945), household division application (-0.899).

Sortation	Change of water supply status	Household movement settlement	Inquiries about changing basic information	Broken Valve	Water quality test	Apply for a freeze protection plaque
Customer satisfaction	0.938	0.877	0.789	0.783	0.779	0.773
Water supply facilities and others	Other complaints	Apply for a measuring device lid	reduction of charges	Other notice	Automatic payment	Leakage reduction
0.766	0.758	0.742	0.723	0.686	0.660	0.657
Water supply Other	Inquiries about fees	Other person in need	Refund	road depression	Inquiries about construction	Water color
0.633	0.535	0.511	0.510	0.504	0.476	0.457
Other measuring instrument	Other Village water supply	Other Leakage	freeze damage	Foreign substance	discharge water	measuring instrument leak
0.446	0.422	0.412	0.359	0.313	0.256	0.233
Request to change the name	Application for business change	Other meter reading	Insufficient recovery	Broken meter	Request for indoor plumbing inspection	Inquiries about stopping water supply
0.183	0.138	0.099	0.096	0.092	0.082	-0.023
Overlapping fee	Simple inquiry	Charges and others	Smell	Road leakage	Meter malfunction	Irregular hydraulic pressure
-0.072	-0.074	-0.193	-0.225	-0.230	-0.267	-0.326

caliber change	measuring instrument relocation	Installment payment	Wired meter reading	Customer information change	Poor rotation of the meter	Request to send mail
-0.360	-0.424	-0.679	-0.717	-0.757	-0.805	-0.857
Re-send the bill	Request for division of households	Deposit without bankbook	Performance test	Credit card payment	Bad water flow	Replacement of old tubes
-0.871	-0.899	-0.945	-	-	-	-

(Table 10) – The correlation between customer satisfaction and middle classification complaints (K-water)

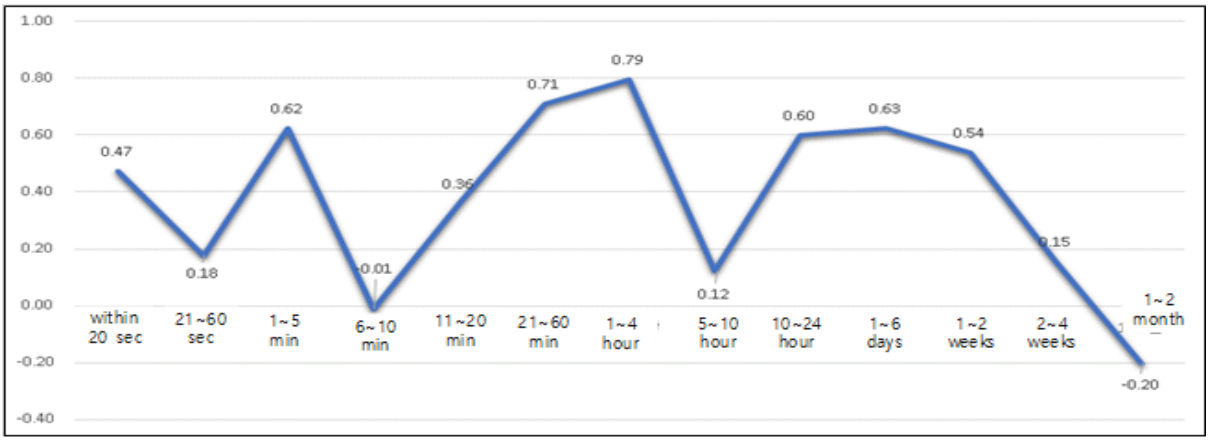
These analysis results show a consistent tendency that customer satisfaction also increases or decreases when specific complaints increase or decrease among various civil petition factors. In particular, the water quality inspection complaint is a request for water quality inspection to local water supply business groups from the audience, providing clues that active water quality inspection services could increase customer satisfaction. Customer complaints items with positive (+) relationships, such as director settlement and water supply status change requests from local water supply operators, and water supply changes (e.g., home → commercial, etc.), indicating that customer satisfaction tends to increase.

4.3. Time required to handle civil complaints and customer satisfaction

To conduct the analysis, individual complaint processing times were classified for each year, and the number of complaints that took more than 1 minute, 3 minutes, 5 minutes, 10 minutes, 15 minutes, 20 minutes, and 20 minutes was identified for each year, respectively. In addition, as a result of analyzing the time required to process civil complaints, about 70% of civil complaints were processed within one minute, and in most cases from 14 to 2018, civil complaints in the form of simple inquiries within one minute were the most common. It can be seen that most complaints have been processed within 10 minutes.

Required time	2014	2015	2016	2017	2018	Total	Correlation coefficient
Within 20 seconds	3143	3474	4153	3638	5845	20253	0.47
21 to 60 seconds	2116	2395	2814	2306	2541	12172	0.18
1 to 5 minutes	1609	1601	2018	2047	1776	9051	0.62
6-10 minutes	213	269	296	246	222	1246	-0.01
11-20 minutes	171	193	216	188	213	981	0.36
21 to 60 minutes	273	332	329	343	422	1699	0.71
1 to 4 hours	776	925	958	993	1129	4781	0.79
5 to 10 hours	853	1048	1556	1181	905	5543	0.12
10 to 24 hours	470	483	691	830	1751	4225	0.60
1~6 days	302	329	363	474	292	1760	0.63
1~2 weeks	82	64	51	128	329	654	0.54
2~4 weeks	1	0	0	0	3	4	0.15
1 ~ 2 months	0	0	1	0	0	1	-0.20
3 ~ 4 months	0	0	1	0	0	1	-0.20
More than 4 months	0	1	0	0	0	1	-0.20

(Table 11) Current Status of Complaint Processing Time by Year (K-water)



(Figure 7) Current Status of Complaint Processing Time by Year (K-water 2014~2018)

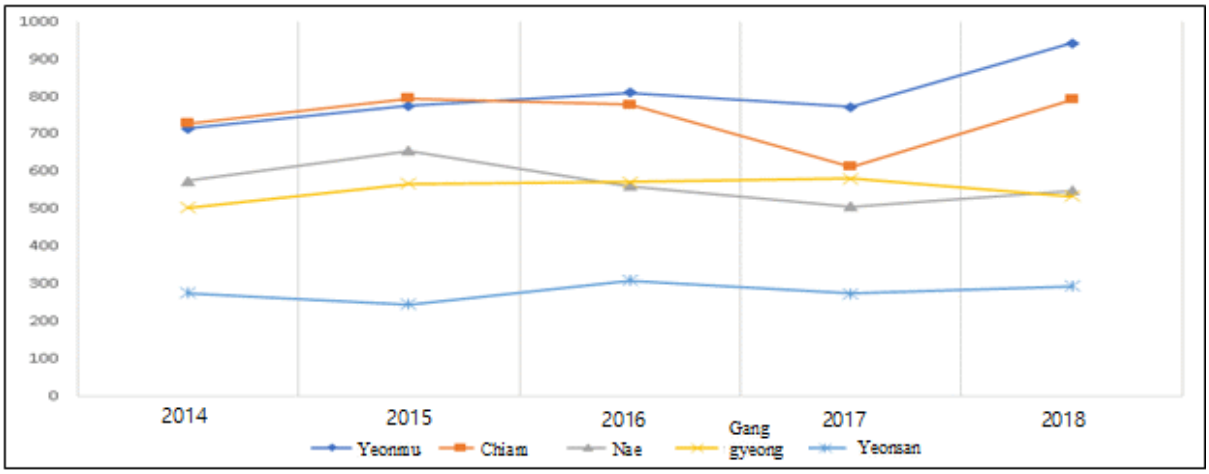
In addition, as a result of analyzing the correlation between customer satisfaction and each item of time required to process civil complaints, customer satisfaction was higher when the number of civil complaints increased within 1 to 5 minutes rather than within 1 minute. And it can be seen that investing time within 4 hours from 20 minutes rather than within 20 minutes is a way to increase customer satisfaction.

4.4. Effect of customer satisfaction according to the characteristics of each region

Looking at the number of civil complaints received by region, Yeonmu-eup and Chiam-dong account for the largest proportion. The regions with positive correlation with overall satisfaction are Gwangseok-myeon, Sangwol-myeon, and Gwanchok-dong, and the regions with negative correlation are Gangsan-dong. Yeonmu-eup and Chiam-dong are believed to have a strong trend of increasing complaints in 2018.

Sortation	2014	2015	2016	2017	2018	Total	Correlation coefficient
Yeonmu-eup	716	777	812	773	944	4022	0.51
Chiam-dong	729	796	780	614	793	3712	-0.48
Naedong	575	656	562	508	550	2851	-0.59
Ganggyeong-eup	505	568	572	581	535	2761	0.57
Yeonsan-myeon	277	246	309	274	294	1400	0.08
Bujeokmyeon	290	224	284	269	316	1383	0.12
Seongdongmyeon	224	310	271	216	290	1311	-0.08
Eunjin-myeon	189	226	266	258	233	1172	0.65
Gayagokmyeon	108	194	209	252	289	1052	0.89
Hwaji-dong	198	163	252	193	203	1009	-0.08
Buchang-dong	189	183	223	190	173	958	-0.26
Daegyo-dong	148	157	207	161	208	881	0.29
Banwol-dong	153	140	155	159	164	771	0.54
Chaeun-myeon	95	143	140	150	182	710	0.78
Yangchon-myeon	58	109	153	131	158	609	0.68
Gangsan-dong	120	122	110	99	80	531	-0.75
Jisan-dong	65	65	66	83	91	370	0.84
Gayagokmyeon	57	59	53	59	91	319	0.43
Noseongmyeon	0	15	63	82	118	278	0.82
Deokji-dong	25	38	33	25	25	146	-0.32
Sangwol-myeon	1	17	28	47	53	146	0.93
Donghwa-dong	18	20	21	28	32	119	0.88
Gwanchok-dong	18	23	19	26	27	113	0.89
Mangseongmyeon	3	4	0	9	4	20	0.71

(Table 12) - Customer satisfaction by eup, myeon, dong (K-water)



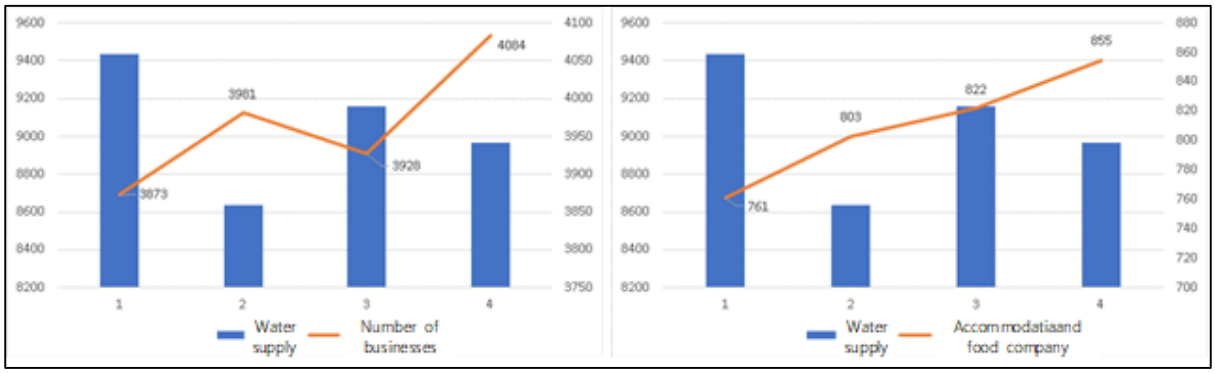
(Figure 8) Customer satisfaction by eup, myeon, dong (K-water)

4.4.1 The main characteristics of Chiam-dong

Looking at the characteristics of Chiam-dong using statistics provided on the Nonsan-si website, the number of businesses and the number of lodging and food companies is on the rise, and the water supply is fluctuating. Looking at the overall satisfaction correlation coefficient, it can be seen that it has a positive correlation with the number of businesses, the number of workers, and the number of lodging/food workers. This suggests that in the case of Chiam-dong, an increase in the number of businesses, workers, and lodging and food companies may have a positive effect on satisfaction. In particular, it can be seen that the increase or decrease in customer satisfaction is significant.

Sortation	Water supply	Total population	Number of businesses	Number of workers	Construction company	employee of construction	Accommodation and food companies	Accommodation and food company staff
2014	9433	31448	3873	13624	133	553	761	1879
2015	8636	32609	3981	14842	146	1034	803	1943
2016	9158	33203	3928	14861	135	857	822	2119
2017	8968	33143	4084	15516	140	887	855	2237
Correlation coefficient	-0.45	0.74	**0.97**	**0.92**	0.40	0.53	**0.94**	0.89

(Table 13) The main characteristics of Chiam-dong (K-water)



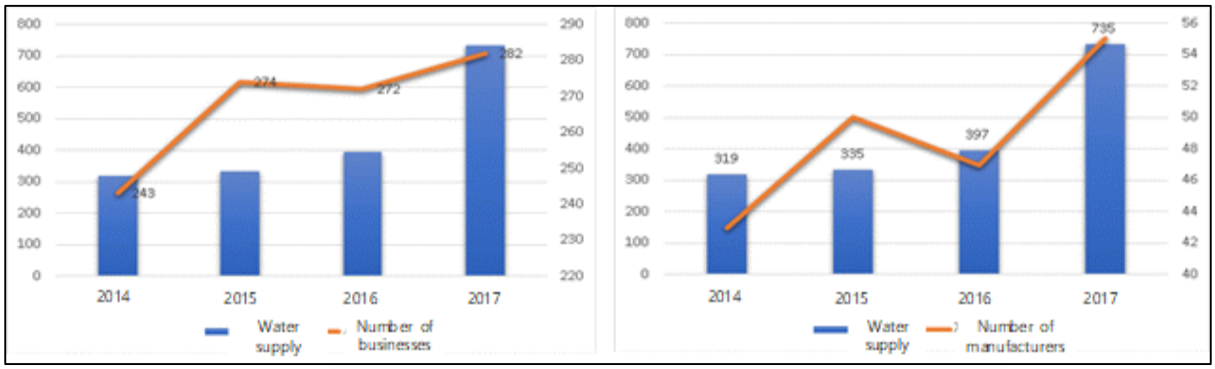
(Figure 9) The main characteristics of Chiam-dong graph (K-water)

4.4.2 The main characteristics of Gwangseokmyeon

Looking at the regional characteristics of Gwangseokmyeon, the amount of water used increased sharply in 2017 and at the same time the number of businesses and manufacturers increased. Looking at the overall satisfaction correlation coefficient, it can be seen that there is a positive correlation between the water supply amount and the number of manufacturers, the number of construction companies, and the number of lodging/food workers, and a negative correlation with the total population and manufacturing workers. This means that in the case of ore asbestos, only customers tend to decrease when the manufacturing population or the total population increases. In addition, as the number of lodging companies increases, customer satisfaction is also increasing.

Sortation	Water supply	Total population	Number of businesses	Number of workers	Manufacturer	Manufacturer staff	Construction company	construction worker
2014	319	5162	243	1280	43	431	11	62
2015	335	5033	274	1250	50	406	11	62
2016	397	4910	272	1210	47	381	12	62
2017	735	4819	282	1192	55	333	14	63
Correlation coefficient	**0.95**	**-0.90**	0.84	-0.87	**0.96**	**-0.97**	**0.93**	**0.92**

(Table 14) The main characteristics of Gwangseokmyeon (K-water)



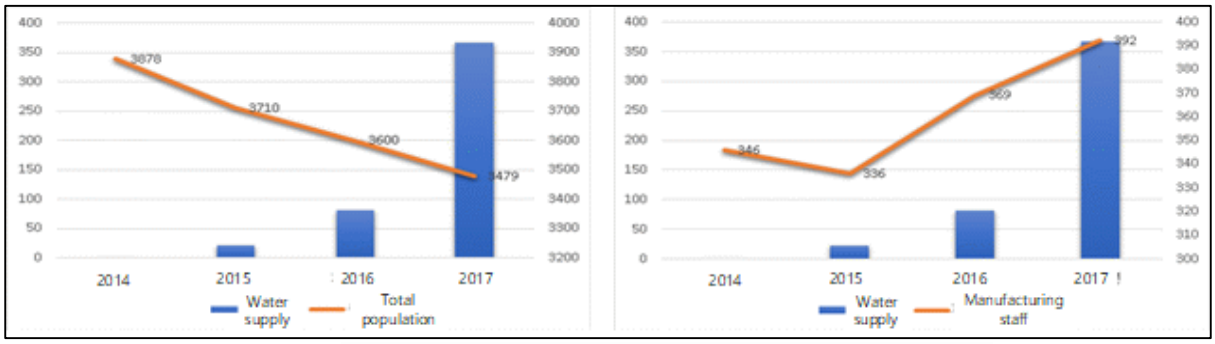
(Figure 10) The main characteristics of Gwangseokmyeon graph (K-water)

4.4.3 The main characteristics of Noseong-myeon

Looking at the regional characteristics of Noseong-myeon, it can be seen that water consumption rapidly increases despite the overall decline in population, and the number of manufacturing workers has increased significantly and the amount of water supply has also increased. Looking through the correlation coefficient, it can be seen that there is a positive correlation with the water supply amount and a negative correlation with the total population and the number of businesses. In the case of Noseong-myeon, customer satisfaction is decreasing as the number of populations and businesses increases, and it can be seen that the increase or decrease in water supply tends to be the same as the increase or decrease in customer satisfaction scores.

Sortation	Water supply	Total population	Number of businesses	Number of workers	Manufacturer	Manufacturer staff	Construction company	construction worker
2014	0	3878	160	736	31	346	1	4
2015	22	3710	162	692	28	336	5	7
2016	81	3600	156	751	32	369	5	19
2017	367	3479	141	757	30	392	6	23
Correlation coefficient	**0.96**	**-0.92**	**-0.91**	0.39	-0.20	0.81	0.82	0.83

(Table 15) The main characteristics of Noseong-myeon (K-water)



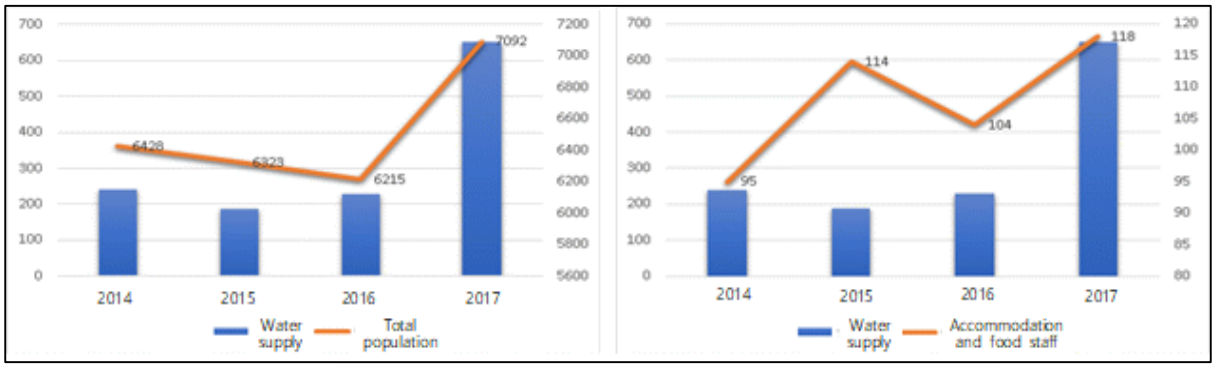
(Figure 11) The main characteristics of Noseong-myeon graph (K-water)

4.4.4 The main characteristics of Yangchon-myeon

Looking at the regional characteristics of Yangchon-myeon, it can be seen that the amount of water used was relatively constant and then increased rapidly in 2017, and the total population increased and the number of people engaged in the lodging and food industry increased. Looking through the correlation coefficient, it has a positive correlation with the amount of water supplied and the number of workers in the lodging and food industry, and has a negative correlation with the number of wholesale and retail companies. This indicates that customer satisfaction tends to decrease as the number of wholesale and retail companies increases, and it can be seen that customer satisfaction increases as the number of lodging and food companies increases.

Sortation	Water supply	Total population	Number of businesses	Number of workers	Manufacturer	Wholesale and retail	Accommodation food company	Accommodation food staff
2014	240	6428	308	1071	29	74	54	95
2015	188	6323	296	1187	26	69	59	114
2016	229	6215	291	1120	27	61	53	104
2017	651	7092	293	1172	29	59	59	118
Correlation coefficient	**0.89**	0.82	-0.68	0.69	0.20	**-0.83**	0.64	**0.86**

(Table 16) The main characteristics of Yangchon-myeon (K-water)



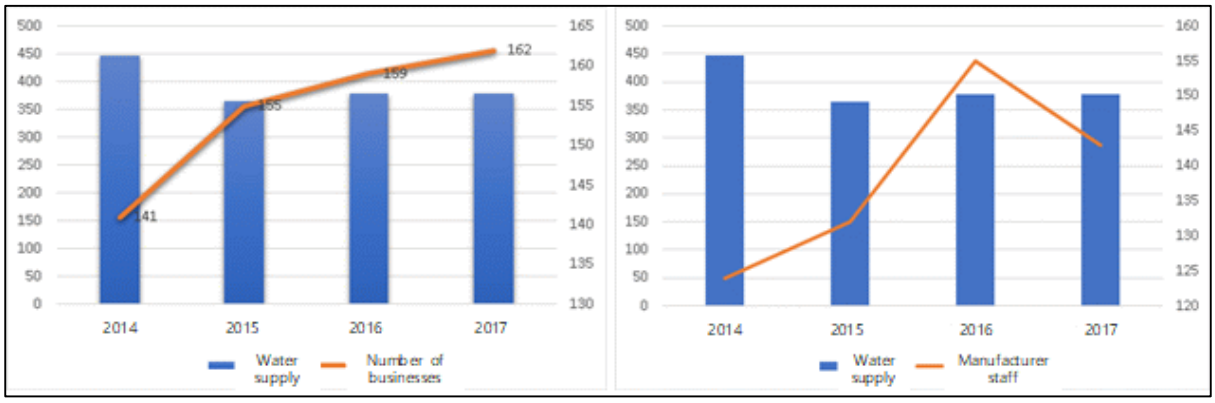
(Figure 12) The main characteristics of Yangchon-myeon graph (K-water)

4.4.5 The main characteristics of Chaeun-myeon

Looking at the regional characteristics of Chaeun-myeon, it can be seen that the amount of water used is relatively constant, but the number of businesses and manufacturers increases. Looking at the correlation coefficient, it can be seen that it has a positive correlation with the number of manufacturers and the number of lodging and food companies, and has a negative correlation with the total population. This means that as the number of people in Chaeun-myeon increases, customer satisfaction decreases, and it can be seen that the increase or decrease in the number of manufacturers tends to be the same as the increase or decrease in customer satisfaction.

Sortation	Water supply	Total population	Number of businesses	Number of workers	Manufacturer	Manufacturer staff	Accommodation food company	Accommodation food company staff
2014	448	2829	141	515	23	124	12	24
2015	365	2711	155	561	25	132	15	35
2016	379	2638	159	677	25	155	15	37
2017	379	2588	162	618	26	143	16	37
Correlation coefficient	-0.61	**-0.88**	0.83	0.50	**0.91**	0.48	**0.85**	0.73

(Table 17) The main characteristics of Chaeun-myeon (K-water)



(Figure 13) The main characteristics of Chaeun-myeon graph (K-water)

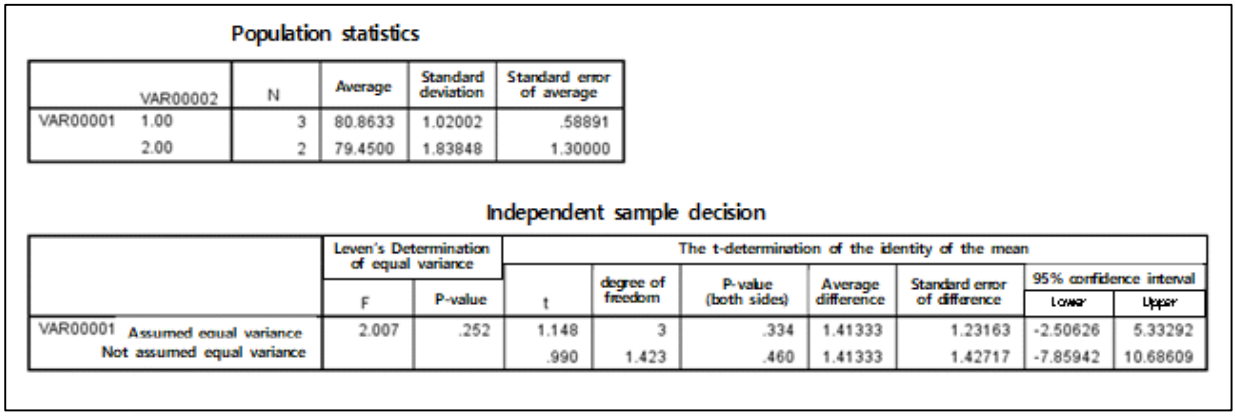
4.4.6 The correlation between average water supply and customer satisfaction

As above, it can be seen that the amount of water supply, the number of populations, and the industry are different for each region, and the customer satisfaction is also different. Based on these results, tried to find out whether the characteristics of water supply status by local government have a significant effect on customer satisfaction. To this end, the area with a large average water supply and the area with a small average water supply were divided into two groups based on the water supply, the most important factors among local governments' water supply status, and then a T-test using SPSS was conducted based on customer satisfaction scores by two regions.

Sortation	Water supply					Customer satisfaction					
	2014	2015	2016	2017	Average	2014	2015	2016	2017	2018	Average
Chiam-dong	9433	8636	9158	8968	9048.75	81.7	81.7	77.4	77.1	81.3	79.8
Gwangseok-myeon	319	335	397	735	446.5	79.7	81.9	-	81.8	80.1	80.9
Noseongmyeon	0	22	81	367	117.5	79.7	81.9	-	83.5	77.9	80.7
Yangchon-myeon	240	188	229	651	327	78.2	80.8	-	74.6	79	78.1
Chaeun-myeon	448	365	379	379	392.75	81	82.2	-	81.7	82.6	81.9

(Table 18) Average water supply and customer satisfaction (K-water)

As a result of the test, it was found that there was no significant difference in the probability of significance between regions with large and small water supply based on the average water supply, at 0.334. Accordingly, it is presumed that the difference in customer satisfaction scores according to the characteristics of water supply use by region is not large.



Population statistics

	VAR00002	N	Average	Standard deviation	Standard error of average
VAR00001	1.00	3	80.8633	1.02002	.58891
	2.00	2	79.4500	1.83848	1.30000

Independent sample decision

		Leven's Determination of equal variance		The t-determination of the identity of the mean						
		F	P-value	t	degree of freedom	P-value (both sides)	Average difference	Standard error of difference	95% confidence interval	
									Lower	Upper
VAR00001	Assumed equal variance	2.007	.252	1.148	3	.334	1.41333	1.23163	-2.50626	5.33292
	Not assumed equal variance			.990	1.423	.460	1.41333	1.42717	-7.85942	10.68609

(Figure 14) T-test results for the correlation between average water supply and customer satisfaction (K-water)

V. Conclusion

As a result of analyzing the status of local water supply consignment projects in Nonsan over the past five years, it was possible to assume that certain customer complaints and customer satisfaction may have a certain correlation based on the decrease in the total number of complaints in 2017. To confirm this, three hypotheses were established as follows to derive items that have a correlation consistent with the increase or decrease trend of customer satisfaction among various customer complaint factors.

First, the increase or decrease of specific civil complaint items among the civil complaint classification items (large classification 11 and middle classification 63) will have a positive/negative effect on customer satisfaction. Second, a short civil complaint processing time will have a positive effect on customer satisfaction and a negative effect if the civil complaint processing time is prolonged. Third, the large and small number of companies that use a lot of water, such as regional (eup, Myeon, Dong) water supply and lodging/food

companies, will affect customer satisfaction in the region. The results of verifying the above three hypotheses are as follows. First, as a result of analyzing the relationship between civil complaint classification items and satisfaction, among the major civil complaint classification items, civil complaint classification items such as water quality, other civil complaints, and water supply facilities have a positive correlation with customer satisfaction. On the other hand, notices (reissuance of notices, change of notification information, etc.) have a negative correlation. This shows that customer satisfaction tends to rise if there are many services such as water quality tests by customer requests, while customer satisfaction tends to decrease if service omission such as customer reissue requests increases after unpaid bills. As a result of analyzing the correlation between the middle classification of civil complaints and customer satisfaction, complaints with a positive (+) correlation were water supply status change and director settlement, and complaints with negative (-) correlation with customer satisfaction evaluation were bankbook deposit and household division application.

Second, as a result of analyzing the effect of satisfaction over the time required to process complaints, about 70% of complaints were processed within one minute. In the case of "18 years," when customer satisfaction has declined, it can be found that civil complaints have decreased relatively within one minute and the number of cases handled has increased after 20 minutes. In addition, as a result of analyzing the correlation between customer satisfaction and each item of time required to process civil complaints, customer satisfaction was higher when the number of civil complaints increased within 1 to 5 minutes than within 1 minute. And it can be seen that investing time within 4 hours from 20 minutes rather than within 20 minutes is a way to increase customer satisfaction.

Third, as a result of analyzing the effect of satisfaction according to the characteristics of each eup, myeon, and dong, it was found that in the case of Chiam-dong, Gwangseok-myeon, and

Chaeun-myeon, the increase or decrease in the number of lodging companies with high water consumption showed the same trend as customer satisfaction. In Noseong-myeon, it was confirmed that the increase or decrease of the total population and customer satisfaction had a negative (-) correlation. Yangchon-myeon has a negative (-) correlation with a weak number of wholesale and retail companies, but the correlation is weak. In addition, as there is no significant difference in customer satisfaction scores between regions with large and small water supplies, it is judged that regional characteristics will not have a significant impact on customer satisfaction.

Through these results, in order to increase customer satisfaction for Nonsan's local water supply business, the number of related cases should be increased by responding more actively to requests for visiting water quality tests and other customer services. On the other hand, efforts should be made to minimize customer re-request complaints due to loss of bills. In addition, efforts are needed to invest time within 4 hours from 1 to 5 minutes rather than 1 minute and 20 minutes rather than 20 minutes by further increasing the time required to handle civil complaints. By eup, myeon, and dong, regional characteristics do not have a significant impact on customer satisfaction. Considering this, it is considered necessary to carry out customer satisfaction activities by paying attention to the common characteristics that appear throughout Nonsan-si.

Unlike private companies, services of public institutions have been guaranteed monopoly, and the importance of customer satisfaction in the field of public services has been somewhat overlooked. People who are beneficiaries of the service often do not expect individual opinions to be reflected in the public service sector. It is true that the government or public institutions, which are suppliers, also focus on whether services are provided quickly and fairly and lack motivation to strive to improve the quality of services. However, in a new national and social

atmosphere, efforts to change the quality of services of public institutions are needed.

The demands of the people are becoming more diverse, and expectations for the state are also increasing. In the tap water field, there is a continuing demand for quality improvement of services that increase consumer satisfaction beyond the existing supply-oriented policy. Through the red water crisis in Incheon, the people are no longer submissive beneficiaries but active and demanding customers. Efforts are needed to listen to the public's demands for tap water services and respond sensitively to individual complaints to improve service quality. To this end, it is necessary to respond in real time to customer complaints about water service in policy. It is necessary to have a system that can analyze various demands such as reasonable rates, stable water supply, and hygienic tap water quality to identify which areas they respond most sensitively to and proactively respond to customers' needs.

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