The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

THE POLICY ON PRICING IRRIGATION SERVICES IN THE MANAGEMENT OF IRRIGATION SYSTEMS AND AGRICULTURAL PRODUCTION VARIES WORLDWIDE AND IN VIETNAM, CASE STUDY IN NAM DINH PROVINCE

BUI ANH TU

Thuyloi University. Email: buianhtu@tlu.edu.vn

Abstract

The role of irrigation is crucial for the development of agriculture, socio-economic growth, ecological protection, and disaster response. However, there are still many limitations in the management and operation of irrigation systems, including low efficiency in water utilization, deficiencies in the management system, complexity in the management process, low labor productivity, weak management capacity, water and irrigation infrastructure wastage, and rapid deterioration of irrigation structures. These issues and constraints result from the lack of appropriate management mechanisms, where water services are still considered the responsibility of the State, and users only have to pay minimal fees determined by the government. Therefore, it becomes necessary and urgent to transition from a fee-based irrigation model to a pricing model for irrigation products and services. This transition would create a transparent and equitable operating environment for organizations and individuals involved in providing irrigation products and services, attracting and stimulating the participation of private enterprises under market mechanisms that align with the policies and objectives of the State. The research employs various analytical methods, including descriptive and comparative statistical analysis and multivariate regression. The study examines the impact of pricing policies for water services on agricultural production, with a typical case study conducted in Nam Dinh province, Vietnam.

Keywords: Irrigation; Pricing Irrigation Services; Agricultural Production.

1. INTRODUCTION

Due to the nature of the irrigation sector, water services and products are considered essential and vital for the economic and social well-being of the country and its population. Therefore, to ensure the common benefits, the State takes responsibility for investing, constructing, and managing the majority of irrigation infrastructure, with contributions from the population and other beneficiaries.

Although water services are crucial for agricultural production, the provision of these services is often considered as the responsibility of the State. Organizations and individuals utilizing water services only need to pay a fee (irrigation fee) as regulated by the government, which is insufficient to cover the costs for the entities providing water products and services. In reality, there is an increasing demand for quantity and quality of water products and services in agriculture, which is challenging to meet due to the limited resources of the State. This situation is impacting agricultural production, particularly in the restructuring of agriculture towards increased value and sustainable development (Cline W., 2007). Based on experiences from many countries worldwide, to ensure common benefits, the State should focus on the most

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

important tasks and transfer the remaining responsibilities to the private sector (Dhiman, 2016). At the same time, it is necessary to encourage and promote the process of socialization by innovating the management mechanism from fees to pricing, in line with the orientations and policies of the State.

The State has financial support policies for the use of water products and services for certain user groups. However, these policies do not integrate social factors into the pricing of water products and services (Hasan A., 2020). Moreover, the support methods have shifted from direct support to service providers to direct support for policy beneficiaries. Service providers and users operate under service contracts to leverage the roles and coordination of the local community in managing and monitoring service providers. This creates a cohesive relationship based on the principles of fairness, equality, and benefit for all parties involved (Elmahdi, 2005).

Financial support policies for the use of water products and services in agricultural production have been established to create conditions for increasing income and improving living standards for farming households (Latinopoulos, 2005). These policies are designed not to affect the interests of service providers and do not differentiate between the entities operating or investing in irrigation infrastructure. The state budget ensures the provision of financial support for the use of water products and services.

This support policy needs to ensure transparency and fairness. Information about who receives support, the level of support, and the method of support must be clearly disclosed for the public to know and carry out monitoring and oversight. The policy should not discriminate between areas with existing irrigation infrastructure and those without, gradually reducing the provision of financial support through pricing, considering water as a commodity (Walter C., 1980). By doing so, the application of pricing mechanisms not only does not adversely affect users of water products and services compared to the current irrigation fees but also helps people access higher-quality water products and services, as committed in the contracts.

2. LITERATURE REVIEW

On a global scale, pricing policies for water products and services have a significant impact on agricultural production activities of farming households, development plans, and the management of irrigation systems at the grassroots level. In Japan, Japanese farmers pay operation and maintenance costs, as well as a portion of the investment costs, which amount to 500 USD/ha and an additional 8% of revenue, along with mandatory labor contributions. The irrigation water price varies based on different regions and distinguishes between gravity and pump irrigation systems. Furthermore, the Japanese government does not provide support for operation and repair costs. In South Korea, over 60% of agricultural land under the management of the Korean Rural Community Corporation has been exempt from irrigation water fees since 2000. The remaining areas, under the management of local authorities, still bear the cost to recover capital and maintain operational expenses (James, 2010). Japan has simplified the calculation of pricing for water services across the entire irrigation system to improve transparency and make it easier to estimate. South Korea has enhanced the efficiency

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

of operation and maintenance activities to gradually reduce the costs associated with irrigation systems. The authors recommend considering indirect beneficiaries, such as those in the industrial, domestic, and tourism sectors when determining the pricing for water services.

European countries have implemented financial and water pricing policy reforms based on the principles of full cost recovery outlined in the EU Water Framework Directive 2000 (WFD), as detailed in the Wateco guidelines. The pricing of water services in these studies includes three components: financial costs, resource costs, and environmental costs. After calculation, Spanish citizens are required to pay \$0.13/m^3, Italians pay a maximum of \$0.1/m^3 (with financial costs accounting for 50%), and in France, the highest irrigation water price is \$0.115/m^3 (excluding resource and environmental costs), consisting of 52% investment costs, 38% operation and management costs, and 10% repair costs. The revenue generated from water services paid by farmers is insufficient to maintain 100% of the irrigation system's operations. Most analyses indicate that the demand for irrigation water is inelastic and depends on three factors: (a) agricultural and environmental policies, (b) agricultural commodity prices, and (c) technology. The cost of water supply is challenging to determine and depends on various factors such as (a) actual infrastructure conditions, (b) construction investment policies, and (c) opportunity costs of using water for other purposes (Alberto G., 2010).

In 2006, Turkish citizens paid \$97/ha for irrigation water use. Turkey has transferred almost all irrigation facilities to water user organizations, but the irrigation water price is still determined based on the operation and maintenance costs set by the state. As a result, users of pressurized irrigation systems bear production costs that are 2.5 times higher than those using gravity irrigation systems (Erol H., 2010). According to Erol, there is a need to transition from pricing irrigation services based on irrigated area to pricing based on water volume used (from \$/ha to \$/m^3) to ensure efficient and cost-effective water use. Climate change and urbanization will increase competition for water use, necessitating rational water pricing policies to balance societal demand and recover full water supply costs from users.

In Vietnam, depending on each development stage, we have different approaches. In the past, the amount paid by water users from irrigation works was referred to as irrigation fees or water fees. When the Irrigation Law was enacted and implemented in 2018, the concept of pricing for water-related products and services was applied nationwide for water users from irrigation systems. Additionally, the construction of unit prices for irrigation services in Vietnam is based on the serving area (VND/ha). This approach is similar to some countries like China, Peru, the Philippines, Greece, and differs from certain developed countries such as the United States, Israel, and France. The enactment of the Irrigation Law marks an important milestone in transitioning from irrigation fee policies to implementing a pricing mechanism. There have been several research topics in this field, such as "Irrigation fees and irrigation fee policies in a market economy and international economic integration" (2007), "Research on pricing 1m3 of irrigation water for the North-South Ha pumping station system" (2007-2008), "Construction of unit prices for irrigation services in Hanoi" (2018), and others. These research topics have made positive contributions to the development of the irrigation sector in Vietnam.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

Firstly, they have provided further clarification on perspectives and approaches to irrigation policies, thereby outlining new models and operational mechanisms for agricultural water enterprises. Secondly, they represent initial steps in researching and learning from the experiences of developed countries in solving the issues related to irrigation fees and pricing of irrigation water for agricultural production...

3. METHODOLOGY

3.1. Select a study location

To select a research topic that aligns with the research objectives, the dissertation is based on the approach of hydrological zoning, which is a distinctive feature when studying irrigation systems. In the Nam Dinh province, it is divided into three different zones: The Northern zone, the Central zone, and the Southern zone. The research locations must represent these mentioned geographical zones. The research will rely on this approach to choose the research sites. In each locality, two communes will be surveyed, with the criteria of selecting one commune located at the beginning of the irrigation system and one commune located at the end of the irrigation system. This approach allows for an assessment of the current situation of irrigation water supply for agricultural production and the level of satisfaction among users with the irrigation services.

Table 1: Basis for selecting localities to collect primary data

ID	Province	Irrigation system	Bases for selection and characteristics of irrigation systems
1	Nghia Hung	Nghia Hung	The irrigation system is located entirely within 01 district and is a coastal plain
2	Xuan Truong	Xuan Thuy	The irrigation system is located in 02 districts and is a low-lying and coastal plain.
3	Giao Thuy		
4	My Loc	My Thanh	The irrigation system is located in 01 district and includes part of the municipality.
5	Y Yen	Y Yen	The irrigation system is located in 01 district and in the low-lying delta north of the Dao River.

3.2. Selecting the sample size for the survey

The sample size of the study is determined by the following formula: (Thu T. T. K., 2013):

$$n = \frac{NZ^2 p(1-p)}{Ne^2 + Z^2 p(1-p)} \qquad (3.1)$$

In which:

n: is the number of survey votes;
N: Is the overall scale;
p(1-p): Is the maximum taken variance [0.5 x (1 – 0.5)] = 0.25 (The ratio convention p, q is 50% - 50%);
Z = 1.96: Corresponds to the probability of confidence 0.95;
e= 0.05: Is the sample selection error;

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

Within the scope of the research of the study, N is the number of households using irrigation water determined by the following formula:

$$N = \frac{DSNT}{NKBQ} \quad \textbf{(3.2)}$$

In which: DSNT represents the rural population of Nam Dinh province, obtained from the Nam Dinh Provincial Statistical Yearbook 2022, and NKBQ is the average population per household in rural areas nationwide, obtained from the Vietnam Household Living Standards Survey 2016 conducted by the General Statistics Office.

After calculating the number of agricultural households using formula (3.1) as 382 households, the author chose to have a sample size of 420 households for the research in the study. The selected sample size is higher than the calculated number to account for potential issues such as survey forms being damaged, lost, or invalid. A total of 420 survey forms were conducted to collect primary information and data. To ensure representation and reflect the current status of the irrigation system for agricultural production in Nam Dinh province, the study selected households that utilize irrigation services using a random sampling method. The list of households utilizing irrigation services is provided by the local communes.

Table 2: Distribution of samples by localities

ID	Province	Number of farmer households	Structure (%)	The sample size for the survey	Selected survey communes
1	Nghia Hung	41820	20.45	86	Nghia Trung Nghia Thinh
2	Y Yen	57671	28.20	118	Yen Ninh Yen Binh
3	Giao Thuy	46026	22.51	95	Giao Tien Giao Thinh
4	My Loc	17131	8.38	35	My Thanh My Trung
5	Xuan Truong	41856	20.47	86	Xuan Ngoc Xuan Chau

3.3. Multivariate regression method

Using the multivariate regression method to establish the relationship between the willingness to pay (WTP) for domestic irrigation water fee and the influencing factors. The dependent variable is the WTP for domestic irrigation water fee, and the independent variables include factors affecting the WTP such as education level, production area, demographic characteristics, etc. The linear model for analyzing WTP in the study is selected based on previous studies by Song N. V. (2011) and Huan N. B. (2017).

ISSN 1533-9211

DOI: 10.5281/zenodo.8424891

The general model for determining the WTP is expressed as follows:

$$WTP = \beta_i \times X_i + \varepsilon$$

In which:

- WTP stands for willingness to pay, which represents the extent to which users are willing to pay for irrigation water.
- X_i represents the i-th independent variable, which is a factor influencing the willingness to pay.
- β_i is the parameter reflecting the impact of the variable Xi on the dependent variable WTP.
- ε is the error term

In cases where the dependent variable is continuous, the economic model used to determine the willingness to pay is the Ordinary Least Squares (OLS) estimation method.

4. FINDINGS AND DISCUSSIONS

4.1. The current situation of the irrigation system in Nam Dinh province

The irrigation system in Nam Dinh province, which has been constructed and put into operation for many years, is currently in a deteriorated state. The primary canals have significantly deteriorated, and the main irrigation channels have experienced sedimentation over the years without proper funding for dredging. As a result, water irrigation management in the province faces numerous difficulties, especially under the current influence of climate change.

The actual irrigation and water consumption ratios of the irrigation systems are lower than the designed irrigation and consumption ratios. This indicates that the planning of the irrigation systems during the 2010-2015 period has improved the maximum operational capacity (under unfavorable conditions) of the irrigation systems. However, the actual irrigation and consumption ratios are still low, with the average irrigation ratio for the entire Nam Dinh province reaching 72% compared to the designed ratio, and the average consumption ratio reaching 70%.

Table 3: Designed and actual irrigation and consumption ratios of the irrigation systems

ID	Irrigation system	The irrigation ratio (l/s.ha)			The consumption ratio (l/s.ha)		
		Design	Actual	Proportion (%)	Design	Actual	Proportion (%)
1	Y Yen	1.25	0.8	64.0	7.0	4.1	58.6
2	Vu Ban	1.25	0.81	64.8	7.0	4.5	64.3
3	My Thanh	1.25	0.81	64.8	7.0	4.9	70.0
4	Nam Ninh	1.3	0.82	63.1	7.2	5.1	70.8
5	Xuan Thuy	1.3	0.85	68.0	7.2	5.75	79.9
6	Hai Hau	1.3	1.16	89.2	7.2	5.83	81.0
7	Nghia Hung	1.3	1.16	89.2	7.2	4.4	61.1
Average				71.9			69.4

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

The participation of the people in the management of irrigation works is increasingly strengthened through the implementation of the State's policies on decentralization and transfer of management of irrigation works to grassroots irrigation organizations. Independent irrigation works managed by grassroots irrigation organizations ensure the irrigation of 2.4 million hectares of rice, accounting for about 50% of the irrigated area in the large-scale system managed by state-owned enterprises.

Regarding the utilization status, the rate of deteriorated works is still high (with an average rate of 33.2%). Deteriorated works refer to the phenomenon where the works are damaged and cannot be repaired to their original condition, or during usage, they are found to be unsafe, unable to meet the original technical standards, resulting in reduced productivity and operational efficiency.

The system of Level II canals has the highest number of deteriorated works (41.8%), which will reduce the efficiency of irrigation and drainage services for agricultural production in the irrigation system. Key works such as head canals account for nearly 30% of the number of deteriorated works, and the management houses have nearly 40% of the number of works that do not ensure the operation and exploitation process.

Irrigation construction play an extremely important role in agricultural production, as well as in other industries and the livelihood of the population. Although the irrigation system in Nam Dinh has been repaired and renovated, there are still some works that remain in a deteriorated condition, leading to their limited capacity to operate at their full design capacity.

Table 4: Number of irrigation construction managed by the state in 2021

Type of construction	Quantity	Usage Status			
		Normal	Ratio (%)	Degradation	Ratio (%)
Construction manager house	243	153	62.9	90	37.1
Head culvert	280	197	70.5	83	29.5
Culvert level 2	3379	1967	58.2	1412	41.8
Pumping station	614	473	77	141	23
Structure on channel level 1, 2	2846	1861	65.4	985	34.6

The level of agricultural production service provided by the irrigation systems managed by the company reaches an average of 95.2% compared to the actual production needs.

Therefore, in general, the irrigation infrastructure in Nam Dinh province has successfully fulfilled the planned objectives of serving agricultural production.

Among them, the irrigation system meets the highest demand for aquaculture with a rate of 96.1%; rice, flowers, and short-term crops are irrigated by the irrigation system with a rate of over 95%. The level of service for salt production and water drainage is the lowest compared to other usage needs.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

Table 5: Current level of agricultural production service provided by the irrigation system in Nam Dinh province

Irrigation system	Farming land (ha)	Actual service area (ha)	Responsiveness (%)
Y Yen	43166	40630.9	94.1
Vu Ban	29475	28325.3	96.1
My Thanh	13635	13282.7	97.4
Nam Ninh	43549	41251.1	94.7
Xuan Thuy	50840	48883.4	96.1
Hai Hau	47401	44262.9	93.4
Nghia Hung	34121	32986.4	96.7

4.2. Policies on pricing of irrigation services in the management of irrigation systems and agricultural production

Every year, water irrigation companies are granted exemptions or reductions in irrigation fees based on the actual service area and the unit price of irrigation services proposed by the provincial People's Committee. The unit price is set according to the maximum level regulated by the State, but in reality, it is still not sufficient for water irrigation companies to maintain all the activities of the irrigation system at a normal level.

On November 14, 2016, the Ministry of Finance issued Circular No. 280/2016/TT-BTC, which regulates the maximum prices of products and public utility services in irrigation. Localities are required to establish prices for public utility services in irrigation, but these prices must not exceed the maximum prices determined by the Ministry of Finance. The maximum prices for products and public utility services in irrigation, as stated in Circular No. 280/2016/TT-BTC, are equivalent to the level of irrigation fee exemptions or reductions under Decree No. 67/2012/ND-CP.

For Nam Dinh province, the level of irrigation fee exemptions or reductions in recent years, as regulated by Decree No. 67/2012/ND-CP, has partially covered the regular and maintenance costs of the irrigation works in the province. Due to limited financial resources, the provincial People's Committee of Nam Dinh has issued directives instructing water irrigation companies in the province to reduce regular expenses and avoid increasing labor costs (while still being responsible for operating the pumping stations transferred by the local authorities), in order to allocate funds for maintenance and repairs of the works. Based on the approved production plan for 2018 by the seven water irrigation companies in the province, the allocated irrigation fee exemptions or reductions for 2018 were divided into two parts:

Regular expenses: 184,169 million VND, accounting for 55.1% of the total costs.

Maintenance and repairs of works: 152,748 million VND, averaging 44.9% of the total costs or 681,742 VND/ha.

Meanwhile, according to the approved economic-technical norms, the average proportion of costs for maintenance and repairs of works is 50.6% (equivalent to 753,000 VND/ha).

ISSN 1533-9211

DOI: 10.5281/zenodo.8424891

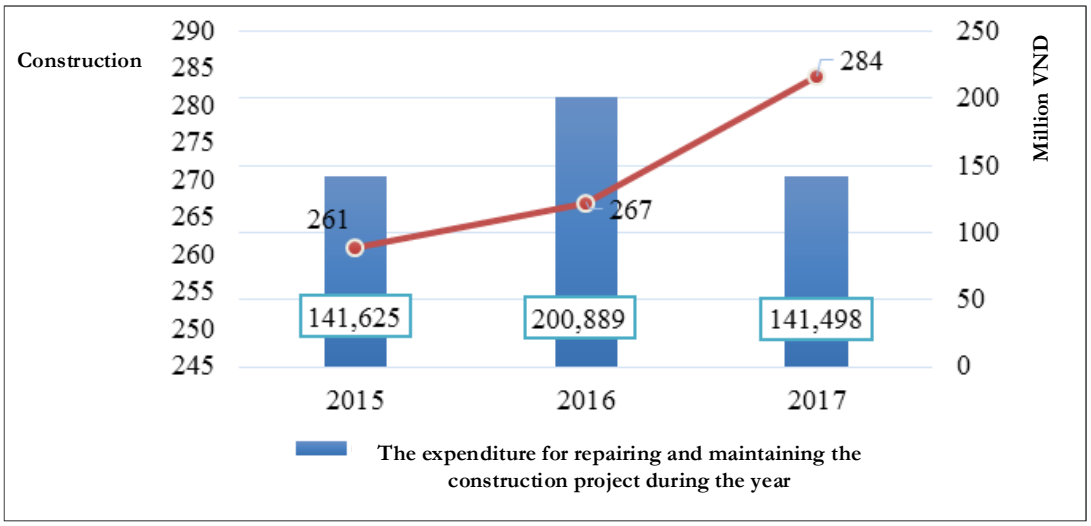

Figure 1: Relationship between the costs of repairs of works and the number of deteriorated works

Therefore, if the maximum prices according to Circular No. 280/2016/TT-BTC were applied, it would still not be sufficient to provide the necessary financial resources for the management and operation of the irrigation works in the province, based on the economic-technical norms.

Table 6: Staff members' opinions on funding sources

Content	Number of officers agreeing	Rate (%)	Number of officers who disagree	Rate (%)	Ob. (n)
The company's operating budget is guaranteed	4	19.1	17	**80.9**	21
The price of irrigation products and services has been reasonable	5	23.8	16	**76.2**	21
Funding for repair and maintenance is still low	18	**85.7**	3	14.3	21

Through interviews with 21 staff members of the joint-stock companies in charge of irrigation in Nam Dinh province, the author found that the majority of the existing issues with the irrigation system are due to insufficient funding. They believe that increasing the allocated budget for water irrigation companies and adjusting the pricing of irrigation services would provide them with the necessary funds to maintain and improve the quality and efficiency of their operations. The internal irrigation fees also need to be reviewed and increased to align with the water users' profile, allowing internal irrigation works to be upgraded and repaired proactively without having to rely on financial support from the companies.

Regarding the internal irrigation fees, the majority of households using water agree with the assessment that the internal irrigation fees should be clearly determined, publicly announced, and transparent (with a rate of 68% of households). Sixty percent of households believe that the current fee is still low, resulting in insufficient funding for the maintenance of the internal canal system to serve the agricultural production activities of the households.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

Table 7: Evaluation of water users regarding the internal irrigation fees

ID	Content	Assessment of water users (%)					
		Very agree	Agree	Normal	Disagree	Very disagree	Ob. (n)
1	Clear and transparent internal irrigation fees	30.3	**38.3**	24.1	7.2	0	**402**
2	The internal irrigation fees are still low	**32.8**	28.2	22.1	16.9	0	**402**
3	The internal irrigation fees need to be appropriate for the income of water users' households	31.1	**40.8**	17.4	10.7	0	**402**

Based on the analysis of the development of the irrigation system serving agricultural production, through evaluating the satisfaction level of farmers using water and their assessment of internal irrigation fees, the author studied the willingness-to-pay of water-using households for internal irrigation fees as a basis for considering the calculation of the price of irrigation services according to the requirements of the Irrigation Law, ensuring the normal operation of the internal irrigation system and meeting the needs of agricultural production.

Through a survey of 402 households using irrigation water in Nam Dinh province, the average number of members in a household was 4.13, and 60% of households had an average income above 7 million VND per month. The average farming experience of the households was 20.8 years, which reflects the continued importance of agriculture in the economic and social life of Nam Dinh. After collecting the 402 observations, the study conducted statistical analysis of the collected data. The results showed that the Adjusted R Square (R2) coefficient calculated based on the 402 observations was 0.538, indicating that this linear regression model is suitable for the sample data at a level of 53.8%. The F-value was 43.419 with sig. = 0.000 < 5%. This indicates that the squared multiple correlation coefficient of the population is different from 0, implying that the constructed linear regression model is appropriate for the overall research.

Table 8: Results of the study on the willingness-to-pay of households for internal irrigation fees

ID	Variables	Beta normalization factor	t	Sig.	VIF
1	(Constant)		-5.627	0.000	
2	KN	0.353	7.457	0.000	1.943
3	SLTVGD	0.083	2.296	0.022	1.142
4	GD	0.184	4.921	0.000	1.213
5	Thunhap	0.052	1.360	0.175	1.251
6	DTRuong	0.128	2.916	0.004	1.670
7	PhiNN	-0.098	-2.719	0.007	1.121
8	KCKenh	-0.222	6.273	0.000	1.083
9	KCCho	0.231	5.766	0.000	1.389
10	Thaido	0.211	5.332	0.000	1.359
11	TCTC	0.057	1.548	0.122	1.176
12	Daotao	0.093	2.155	0.032	1.616
Adjusted R Square		0.538			
Test DW		1.987			
Test F		43.42			
Prob. F		0.000			

ISSN 1533-9211

DOI: 10.5281/zenodo.8424891

Based on the results presented in the table above, it is observed that the variables TCTC (Non-agricultural income) and Thunhap (Income) do not have a significant impact on the dependent variable WTP (Willingness to Pay) (as the Sig. value of the t-test is greater than 0.05). On the other hand, the remaining variables have statistically significant effects on the dependent variable. Among them, the variables GD (Household size), KN (Farming experience), DTRuong (Educational level), KCKenh (Distance to canal), KCCho (Distance to market), and Thaido (Attitude) have a higher degree of influence compared to other factors in the research model.

The VIF (Variance Inflation Factor) values of all factors are less than 2, indicating no multicollinearity issue. Non-agricultural income factors negatively affect the willingness-to-pay of farmers. The development of tourism, commerce, and industry leads to a gradual shift of people from agricultural to non-agricultural areas, resulting in limited willingness to contribute to internal irrigation fees and leading to land abandonment and the deterioration of irrigation systems.

The regression results demonstrate that the willingness-to-pay for internal irrigation fees by water-using households is influenced by factors such as farming experience, household size, educational level, land area, non-agricultural activities, distance between the canal and agricultural land, distance from home to the market, household attitude, and the frequency of training on internal irrigation.

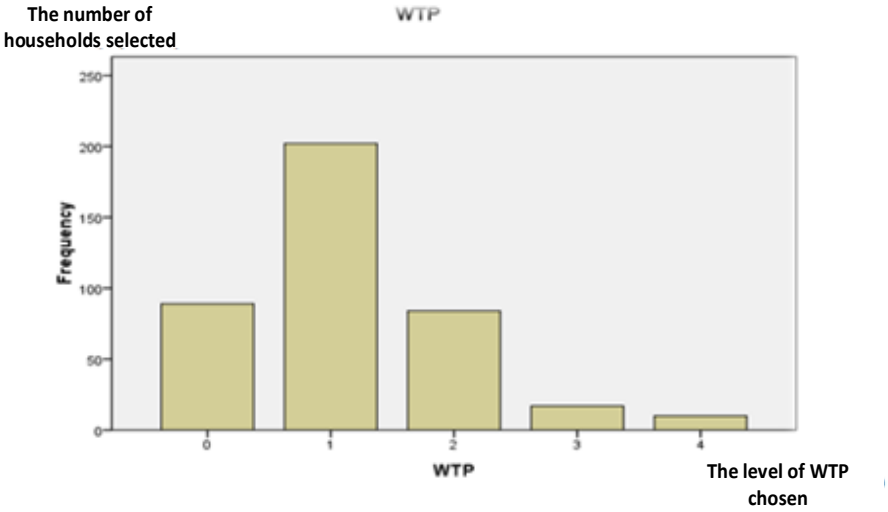

Figure 2: Relationship between infrastructure repair costs and the number of deteriorated structures

The highest preferred price range (WTP) chosen by the 402 farmers is category 1 (below 5,000 VND) with a selection rate of 50.2%. There are 89 farmers who do not agree to pay any additional amount, 202 farmers are willing to pay less than 5,000 VND per crop per unit, and 84 farmers are willing to pay between 5,000 and less than 10,000 VND per crop per unit, accounting for corresponding percentages of 22.1%, 50.2%, and 20.9% respectively.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

Assuming that the internal irrigation fee is increased at different levels, it will significantly enhance the effectiveness for the Agricultural Service Cooperative as exemplified by the study conducted at Toan Thang Agricultural Service Cooperative in Hai Toan commune, Hai Hau district.

Therefore, based on the survey results, over 78% of households surveyed are willing to pay an additional fee for internal irrigation services if the quality of irrigation services is improved. This means that the management agency can determine the pricing of public irrigation services based on the users' perception of the value of the product rather than production costs.

Table 9: Scenarios of increasing internal irrigation fees at Toan Thang Agricultural Service Cooperative

ID	Content	Increase in internal irrigation fees	Increase in workload
Scenario 1	Increase infield irrigation fee by 2000 VND/pole/crop	36.1 million VND/case	- Three additional dredging operations for internal canal channels - Pay an additional 10% of the aqueduct wages - Actively maintain more small field pumping stations.
Scenario 2	Increase infield irrigation fees by 5000 VND/pole/crop	90.3 million VND/case	- Five additional dredging operations for internal canal channels - Strengthening an additional 500m section of canal channel - Paying an additional 10% for water diversion labor - Proactively maintaining additional small field pump stations
Scenario 3	Increase infield irrigation fees by 10000 VND/pole/crop	180.6 million VND/case	- Perform 5 additional dredging operations for internal canal channels. - Strengthen an additional 2000m section of canal channel. - Pay an additional 10% for water diversion labor. - Proactively maintain additional small field pump stations. - Provide additional working allowances to the Chairperson of the Agricultural Services Cooperative during months of water diversion and drainage.

However, considering the current practical conditions and the economic restructuring from agriculture to services and trade, fully imposing the cost of irrigation services on water users would lead to the abandonment of farmland. This is because the economic efficiency derived from agricultural production is still lower than that of non-agricultural production. Therefore, in the short term (3-5 years), the current method of charging for irrigation services should still be used to ensure

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

food security. The price of irrigation services is still paid by the State to the irrigation companies, while individual farmers using irrigation services pay the internal irrigation fee. However, the pricing should be gradually adjusted and increased over time.

The level of compensation for irrigation fees for mechanized irrigation measures is currently set too low compared to the actual operational costs. The allocated funds for waiving irrigation fees are only used for maintenance, repair, and upgrading of irrigation works, but there is a need for additional investment to complete the internal irrigation system to meet the current production needs.

The study has shown that the majority of households with irrigation services in Nam Dinh province are willing to pay an additional internal irrigation fee to serve agricultural production, with the most commonly chosen price being a maximum increase of 5000 dong/pole/crop season.

References

1) Cline, W. (2007). *Global Warming and Agriculture: Impact Estimates by Country*. Washington, D.C.: Center for Global Development and Peterson Institute for International Economics.

2) Dhiman (2016). *New Approaches and Strategies for Irrigation Water Management*. Indian Journal of Economics and Development. 12(1). p. 1 – 14.

3) Elmahdi (2005). *System Dynamics Optimisation Approach to Irrigation Demand Management*. Conference: MODSIM, International Congress on Modelling and Simulation, Australia. 196 – 201.

4) Hasan A. (2020). *Impact of agricultural supports on competitiveness of agricultural products*. Agricultural Economics. 66(6): 286 – 295.

5) Latinopoulos (2005). *Valuation and pricing of irrigation water an analysis in Greek*. Global NEST Journal. 7(3): 323 – 335.

6) Walter C. (1980). *Irrigation and agricultural development in Asia: perspectives from the social sciences*. Cornell University. USA. 40 – 69.

7) James N., Chisa O. (2010). *Agricultural Water Pricing: Japan and Korea*. Sustainable Management of Water Resources in Agriculture, OECD study.

8) Alberto G., Javier C. (2010). *Agricultural Water Pricing: EU and Mexico*. Sustainable Management of Water Resources in Agriculture, OECD study.

9) Erol H. C. (2010). *Agricultural Water Pricing: Turkey*. Sustainable Management of Water Resources in Agriculture, OECD study.

10) Thu T. T. K. (2013). *Statistical theory.* National Economics University Press.

11) General Statistics Office (2016). *Results of the Vietnam Population Living Standards Survey in 2016*. Hanoi

12) Nam Dinh Provincial Statistics Office (2022). *Nam Dinh Provincial Statistical Yearbook 2022*. Statistics Publishing House, Hanoi.

13) Huan N. B. (2017). *Estimate the willingness of people to pay for clean water use in Chuong My district, Hanoi City.* Journal of Forest Science and Technology. 1/2017: 129 – 139.

14) Song N. V. (2011). *Determining the willingness to pay of farmers for the collection, management, and treatment of household solid waste in the Gia Lam district of Hanoi.* Journal of Science and Development.. 9(5): 853 – 860.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8424891

15) Department of Irrigation of Nam Dinh Province (2017). *Report on management and use of irrigation infrastructure 2017*. Nam Dinh.

16) Department of Irrigation of Nam Dinh Province (2018). *Synthesis report on the results of business operations of Joint Stock Companies for Construction and Technical Services in Nam Dinh Province during the period 2015-2018*. Nam Dinh..

17) People's Committee of Nam Dinh Province (2017b). *Decision approving the irrigation system planning of Nam Ninh, Hai Hau, Nghia Hung, Xuan Thuy, Bac Nam Ha areas within the jurisdiction of Nam Dinh Province*. Nam Dinh..

18) People's Committee of Nam Dinh Province (2019a). *Decision on the issuance of specific pricing regulations for irrigation products and public utility services in the province of Nam Dinh during the period 2018-2020*. Nam Dinh.

19) People's Committee of Nam Dinh Province (2019b). *Decision on the regulation of specific pricing for irrigation products and public utility services in the province of Nam Dinh during the period 2018-2020*. Nam Dinh.

20) People's Committee of Nam Dinh Province (2019c). *Decision No. 443/QD-UBND dated March 5, 2019, approving the volume of work and supported area for the payment of public utility products and services in irrigation in 2019*. Nam Dinh.

21) People's Committee of Nam Dinh Province (2019d). *Decision regarding the allocation of funds for the implementation of the policy to support the funding for the use of public utility products and services in irrigation in 2018 and 2019*. Nam Dinh.