IMPACT OF NATURAL CONDITIONS, CLIMATE CHANGE AND POLITICAL, CULTURAL AND SOCIAL FACTORS ON THE EFFICIENCY OF IRRIGATION DEVELOPMENT INVESTMENT IN THE MEKONG DELTA

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Abstract: ***Irrigation infrastructure plays a particularly important role in the economic development of the Mekong Delta in general and Vietnam in particular. Thanks to the investment in irrigation infrastructure, it will help develop economic sectors, improve labor quality, and improve people's income. This paper focuses on studying the impact of natural conditions, climate change, and political, cultural, and social factors on the efficiency of investment in irrigation development using state budget capital in the Mekong Delta. Through a survey of 348 officials working in project management boards, state management agencies on irrigation in the Mekong Delta, etc., the results have shown that natural conditions and political, cultural, and social factors have the same impact, while climate change has the opposite impact on the efficiency of investment in developing irrigation infrastructure in the region.***

• Keywords: *efficiency, investment development, irrigation.*

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1. Introduction

The Mekong Delta is an area located at the end of the Mekong River, spanning 6 countries and flowing into the East Sea. After more than 30 years of renovation, this is an economic region that contributes more than 33% of the country's agricultural GDP, 56% of rice output, 60% of fruit output, 95% of rice export output, and about 60% of Vietnam's seafood export output (Ministry of Agriculture and Rural Development, 2023).

In recent years, the region's irrigation infrastructure has received attention from the state. Thanks to the investment in irrigation infrastructure, it has contributed to flood control in the region, acidification and alum washing, salt prevention and freshwater retention, expansion of cultivated land area, increased productivity and crop yield, and ensured water for people's daily life (Le Manh Hung, 2015). However, investment in developing irrigation infrastructure from the state budget in the region has not been highly effective; irrigation infrastructure is incomplete, asynchronous, and degraded, and there is overlap in the management and coordination of resources and stakeholders.

There have been many domestic and foreign studies on the effectiveness of investment in developing irrigation infrastructure; however, the authors have only mentioned small irrigation projects, such as Leslie E. Small and Mark Svendsen (1990), Eliakim C. Matekere and Ninatubu M. Lema (2012). In Vietnam, there are many studies on the effectiveness of investment in developing irrigation infrastructure, such as Le Manh Hung (2015), Bui Thi Bong Trang (2017), Nguyen Hong Nhung (2020), mainly focusing on analyzing the current investment status and proposing solutions to improve investment efficiency without quantifying the factors affecting the efficiency of irrigation development.

2. Literature review

Natural conditions

The group of natural conditions is understood as geographical location, climate conditions, hydro-oceanographic conditions, topographic and geological conditions, etc.

Climate conditions: Due to the characteristics of construction works being outdoors, they are affected by climate and weather conditions. If the locality has

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a lot of rain or a lot of sunshine, it can slow down the construction progress of the project, increase investment costs due to prolonging the project implementation time, thereby reducing investment efficiency (Ha Duy Khanh and Nguyen Khanh Duy, 2022).

Geological conditions: including stratigraphy, geological structure, geomorphology, etc., at the project implementation location (Nguyen Hong Duc and Nguyen Viet Minh, 2015). If the geological conditions of the construction site are complex and unpredictable, it will affect the construction investment costs, thereby affecting the efficiency of investment and development (Do Van Chinh, 2020).

Terrain conditions: if the locality has flat terrain, favorable for the construction process, it will reduce investment costs and improve investment efficiency (Cu Thanh Thuy, 2018; Nguyen Van Phuc, 2023).

Hydrological characteristics: factors related to hydrology, abnormal flow will affect the construction process of irrigation works, possibly slowing down progress, prolonging project implementation time, increasing costs for investors, thereby the project is not as effective as expected (Nguyen Huu Hue and Nguyen Van Son, 2020)

Geographical location: If the locality has a preferential geographical location, it will be easier to attract and mobilize capital for investment and development than other localities. On the contrary, in economically disadvantaged areas, poor areas, remote areas, with unfavorable geographical locations, frequent natural disasters, floods, and droughts will increase costs for investors when implementing projects, and may even lead to delays, unfinished investment projects, and ineffectiveness as expected (Pham Minh Hoa, 2017; Cu Thanh Thuy, 2018; Nguyen Van Phuc, 2023).

Climate change

Temperature increase: According to Nguyen Tuan Anh et al (2022), increased temperatures change water demand as well as water resource balance. Therefore, it will affect investment activities in irrigation works and the efficiency of works during the implementation and operation stages.

Changes in rainfall and rainfall intensity: Nguyen Tuan Anh et al (2022) pointed out that changes in rainfall and rainfall intensity cause investors to increase investment costs, and the safety level and service assurance of the project as originally designed are also affected.

Floods, droughts, landslides: Floods, droughts and landslides affect the water intake capacity of irrigation and water supply systems, the drainage capacity of drainage systems, and increase construction, repair, and operation management costs of the project. This is a factor that damages two irrigation works after construction as well as increases construction costs during the implementation of the investment project (Nguyen Tuan Anh et al, 2022).

Storms and tropical depressions: When storms and tropical depressions occur frequently, they will increase construction costs as well as repair and management costs, reducing the level of service assurance and safety of the works, thereby reducing the efficiency of irrigation investment (Nguyen Tuan Anh et al, 2022)

Saltwater intrusion, sea level rise: Rising sea levels and saltwater intrusion increase the scale of irrigation and water supply works, in addition to increasing the management and operation costs of these works (Nguyen Tuan Anh et al, 2022).

Political, cultural, and social factors

Political stability has a close relationship with investment activities (Jovana Trkulja, 2005). Ensuring political security in the country or locality will positively affect the decision to invest in infrastructure development as well as improve the output of development investment activities (Mustajab M, 2009; Pham Van Hung and Nguyen Thi Ai Lien, 2024).

The support of the people where the investment project is located also greatly affects the implementation of the investment project. Only when people trust and support the implementation of the project, especially in the site clearance of the investment project, will the project implementation progress be accelerated, helping the project achieve high efficiency (Cu Thanh Thuy, 2018; Mai Thi Kim Oanh, 2022).

Factors of culture, history, and customs of people living around the project location affect the implementation of the investment project, facilitating or hindering the investment process (Cu Thanh Thuy, 2018; Nguyen Van Phuc, 2023).

3. Research method

Research method

The author uses a combination of qualitative and quantitative research to measure the level of influence of the following factors: Natural conditions, Climate change, Political, cultural, and

social factors on the effectiveness of investment in developing irrigation infrastructure using state budget capital.

The author also uses a 5-level Likert scale to assess the level of influence of the factors on the effectiveness of investment in developing irrigation infrastructure.

Data collection

The author uses a survey form to interview officials directly working at units and state management agencies related to investment in irrigation infrastructure development using state budget capital, including the Ministry of Planning and Investment, the Ministry of Agriculture and Rural Development and affiliated units; staff working at Project Management Boards, construction contractors, consulting contractors, and supervision contractors of irrigation works using State budget capital in the Mekong Delta.

Sample

With a sample size of 348, it is enough to ensure the sampling principle according to Yamane (1967) and Rao (1985). The questionnaire was coded, entered using Excel, and processed using SPSS 20 for analysis.

4. Research results

Scale reliability results

Conducting a reliability test of the scales, the results showed that all factors had Cronbach's Alpha coefficients > 0.7, and the total correlation coefficients were all greater than 0.3. Therefore, the scales of the factors met the reliability requirements.

Table 1: Cronbach's Alpha test results

STT	Factors	Cronbach's Alpha
1	National conditions (DKTN)	0,927
2	Climate change (BDKH)	0,923
3	Politics, culture, society (CTVH)	0,871
4	Efficiency of irrigation development investment (HQ)	0,915

Results of exploratory factor analysis EFA

Table 2: KMO and Bartlett's test with independent variables

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.719
Bartlett's Test of Sphericity	Approx. Chi-Square	5932.315
	Df	78
	Sig.	.000

The results of the EFA exploratory factor analysis with independent variables in the research model gave quite good results. This is shown in the KMO coefficient = 0.719 corresponding to the significance level Sig = 0.000 < 5%. This result indicates that the results of the EFA exploratory factor analysis have high reliability. In addition, the total value of the extracted variance of the third factor and the convergence coefficient of eigenvalues of this factor are 79.539% > 50% and 2.411>1, respectively. In addition, the rotated matrix table of factors shows that the loading factors of the observed variables are all greater than 0.5. Thus, the factors after performing the EFA exploratory factor ensure the ability to represent the original survey data and are eligible to perform multivariate regression. Three factors were extracted after performing EFA analysis including: Natural conditions; Climate change; Politics, culture, society.

Correlation analysis results

Based on the correlation analysis results, we can see that the dependent factor of efficiency in irrigation development investment (HQ) has a positive correlation with the independent factors of natural conditions (DKTN); political, cultural and social factors (CTVH); and has a negative relationship with climate change (BDKH), which is shown by the Pearson correlation coefficient of these relationships being greater than 0. This strong relationship is highly desirable because it is the strong, linear relationships between the variables that explain the influence of the model results. Therefore, these independent variables can be included in the regression analysis to explain the influence on the results of the research model.

Regression analysis

Multiple linear regression results

The results of the model show that the adjusted R^2 is 0.416, which means that 41.6% of the variation in the dependent variable HQ is explained by the independent variables in the model. In addition, the results also show that the F test also gives a very small Sig. value, which proves that the research model is suitable for the data set being surveyed.

On the other hand, the independent variables DKTN, BDKH, CTVH are all statistically significant with a significant level of Sig. < 0.05.

The regression model results also show that the Tolerance coefficient is quite high (0.958 to 0.992), while the VIF variance inflation factor is low (from 1.008 to 1.044) less than 2.

On that basis, we can conclude that the relationship between these independent variables is insignificant and there is no multicollinearity phenomenon.

Table 3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig. Zero-order	Correlations			Collinearity Statistics
		B	Std. Error	Beta			Partial	Part	Tolerance	VIF
1	Constant	3.067	.237		12.953	.000				
	DKTN	.214	.035	.254	6.053	.000	.365	.310	.248	.958
	BDKH	-.423	.037	-.483	- 11.538	.000	-.548	-.528	-.473	.959
	CTVH	.218	.039	.229	5.555	.000	.278	.287	.228	.992

From the results of the regression model, we can draw a multiple regression equation representing the relationship between the independent variables and the dependent variables as follows:

*HQ = 0.254*DKTN – 0.483*BDKH + 0.229*CTVH*

Multivariate regression model results: Based on the results of the multivariate regression analysis, it shows that there are 3 factors affecting the efficiency of irrigation development investment using state budget capital, including: (1) Natural conditions, (2) Climate change, (3) Political, cultural, and social factors. In which the factor "Climate change" has the greatest impact on the efficiency of irrigation development investment using state budget capital, with a regression coefficient of -0.483.

The results of the regression analysis show that the factors affecting the efficiency of irrigation development investment using state budget capital are as follows:

+ Natural conditions: The results of the regression analysis show a positive correlation between the factor "natural conditions" and "the efficiency of investment in developing irrigation infrastructure using state budget capital". The regression coefficient is 0.254, which means that under the condition that other factors remain unchanged, when the factor "natural conditions" increases by 1 unit, the efficiency of irrigation development investment using state budget capital will increase by 0.254 units.

+ Climate change: The regression analysis results show a positive correlation between the factor "climate change" and "efficiency of irrigation development investment using state budget capital". The regression coefficient is -0.483, which means that under the condition that other factors remain unchanged, when the factor "climate change" increases by 1 unit, the efficiency of irrigation development investment using state budget capital will decrease by 0.483 units.

+ Politics, culture, society: The regression analysis results show a positive correlation between the factor "politics, culture, society" and "efficiency of irrigation development investment using state budget capital". The regression coefficient is 0.229, which means that, assuming other factors remain constant, when the factor "politics, culture, society" increases by 1 unit, efficiency of irrigation development investment using state budget capital will increase by 0.229 units.

5. Conclusion

The article has studied the level of influence of 3 groups of factors: natural conditions; climate change; political, cultural and society factors. The results show that natural conditions and political, cultural, social factors all have a positive impact on the efficiency of irrigation development investment using state budget capital. This result is consistent with a number of previous studies in the field of investment in developing infrastructure (Cu Thanh Thuy, 2018; Nguyen Van Phuc, 2023). Climate change has a negative impact on the efficiency of irrigation development investment using state budget capital. This result is consistent with the study of Nguyen Tuan Anh et al. (2022). In particular, this study has shown that climate change has the strongest impact on the efficiency of irrigation development investment using state budget capital. Therefore, irrigation development investment using state budget capital in the Mekong Delta needs to take into account the impact of climate change and have solutions to respond to climate change in the coming time.

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