

# Social Housing Stock Management toward Sustainable Development Goals in Vietnam: a Case Study of Bac Ninh Province

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## Abstract

With the goal of constructing one million social housing apartments in the near future, managing social housing development toward sustainable development has become a critical and urgent issue. This management plays a decisive role in shaping the social housing stock in Bac Ninh province and across Vietnam. Through field surveys combined with document synthesis, this study investigates and analyzes the current state of social housing development management in Bac Ninh Province. The findings reveal significant shortcomings, including inadequate oversight of eligibility for purchasing and lease-purchasing social housing, delays in project implementation, reduced quality during the operational phase, and increased investment costs. To address these challenges and align social housing development with the sustainable development goals of the construction industry, the study proposes targeted solutions focusing on environmental, social, and economic sustainability. Additionally, it emphasizes the application of Industry 4.0 technologies to enhance the efficiency and effectiveness of social housing management in Bac Ninh Province.

## 1. Introduction

Ensuring a safe living and working environment is one of the important sustainable development goals that have been emphasized by [1]. The Government of Vietnam also has set this goal in the "National Action Plan for the Implementation of the 2030 Agenda for Sustainable Development Goals"[2] and a specific roadmap for implementation [3]. In Vietnam, in addition, owning a house is also a legitimate desire of people in each country and is focused on research by Governments to come up with many different solutions to solve the housing problem. However, in major cities of Vietnam such as Hanoi, Ho Chi Minh City, Da Nang, Quang Ninh, Bac Ninh, Binh Duong ... In recent years, real estate prices in general and housing in particular have increased rapidly. This has led to the inability to afford housing, whether rented or purchased by low-income workers, who are vulnerable in these areas.

To have a solution to the above problem, in April 2023, the Government approved and promulgated the project "Investing in the construction of at least one million social housing apartments for low-income people and industrial park workers in the period of 2021 - 2030"[4]. The project aims to develop social housing and housing for workers with prices suitable to the affordability of middle-income and low-income households in urban areas

and of workers and labourers in industrial parks and export processing zones. In particular, the Ministry of Construction proposes, from 2021 to 2025, to build about 428,000 social houses, and from 2025 to 2030, to build 634,200 social houses. If this goal is achieved, an additional one million apartments will be added to provide vulnerable low-income people in many major cities across the country.

However, the general statistics show that the results achieved are still very modest. As of 2023, in the country, only 307 social housing projects in urban areas have been completed, with a construction scale of about 157,100 units, with a total area of more than 7,950,000 m<sup>2</sup> [5] (Figure 1). In which:

- Social housing development program for industrial park workers: Up to now, the investment in the construction of 126 projects has been completed, with a construction scale of about 62,700 apartments, with a total area of 3,135,000 m<sup>2</sup>. It is continuing to implement 127 projects with a construction scale of about 160,900 apartments, and a total area of 8,045,000 m<sup>2</sup>.

- Social housing development program for low-income people in urban areas: Currently, the investment in the construction of 181 projects with a construction scale of about 94,390 apartments, with a total area of about 4,815,000 m<sup>2</sup> has been completed. It is continuing to implement 291 projects, with a construction scale of about 271,500 apartments, with a total area of about 14,520,000 m<sup>2</sup>.

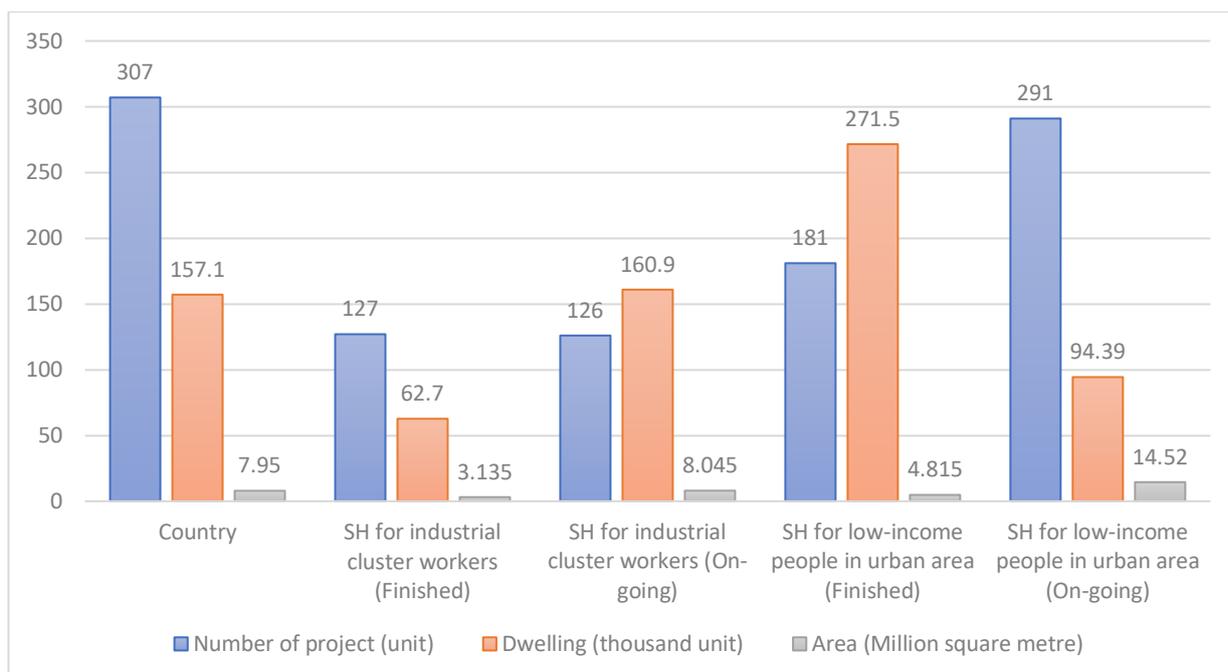


Fig. 1 Social housing stock in Vietnam in 2023 [5]

Particularly for Hanoi City, from 2016 to 2020, there were 25 completed social housing projects, equivalent to 12,659 apartments, and about 1.25 million m<sup>2</sup> of floor area. In 2021, due to the complicated developments of the COVID-19 epidemic, social housing projects are still being implemented but progress is affected. Only 2 social housing projects have been completed and put into use, equivalent to 1,234 apartments [6]. Ho Chi Minh City has also recently planned to develop one million low-cost houses for workers at the lowest possible prices, so that workers can easily access and replace old apartments and houses on canals, improving the current hostels. In addition, Da Nang is one of the leading localities in the development of social housing projects. In the city, 6 social housing projects with 7,023 apartments are being implemented and currently, there are 4 social housing projects with 4,119 apartments calling for investment. As of July 2022, Da Nang has developed 13,938 apartments and implemented a social housing project for people with meritorious services to the revolution with a scale of 209 units [7]. Obviously, with the history and speed of social housing development in recent years, the implementation to achieve the target of one million social housing apartments as set out by the Government is not feasible without effective solutions. The development of social housing is still generally slow and inefficient, due to several problems in both institutions and policies and the organization of implementation.

In addition, a significant issue posed to the Government when approving the Project "Investment in the construction of at least one million social housing apartments for low-income people and industrial park workers from 2021 to 2030" [4] is the management and operation of these apartments. Currently, many data show that social housing buildings after being put into operation have deteriorated very quickly, and the quality management of works in the operation period is inefficient. The serious deterioration is not only in old buildings,

but even newly built social housing areas have water seepage and cracked walls,... This situation has not yet been overcome, leading to inconveniences and difficulties in the process of people's daily activities. According to representatives of shared housing management companies, the management and operation of social housing have its characteristics; The management and operation processes and procedures are complicated, so it is very difficult for the house management unit to overcome the above shortcomings. With the goal of the project to build at least one million social housing apartments, the management and operation of both apartments that have been put into operation and those that are expected to be further developed in the next period will face many problems if the Government does not have solutions and specific mechanism.

## 2. Literature Review

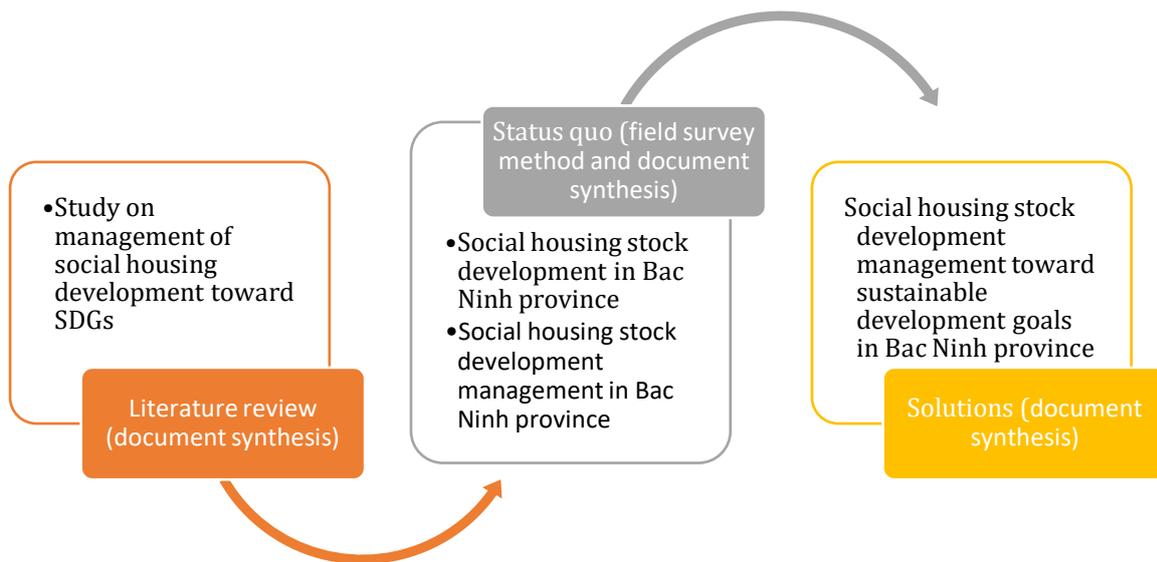
Social housing development has economic and social significance, not only meeting the housing needs of millions of households of officials, workers, public employees and employees working in agencies, industrial parks, export processing zones, factories, construction sites and households subject to site clearance. Social housing does not need a lot of capital and high technology, sophisticated and comfortable design, but needs a large quantity, diverse area size, utilities and affordable prices, suitable for people's needs and pockets. However, it is not for this reason that it is not taken lightly both in the management and implementation of social housing projects. If this problem is neglected, it will lead to an increase in not only supply shortages but also increased imbalances, and price inflation due to speculation and intermediaries.... In particular, people's rights, lives and beliefs are seriously affected when the quality of social housing deteriorates rapidly.

The literature review of studies related to the sustainable development of social housing in developed countries such as Korea [8], the UK [9] and even developing countries like Colombia [10] and Brazil [11] shows that if social housing is built and operated only to meet the needs of low-income people while ignoring environmental and social factors, it will face many complex problems in the future (Such as CO<sub>2</sub> emission, energy consumption...). In 2007, the research on the awareness and implementation of sustainable development policies in social housing projects in the UK [9] emphasised that it is necessary to combine all three factors of economic, social and environmental sustainability from policy to practice in social housing projects to ensure the set sustainable development goals. A study by Biagio F. Giannetti and colleagues conducted in 2018 in Brazil [11] showed that when constructing new buildings and during the operation phase, the construction industry consumes a large amount of resources (materials, fuel, energy) and directly and indirectly pollutes the environment (dust, CO<sub>2</sub> emissions). Therefore, if social housing projects only care about saving costs without minimizing their environmental impacts, with a large number of projects implemented in the future, the environmental and social consequences that must be borne are inevitable.

The above studies show that, in order to develop social housing sustainably and protect the environment, the management of social housing development (including the management of development plans, beneficiaries, investment capital sources; management of construction investment projects and management of the operation of social housing projects) is extremely important. Only when each content of social housing development management is well implemented and sustainable in terms of economy - society - environment, will the general goal of development management of social housing stock towards sustainable development goals be ensured. In Vietnam's sustainability development context [12], it is very necessary to research and find solutions to develop and manage the operation of social housing toward SDGs, particularly for Bac Ninh province. However, there are a few studies that focus on social housing development toward SDGs [8]-[15], and most studies are conducted in other countries. To adapt Vietnamese context, the issues can vary and the solutions need to be tailored.

## 3. Methodology

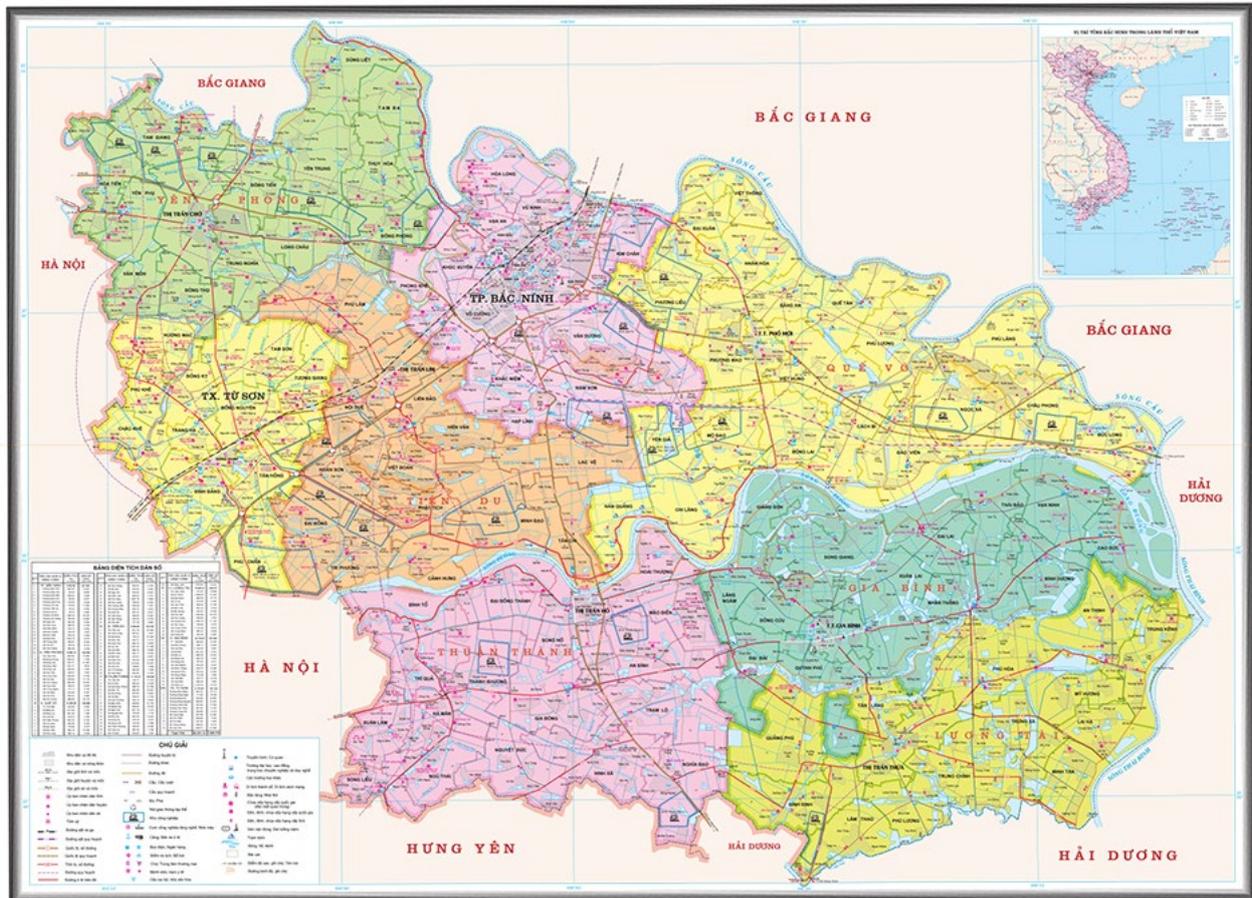
By field survey method combined with document synthesis, the article has investigated and analyzed the current situation of social housing development management in Bac Ninh province, thereby finding out the shortcomings and limitations that need to be overcome to harmonize the goal of social housing development with the sustainable development goal of the construction industry. Specific solutions for sustainable development in terms of environment, society and economy will be developed based on the experience worldwide. The Sequence of study procedures present in Figure 2.



**Fig. 2** *Sequence of study procedure*

#### 4. Social Housing Stock Development in Bac Ninh Province

Bac Ninh is a province in the Red River Delta, located in the key economic triangle of Hanoi - Hai Phong - Quang Ninh and the Northeast gateway of Hanoi, with a natural area of 822.7 km<sup>2</sup>, is the smallest province in the country, with administrative boundaries adjacent to the following provinces: Bac Giang is to the north, Hai Duong is to the southeast, Hung Yen is to the south and the capital Hanoi is to the west (Figure 3). Located in a convenient location for road and air traffic, there are arterial roads: National Highway 1A, DT295B, National Highway 18, National Highway 38, New National Highway 3, Hanoi-Lang Son, Hanoi-Quang Ninh, Bac Ninh railways are connected to the economic, cultural and commercial centres of the Northern region of Vietnam, with Noi Bai international airport and connected to the system of national highways to all regions of the country.



**Fig. 3** Administrative map of Bac Ninh Province (Source: Bac Ninh Province Electronic Information Portal [16])

After more than 20 years of re-establishment, from a purely agricultural province, Bac Ninh has become an industrial province in the direction of modernity, with many socio-economic indicators ranking at the top of the country. Promote the application of information technology and build a smart city, complete the criteria for Bac Ninh to become a city directly under the Central Government in the direction of civilization and modernity. In terms of industrial and handicraft development, Bac Ninh province currently has 16 concentrated industrial parks, with a total area of about 6,364.8 hectares, which are operating effectively, have 28 industrial clusters in operation and continue to invest in construction in the coming time, with an area of about 1,384 hectares. With the strategy of developing into an industrial and service province, up to now, Bac Ninh province has attracted a large number of workers to work and live (more than 350,000 workers working in 12 concentrated industrial parks). In which, there are more than 230,000 low-income people and groups in need of housing. Accumulated from 2010 to now, Bac Ninh province has 51 social housing projects that have had investment policies and are under construction, with a total land area of about 156.58 hectares, a total floor area of about 3,931,992 m<sup>2</sup>, with about 46,462 apartments, meeting the housing needs of about 182,595 people [17].

From 2021 to 2023, the total area of social housing has been accepted and put into operation phase is 505,801 m<sup>2</sup> of floor, accumulating only 23.4% of the plan (the plan for the period 2021-2025 is to complete 2,165,214 m<sup>2</sup> of floor). The number of social housing projects that have been developed and built is only nearly 24% of the plan, so it cannot meet the housing needs of workers and low-income workers. Most of the workers still have to rent hostels and mini apartments with unsafe and poor hygienic conditions. Numerous pressing societal issues have emerged, including concerns over security, environmental degradation, and the overloading of technical and social infrastructure in densely populated areas. One contributing factor is the ineffective management of social housing development by the Department of Construction in Bac Ninh province, which has yet to align with sustainable development principles.

To address the challenges outlined, the "Social Housing Development Plan for the Period 2021-2025" (Table 1) [17] and the project "Investment in the Construction of at Least One Million Social Housing Units for Low-Income People and Industrial Park Workers for the Period 2021-2030" [4] set clear objectives. This article examines the current state of environmental development in Bac Ninh province and proposes solutions for advancing social housing initiatives aligned with sustainable development goals.

**Table 1** Social housing development plan for the 5 years of 2021-2025

Group of people	Statistic number (people)	Demand for housing (people)	Planned quantity of supply (people)	Total area (m2)	Increased area (m2)
Pupils and students	92,333	27,700	20,775	366,760	171,321
Industrial cluster workers	485,764	219,730	164,798	2,909,342	
Low-income people and other groups	249,162	166,108	124,581	2,199,359	1,993,893

(Report of the People's Committee of Bac Ninh province [17])

## 5. Status Quo of Social Housing Stock Development Management in Bac Ninh Province

### 5.1 Management of Capital Sources and Loan Support Programs for Social Housing Projects

All social housing projects in the province use capital invested by enterprises and cooperatives to build social housing for lease, lease-purchase, and sale, but with the State's incentives. This is the capital source identified as the main source of capital for the successful implementation of the project "Investing in the construction of at least one million social housing apartments for low-income people and industrial park workers in the 2021-2030 period" [4] in the province and implementing other social housing projects in the next stage. According to reports of the People's Committee of Bac Ninh province, the use of capital of enterprises, cooperatives, households and individuals investing in building social housing ensures the efficiency of using capital; enterprises participating in investing in the construction of social housing in the province have made profits.

To support the field of social housing construction, Bac Ninh has issued several supporting documents. By the end of 2023, 8 out of 8 districts and cities have disbursed outstanding loans of VND 525,628 million with 1,298 outstanding customers (Table 2).

**Table 2** Status of disbursement of preferential loans of the government for social housing construction investment

Group of people	Statistic number (people)	Debt balance (VND million)
Low-income people, poor households, and near-poor households in urban areas	638	243,065
People with meritorious services to the revolution	10	3,611
Workers are working at enterprises inside and outside the industrial park	160	96,240
Officers, non-commissioned officers, military personnel	100	39,219
Officials, civil servants, public employees	390	143,523
<b>Total</b>	<b>1,298</b>	<b>525,628</b>

Note: Exchange rate: About 1 USD/25,346 VND (Report of the People's Committee of Bac Ninh province [17])

There are 06 projects with a total investment of more than VND 14,500 billion with an expected loan amount of about VND 3,380 billion that have been approved under the program of VND 120,000 billion to lend to social housing, worker housing, renovation and reconstruction of old apartments according to Resolution 33/NQ-CP. According to the report of the State Bank of Bac Ninh province, up to now, in Bac Ninh province, 02 social housing projects have received preferential loans with an approved loan limit of VND 170 billion and have been disbursed VND 115.2 billion. It can be seen that, compared to the demand for capital for the development of social housing stated in the Development Plan for the period 2021-2025 of about VND 17,295 billion, the expected number of loans and the expected amount of capital to be disbursed are still quite small, proving that many projects do not meet the conditions for borrowing capital or because there is no need to borrow capital for construction investment social housing.

## 5.2 Management of Social Housing Prices

In the process of appraisal of the selling price plan, the main parameters of projects include the total construction investment capital (including construction investment costs and a number of other reasonable expense items) is determined in accordance with the time of submission for the appraisal; profits from the sale, lease or lease-purchase of commercial housing areas in social housing construction investment projects; the normative profit calculated for the project, up to 10% of the total construction investment capital; the total area of social housing use of the project; selling price adjustment coefficient; interest rate on investment capital preservation; the number of years of recovery of investment capital; the average annual cost of maintenance of the work and the main parameters are synthesized and determined by the investor to comply with the provisions of law over each period. Based on the selling price plan submitted by the investor, relevant agencies, including: the Construction Department, Department of Natural Resources and Environment, Finance, and Provincial Tax Department for joint appraisal and verification; issue notices of appraisal of selling prices to investors under law.

By the end of December 2023, the total number of projects appraised by the Department of Construction in coordination with inter-sectoral appraisal is 19 social housing, the highest rental price is 70,300 VND/m<sup>2</sup>/month - the lowest rental price is 45,200 VND/m<sup>2</sup>/month; the highest selling price is 12,874,000 VND/m<sup>2</sup> - the lowest selling price is 9,091,000 VND/m<sup>2</sup> (Table 3).

**Table 3** Status of appraisal of social housing prices in the period 2019 – 2023

Type	2019	2020	2021	2022	2023
Selling price (VND/m <sup>2</sup> )	9,840,000 – 12,140,000	9,091,000 – 12,699,000	11,060,000 – 12,695,000	10,360,000	12,320,000 – 12,874,000
Rental price (VND/m <sup>2</sup> /month)	48,800 – 70,300	45,200 – 66,500	56,300 – 62,100	54,00	63,000 – 69,700

Note: Exchange rate: About 1 USD/25,346 VND

(Report of the People's Committee of Bac Ninh province [17])

It can be seen that the selling price over the years has not increased much, from 2021-2022 there is also a slight decrease. The price is assessed quite by the actual conditions of the locality, with the needs of the people. However, there is a current situation about social housing selling at 2 prices. In 2022, 3/160 householders confirmed that they must pay additional non-contractual revenues with an amount of 30-60 million VND/apartment at the Highland 3 social housing project. At the Dabaco Khac Niem social housing project, the 3 apartment owners said that they bought a house through a broker, Cen Bac Ninh Joint Stock Company (a unit of Century Real Estate Joint Stock Company - Cen Land), the amount of non-contractual revenue is up to 100 million VND/apartment.

## 5.3 Management of Construction and Quality of Social Housing

Up to now, in Bac Ninh province, 54 social housing projects for low-income people, and housing for industrial park workers have been implemented (of which 29 projects have been completed, partially completed, or under construction, 25 projects are being implemented at the stage of preparation for construction investment). With a total land area of about 173 hectares, the projects, when completed, will meet about 7.1 million m<sup>2</sup> of floor space with more than 77,000 apartments for about 231,000 people (Table 4).

**Table 4** Social housing stock in Bac Ninh province in 2023

District	Total Floor Area (m <sup>2</sup> )	Total Units (Unit)	Number of Units Occupied (Unit)
Bac Ninh City	849,898	7,602	5,778
Tu Son City	121,813	1,214	400
Que Vo District	129,712	1,712	317
Tien Du District	36,767	312	135
Yen Phong District	270,000	2,599	93
<b>Total</b>	<b>1,408,190</b>	<b>13,439</b>	<b>6,723</b>

(Report of the People's Committee of Bac Ninh province [17])

**Social housing for workers** has a **higher occupancy rate** (57.4%) than **low-income housing** (50%). This shows that the demand for **worker housing** in Bac Ninh is high, especially in industrial centre areas. **Bac Ninh City** leads the occupancy rate in both housing types, reflecting high demand in urban and industrial areas. **Some areas** such as Que Vo, Tien Du, and Thuan Thanh have low occupancy rates, and it is necessary to review **utilities, locations, or attraction policies** to improve housing efficiency.

Of the 54 projects, there are: 33 projects for low-income people (with 23 projects completed and partially completed, 10 projects are being implemented); and 21 projects for workers (with 08 projects completed and partially completed, 13 projects are being implemented). From here, it can be seen that projects that have been completed and partially completed account for about 57.4%, and projects that are being implemented account for about 42.6%. The proportion of projects behind schedule accounts for about 20.4% of the total social housing projects. Although most of the reasons come from objective factors such as epidemics and the environment (Table 5). However, it can be seen that the coordination to remove difficulties for investors has not been drastically implemented, quickly leading to long project progress, which has greatly affected the quality of investment and the quality of the project in general.

**Table 5** Social housing projects are behind schedule

Project	Investor	Causes of delay
Social Housing Thong Nhat Smart City	Thong Nhat Trading and Development Investment Joint Stock Company	<ul style="list-style-type: none"> <li>- Impact of Covid-19 pandemic</li> <li>- Compensation for land acquisition (areas with many graves)</li> <li>- The selling price of social housing has not been appraised by the state agency, so it is impossible to borrow capital</li> </ul>
Social housing in Dinh Bang ward, Tu Son City	Van Khoi Thanh Joint Stock Company	<ul style="list-style-type: none"> <li>- Investors have difficulty accessing preferential loans</li> <li>- Difficulty in attracting investment</li> <li>- Determining the conditions for purchasing social housing is complicated, and must go through many agencies, leading to a longer processing time for selling and renting apartments, increasing project investment costs.</li> <li>- Low construction density reduces investors' profits.</li> <li>- Complicated procedures for fire safety acceptance.</li> </ul>
Social housing area for low-income people in the Bac Tu Son residential area	Green Environment Company Limited	<ul style="list-style-type: none"> <li>- Building CT1, at the time of fire prevention and fighting approval in 2018, the investor completed the construction, but in 2021, the fire prevention and fighting acceptance was reviewed according to the regulations of 2021, making the investor have to review, adjust and supplement, increasing the investment cost.</li> </ul>

*(Report of the People's Committee of Bac Ninh province [17])*

## 5.4 Management of People Allowed to Purchase Social Housing

Investors of social housing construction investment projects are responsible for sending the list of subjects expected to be settled to buy social housing in order of priority according to the principles specified in Decree 100/2024/ND-CP to the Department of Construction. After signing the social housing purchase and sale contract, the project investor shall have to make a complete list of subjects (including household members) who have purchased social housing and send it to the Department of Construction for a public announcement within 30 days from the date of receipt of this list and archive it for management. Inspection (post-inspection). The investor shall make a list and report to the Department of Construction on cases of liquidation of social housing purchase, lease or lease-purchase contracts for synthesis and update in the database system and publicly announce it on the website of the Department of Construction.

On average, the Department of Construction receives about 1,193 hard copy documents sent by investors every year, on average, each month professional staff will have to check and approve about 100 documents, this is a fairly large workload to be done. Sometimes there is still a delay because the information sent by the investor is sometimes inaccurate, making it difficult to review or duplicate inspection, due to the lack and incorrect confirmation of the coordinating units. Checking all hard copy records also creates quite a lot of workload for professional staff, so the inspection usually lasts up to 15 days and sometimes errors occur. However, the errors were immediately corrected and corrected. It can be seen that the rate of eligible applications after approval is quite high but rarely exceeds 95% (Table 6), proving that although the investors are committed to only confirming

the eligible documents to be submitted to the Department, the professional staff still carefully reviews and filters out many subjects with illegal documents. have not met the conditions for enjoying social housing policies.

**Table 6** Number of people confirmed to be allowed to purchase social housing in the period 2019 – 2023

Type	2019	2020	2021	2022	2023
People to be allowed to buy or rent social housing (Planned)	1,287	1,224	1,172	1,198	1,086
People to be allowed to buy or rent social housing (Confirmed)	1,235	1,160	1,078	1,117	1,027
<b>Proportion</b>	<b>95.9%</b>	<b>94.8%</b>	<b>91.9%</b>	<b>93.2%</b>	<b>94.5%</b>

(Report of the People's Committee of Bac Ninh province [17])

In addition, there is still a situation where foreigners rent social housing in contravention of regulations. The Department of Construction has inspected and reviewed the period of operation of social housing and found that there is a situation that many people after buying social housing have let foreigners live through the following forms: Allowing foreigners to play, marrying foreigners (after buying social housing), especially the phenomenon of renting to foreigners, (Table 7).

**Table 7** Social housing projects where foreign people lived in

Project	Investor	Location	Number of dwellings
Apartment project for low-income people (Cat Tuong low-income housing)	Cat Tuong Company Limited	Vo Cuong Ward, Bac Ninh City	100
Cao Nguyen 2 Social Housing Area	Cao Nguyen Company Limited	Vo Cuong Ward, Bac Ninh City	4
Thong Nhat Social Housing Area	Thong Nhat Trading and Development Investment Joint Stock Company	Vo Cuong Ward, Bac Ninh City	60
Cat Tuong ECO Social Housing Project	Cat Tuong ECO Company	Vo Cuong Ward, Bac Ninh City	150
Social housing area combined with commercial services on Le Thai To Street	Vinh Cat Company Limited	Vo Cuong Ward, Bac Ninh City	80
Housing area for low-income people in Vu Ninh ward, Kinh Bac ward	Dong Duong Education Investment Joint Stock Company	Vu Ninh Ward, Bac Ninh City	6
Social housing area in combination with commercial services in Kinh Bac ward and Vo Cuong ward	Anh Phu Trading and Service Company Limited	Vo Cuong Ward, Bac Ninh City	156
Low-income housing area in Bac Ninh City	Hud land Real Estate Investment and Development Joint Stock Company - Housing and Urban Development Group (Hud)	Vo Cuong Ward, Bac Ninh City	9
Housing project in Que Vo 1 Industrial Park – Social housing Hillview	Song Hong Real Estate Management Company Limited (Singapore)	Nam Son Ward, Bac Ninh City	16
Apartment complex for low-income people in Bac Tu Son Residential Area	Green Environment Company	Dong Nguyen Ward, Tu Son City	1

Project	Investor	Location	Number of dwellings
Social housing area, retail supermarket for electronics and household appliances, groceries in Pho Moi town	Kinh Bac Real Estate Investment and Trading Joint Stock Company	Pho Moi town, que vo town	25
Social housing area in Viet Hung commune	Sao Hong Investment, Construction and Trade Joint Stock Company	Viet Hung commune, Que Vo town	1
Social housing area combined with commercial services in Yen Trung commune	Bac Ky Industrial Urban Development Joint Stock Company	Yen Phong district	12
Investment project to build social housing area serving industrial park	Lan Hung Real Estate Group Joint Stock Company	Ho town, Thuan Thanh town, Bac Ninh province	25
<b>Total</b>			<b>645</b>

(Report of the People's Committee of Bac Ninh province [17])

## 5.5 Post-construction Operation Management

Social housing projects in the province after being completed and put into use are implemented by units that meet the conditions specified in Article 105 of the Law on Housing. All social housing projects are selecting housing management and operation units through the Apartment Building Conference. The units managing and operating social housing all meet the requirements for conditions specified in Article 105 of the Law on Housing and Article 27 of the Regulation on Management and Use of Apartment Buildings, issued together with the Consolidated Document No. 05/VBHN-BXD dated September 7, 2021, of the Ministry of Construction. Currently, the price of social housing management and operation services in the province complies with Article 106 of the Law on Housing and Articles 29 and 30 of the Regulation on Management and Use of apartment buildings, issued together with the Consolidated Document No. 05/VBHN-BXD dated September 7, 2021, of the Ministry of Construction. The current service price is the highest is 10,000 VND/m<sup>2</sup>/month - the lowest is 5,000 VND/m<sup>2</sup>/month (table 8), ensuring conformity with the price bracket for management and operation services of apartment buildings in Bac Ninh province issued together with Decision No. 06/2020/QD-UBND dated March 10, 2020, of the Provincial People's Committee.

**Table 8** Social housing management fee in the period 2019 – 2023

Type	2019	2020	2021	2022	2023
Social housing management fee (dong/m <sup>2</sup> )	3,500 – 5,000	3,500 – 8,500	3,500 – 8,000	3,500 – 8,000	5,000 – 10,00
Commercial housing management fee (dong/m <sup>2</sup> )	7,000-10,000	7,000-10,000	7,000-10,000	7,000-10,000	8,000-12,000
<b>Reduce</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>60%</b>

(Report of the People's Committee of Bac Ninh province [17])

The Department of Construction regularly inspects and examines the identification, collection and use of funds for social housing maintenance in the province according to Article 107 of the Law on Housing and the Regulation on Management and Use of Apartment Buildings issued together with the Consolidated Document No. 05/VBHN-BXD dated September 7, 2021, of the Ministry of Construction. All questions and complaints of people about the operation and maintenance of post-construction social housing are sent to the Department of Construction to be answered within the prescribed time, thoroughly solving the problem for the people. The assessment of the capacity profile of the operation management unit is also very carefully appraised, ensuring that according to regulations, the price bracket for operation management services is issued on the affordability of the people. Social housing projects in the area are operating well in terms of functionality after being put into use. However, in many projects, there has been a situation where the works have been damaged but have not been

repaired in time by the Management Board. In addition, the awareness of environmental protection and common property of people living in social housing is not high, leading to a decline in the quality of the living environment, which is not guaranteed.

## 5.6 Shortcomings and Limitations in the Management of Social Housing Stock Development in Bac Ninh Province

Due to difficulties in site clearance compensation, changes in legal regulations related to project implementation as well as price fluctuations after the COVID-19 pandemic, most social housing development projects are currently behind schedule and over budget. This leads to an increase in social housing prices, affected quality and increased risks to the effectiveness of projects. Due to many regulations on procedures, processes, and requirements that are not suitable, groups of beneficiaries are reluctant to access or have to go through brokers/intermediaries to prepare documents to buy/hire/rent social housing. There are no sanctions for those who make dishonest declarations in their house purchase or rental records, leading to buyers and renters having to fill out records multiple times until they can purchase (when they discover they are not eligible, they have to fill out new records); or those whose social housing is revoked continue to complete new records to buy back social housing.

In addition, the preferential loan policy for investment in social housing construction has been specifically stipulated in Article 15 of Decree No. 100/2015/ND-CP. However, in reality, project investors cannot access this capital source and must borrow commercially. Some enterprises have to issue corporate bonds with high interest rates and risks, leading to increased construction investment costs. The establishment of local social housing development funds cannot be implemented due to many obstacles in financial and credit policies, leading to capital sources for social housing development not being circulated to develop social housing but being integrated into the local general budget and used for other purposes. The incentive mechanism for social housing development is still unreasonable, not harmonizing the interests and responsibilities between the state, enterprises and people. Incentives mostly focus on supporting buyers, renters, and lease-purchasers of social housing, not investors (most incentives are aimed at reducing product prices), leading to investors not being interested in developing social housing.

Thus, it can be seen that the critical shortcomings in the management of social housing stock include the management of people allowed to buy and lease-purchase social housing, delayed project implementation progress, and reduced project quality during the operation phase, as well as increased investment costs. With the experience of countries worldwide, sustainable development management is the main solution for sustainable development in terms of environment, society and economy, along with the application of 4.0 technology to manage social housing development and deal with the above problems in Bac Ninh province [8]–[15].

## 6. Social Housing Stock Development Management Toward Sustainable Development Goals in Bac Ninh Province

### 6.1 Sustainable Development Management of Social Housing from The Economic Perspective

Sustainable development of social housing from an economic perspective is to ensure that social housing projects are implemented in a financially efficient manner, meeting the housing needs of low-income people while maintaining economic sustainability. This requires a balance between providing affordable housing, securing funding, and optimizing resources during development through the overall coordination of the following solutions:

- Mobilize and use capital effectively: Managers should mobilize capital from various sources such as the state budget, preferential loans, and socialized investment from enterprises and financial institutions. Strict management and effective use of these funds are crucial in minimizing waste and optimizing costs. This not only enhances capital efficiency but also ensures long-term sustainability and effectiveness.

- Preferential loan support: Preferential loan support is vital for enabling beneficiaries of social housing, such as low-income workers and industrial zone employees, to access low-interest, long-term loans. This reduces financial burdens, increases the ability to own or lease social housing, improves living conditions, and promotes sustainable social welfare for disadvantaged groups.

- Management of operation and maintenance costs: Effective management of operational and maintenance costs is essential to ensure the economic sustainability of social housing projects. After completion, a strict mechanism should be established to control these costs. One effective solution is establishing a maintenance fund contributed by residents or supported by the state budget. This helps alleviate household financial burdens while maintaining the quality of buildings over time, ensuring long-term economic and structural sustainability for the community.

- Optimize management costs: To optimize management costs, social housing management boards should implement advanced methods and technologies, such as building management software. These solutions enhance management efficiency, automate processes, reduce errors, and save labour. Consequently, operating costs are optimized, unnecessary expenses are minimized, and rental and purchase prices can remain affordable, benefiting low-income groups. Modern technology also enhances transparency, service quality, and resident satisfaction.

- Building a public-private partnership model: Public-private partnerships play a key role in mobilizing private sector investment for social housing projects. This model is considered optimal as it reduces the financial burden on the state budget while ensuring project efficiency. Through PPP, participants can share risks and benefits, enhancing transparency and management effectiveness. It also encourages private sector involvement, accelerating construction progress, improving project quality, and better meeting public needs.

- Promote the development of accompanying business services: Promoting the development of commercial and business services around social housing projects is an essential solution. This not only generates stable revenue for operations and maintenance but also reduces housing costs for residents. Moreover, it creates job opportunities for the local community, enhancing the overall quality of life. Integrated service development boosts the vibrancy of the surrounding area, attracts investment, and fosters sustainable local economic growth, ensuring a balance of benefits for both residents and investors.

## 6.2 Sustainable Development of Social Housing from the Social Perspective

Sustainable development of social housing from a social perspective is the focus on human factors, quality of life and social integration in the housing development process. This is not only the construction of housing works, but also to ensure that social housing projects fully meet the needs of daily life, improve living conditions, improve the quality of life and protect the interests of beneficiaries.

- Identify the right low-income subjects: To ensure fairness in the allocation of social housing, managers must accurately identify the low-income group. Social housing projects should be distributed fairly to low-income groups, workers, and policy beneficiaries. This requires clear and transparent identification of the beneficiaries to avoid misallocation or unfair distribution. This approach not only protects the rights of the people but also enhances the effectiveness of social housing development programs, providing long-term benefits to the community.

- Transparency in review and allocation: The review and approval system must ensure openness, transparency, and accessibility for the public. The application of digital technology in registration and tracking approval status helps speed up the process while reducing the risk of fraud. This technology allows authorities to monitor more closely and provide clear information to the public, thus creating favourable conditions for those who truly need social housing.

- Synchronous social infrastructure development: When developing housing, it is crucial to build social infrastructure to fully meet the living needs of residents. Projects such as schools, hospitals, healthcare centres, markets, and recreational areas should be built to serve the daily lives of the people. Additionally, transportation systems and technical infrastructure should also be adequately invested in to ensure connectivity and meet the mobility needs of residents. Proper investment in infrastructure not only improves the quality of life but also creates a safe and convenient living environment for the community.

- Strengthen propaganda about social housing policies: A strong communication strategy should be implemented so that people understand their rights and responsibilities when participating in social housing programs. This communication helps people not only understand the benefits they will gain from these programs but also raise awareness about their responsibility to protect and preserve the living environment. As a result, people will actively engage in environmental protection activities, contributing to building a green, clean, and beautiful community. These strategies should also be organized regularly and effectively to create long-lasting changes in public awareness.

## 6.3 Sustainable Development of Social Housing from the Environmental Perspective

The renovation and upgrading of social housing in the direction of green buildings is an important trend to enhance the quality of life, save energy, and protect the environment. Some solutions to renovate and upgrade social housing in the direction of green buildings, specifically:

- Greening the surface of the building (façade and roof)

Enhancing green spaces is an effective solution to improve the quality of life in construction projects. Developers can implement rooftop gardens or green systems within the project's premises. These green spaces play an essential role in improving air quality, reducing pollution, and creating a comfortable, nature-friendly living environment. Gardens and plants also help cool the surroundings, lower urban temperatures, create pleasant landscapes, and promote the health of residents.

- Use energy-efficient LED lighting system

Energy-efficient LED lighting systems are becoming an effective solution for reducing electricity costs for households, especially those with low income. LED lights consume significantly less energy compared to traditional bulbs, leading to a substantial decrease in monthly electricity bills. Additionally, LED lights have a long lifespan, reducing the frequency of replacements, which helps save costs and decreases waste generated from changing light bulbs.

Environmental protection: Using LED lights not only saves energy but also reduces greenhouse gas emissions, contributing to the achievement of sustainable development goals.

- Rainwater collection and treatment systems

The system is implemented to reuse rainwater for purposes such as watering plants, cleaning, or using toilets. This not only helps reduce dependence on clean water sources but also contributes to water resource conservation and lowers water usage costs for residents. Investing in a rainwater collection system brings not only economic benefits but also supports environmental protection, helps reduce the burden on the water supply system, and reduces the amount of wastewater released into the environment.

- Solar Battery System

Use renewable energy: Using renewable energy, especially solar energy, is an effective solution to minimize environmental impact and save costs. Installing solar panels in public lighting areas such as streetlights and playgrounds not only reduces energy consumption but also helps reduce service costs for residents. Solar energy is a clean, renewable source of energy that does not emit greenhouse gases and causes minimal pollution. Therefore, applying this technology to public infrastructure will contribute to environmental protection and promote sustainable development for the community.

## 6.4 Applying 4.0 Technology to Social Housing Development Management

### 6.4.1 Building a Subject Management Platform for State Management Agencies

This platform will assist project investors in submitting online lists of eligible individuals for social housing, ensuring transparency and speed in the process of receiving information. Additionally, the platform will provide features to assist professionals in verifying applicant documents, checking for duplication, and linking information, helping to validate relevant authorities and organizations. The verification steps will be optimized through the online platform, reducing processing time and increasing accuracy. The system will also connect with relevant agencies, ensuring information is synchronized and easily shared. As a result, reporting and publishing eligibility for social housing will become simpler and more efficient. This not only saves time but also enhances coordination among agencies, ensuring citizens' rights are protected.

### 6.4.2 Developing an Online Management Platform and Digitizing the Process

To improve the management of social housing, an online management platform and digitized processes should be developed. The electronic portal will help citizens register, search for information, and carry out transactions related to buying, selling, and renting social housing easily, saving time and costs. This system also facilitates quick access to information for the public. Moreover, digitizing files and approval processes will enable authorities to search and process documents quickly, transparently, and effectively, reducing the risk of document loss or errors.

### 6.4.3 Creating an Intelligent Evaluation and Feedback System

Citizen Feedback Application: Develop an online application or portal for social housing residents to submit opinions and evaluations on housing quality, utilities, and related issues. This system will provide management authorities with tools to monitor and track issues within social housing areas, helping to improve quality. Additionally, AI technology will be used to analyze residents' feedback and propose improvement measures, optimizing services and infrastructure. Applying AI to feedback analysis helps quickly identify priority issues and suggest effective improvements, aiming to increase resident satisfaction with social housing projects. This system not only improves living conditions but also fosters an environment of continuous feedback and improvement.

### 6.4.4 Application of Building Information Modelling (BIM) in the Management of Investment in the Construction of Social Housing

Building Information Modelling (BIM) is a method of integrating information and technology in the construction industry. It creates an interactive 3D model of the project, combining information about design, construction, and operation. BIM helps improve project management, optimize costs, and enhance operational efficiency, making the construction process efficient and sustainable. In 2023, Vietnam issued an official decision on the roadmap for applying BIM [18]. Social housing projects in Bac Ninh province are usually group II projects or higher and will be

required to apply BIM in the coming time. This is an important premise to take advantage of the efficiency brought by BIM technology in the management of social housing development in Bac Ninh province.

- For new social housing projects, it is required to apply the building information model (BIM) in construction investment management.

+ Construction preparation stage: BIM provides very good visual support in the process of selecting investment plans, design plans, determining capital plans following the implementation plan; helping investors easily consider and make decisions through information built into the model; analysing the energy use of design options, through supporting tools, contributing to environmentally sustainable design. Integrate green design standards such as LEED or LOTUS to assess the sustainability of buildings.

+ Construction phase: Minimize the pending time of unintended conflicts (due to design errors or from inconsistencies between design and construction) and thereby also contribute to cost savings for the project; Integrating material information into the model helps manage material performance, reduce waste, and ensure quality.

+ Operation phase: Use the BIM information database to build operational reports, analyse and report on space utilization, and store detailed information about the components of the building to help manage and plan maintenance effectively.

- For existing social housing projects, investors are encouraged to apply BIM in the operation process. By providing design profiles to companies and organizations that have BIM capabilities. To create a 3D model with full parameters and accurate materials for the management and operation of the project to take place reasonably. Thereby, maintenance or even renovation has also become easier and simpler, in line with the requirements of information system management, housing and real estate market databases issued by the Government.

## 7. Conclusion and Discussion

Intending to build one million social housing apartments in the coming time, the development of social housing toward sustainable development is an important, urgent issue, which plays a decisive role in the development of the social housing stock in Bac Ninh province in particular, as well as of Vietnam in general. The article has analysed the current situation of social housing development in Bac Ninh, thereby finding out the shortcomings and limitations that need to be overcome to harmonize the goal of social housing development with the sustainable development goal of the construction industry. The critical shortcomings in the management of social housing stock include the management of people allowed to buy and lease-purchase social housing, delayed project implementation progress, and reduced project quality during the operation phase, as well as increased investment costs. Specific solutions for sustainable development in terms of environment, society and economy, along with the application of 4.0 technology to manage social housing development in Bac Ninh have been researched and proposed. Although the research is typical for Bac Ninh province, the solutions are scientific, and practical and can be applied to the management of social housing development in a sustainable direction for other urban areas across the country. The research method can be expanded to investigate and survey nationwide to understand the current status of social housing development and management in Vietnam, as a basis for in-depth research to find factors that influence, promote and inhibit the development of social housing oriented to sustainable development in the coming time.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design:** Quynh To Thi Huong; **data collection:** Phuong Pham Thu; **analysis and interpretation of results:** Quynh To Thi Huong, Ngan Vu Phuong, Phuong Pham Thu; **draft manuscript preparation:** Quynh To Thi Huong, Ngan Vu Phuong, Phuong Pham Thu. All authors reviewed the results and approved the final version of the manuscript.*

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