MINISTRY OF EDUCATION AND TRAINING MINISTRY OF CONSTRUCTION
HANOI ARCHITECHTURAL UNIVERSITY

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SPATIAL ORGANIZATION OF AGRO-INDUSTRIAL PARKS IN THE NORTHWEST (THE MAIN RESEARCH AREA IS SON LA PROVINCE)

MAJOR: ARCHITECTURE

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SUMMARY OF DISSERTATION

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INTRODUCTION

1. Reasons for choosing the topic

The Northwest occupies a large land area and holds significant importance in terms of economy, politics, national defense, security, and ecological environment, with ample conditions for rapid and sustainable development; however, to date, the Northwest remains the "hollow" and "poor core" of the country.

In the region, agro-industrial production facilities (AIPFs) and production linkages have begun to take shape. These AIPFs demand entirely different spatial organization and technical infrastructure conditions compared to traditional AIPFs.

Additionally, there is a significant demand for support in production and processing of agricultural products in the region. However, most large-scale processing plants tend to be located outside of industrial parks (IPs) and industrial clusters (ICs) that have been planned, as these models have not met the requirements of businesses.

The agro-industrial park (AIP) model, which combines AIPFs and production support services within a designated area, has been established in many countries worldwide. Vietnam has also begun to develop these models with outstanding advantages over decentralized production, including resource efficiency, environmental protection, and product quality improvement, while also stimulating the formation of closed-loop agricultural value chains.

Based on these observations, researching the "Spatial Organization of Agro-Industrial Parks in the Northwest" to find solutions for developing concentrated production parks that leverage the strengths of agriculture and industry, serving as the center for regional development, is an urgent necessity for the region.

2. Research Objects and Scope

Research Objects: Spatial organization of Agro-Industrial Parks (SOAIPs) and the Architecture of Agro-Industrial Production Facilities (AIPFs).

Research Scope: Limited to types of parks (clusters, complexes) combining industrial and agricultural production. Research Area: Northwest (Son La, Dien Bien, Lai Chau provinces).

Research Timeframe: Oriented towards 2030 with a vision to 2050.

3. Purpose and Objectives of the Research

- *Research Purpose:* To develop solutions for the SOAIPs and the architecture of AIPFs in the Northwest, stimulating the development of agro-industrial production and the overall economy of the region.
- *Research Objectives:* Propose viewpoints, objectives, principles; Develop a system of characteristic features; Propose solutions for the SOAIPs and the architecture of AIPFs in the Northwest.

4. Research Methodology

Survey method to assess the current situation; Analysis and system approach method; Statistical, comparative, and comparative method; Diagram method; Inheritance method; Expert method; Forecasting method.

5. Scientific and Practical Significance of the Topic

- *Scientific Significance:* Supplements theoretical foundations on the SOAIPs and the architecture of AIPFs; Identifies characteristic features of AIPs and AIPFs in the Northwest; Develops solutions for the SOAIPs and the architecture of AIPFs in the Northwest.
- *Practical Significance:* Basis for further development and improvement of regulations, policies, and other research on AIPs,

AIPFs; serves as reference material for training activities.

6. Research Content

Synthesis and evaluation of AIP models combining industrial and agricultural production; Establishing scientific foundations for the SOAIPs in the Northwest; Proposing viewpoints on the SOAIPs and the architecture of AIPFs in the Northwest; Proposing solutions for the SOAIPs in the Northwest; Proposing architectural solutions for AIPFs in AIPs.

7. Research results and new contributions

Research results

- Developed a theoretical framework on the SOAIPs and the architecture of AIPFs.

- Clarified the Northwest-specific factors influencing the SOAIPs and the architecture of AIPFs.

Research outcomes and new contributions of the thesis

- Proposed 4 viewpoints and 3 principles on the SOAIPs and the architecture of AIPFs in the Northwest, thereby contributing to the improvement of the theoretical framework on the SOAIPs and the architecture of AIPFs.

- Identified characteristic features of various types of AIPs and AIPFs in the Northwest.

- Proposed solutions for the SOAIPs and architectural solutions for AIPFs in AIPs in the Northwest.

8. Related concepts

- *Agro-industrial park (AIP)* is a concentrated production area, including AIPFs and support services within agricultural value chains, organized within defined boundaries.

9. Thesis structure

Comprises: Introduction (9 pages); Content (138 pages: Chapter 1 - 36 pages, Chapter 2 - 35 pages, Chapter 3 - 67 pages); Conclusion and recommendations (3 pages).

CONTENT

and architecture of AIPFs.

1.3. Development process of AIPs and AIPFs in the Northwest (the main research area is Son La Province)

Types of agro-industrial production in the Northwest: IPs and ICs function in agricultural production and processing; Integrated production-processing complexes; Independent AIPFs.

In the three provinces of the Northwest, agricultural industrial production in Son La surpasses others in terms of quantity and scale of industrial production models.

The network of IPs, ICs and Integrated production-processing complexes - overlaps in functionality, with unclear specific tasks, raw materials, labor sources, and product consumption directions (Figure 1.1). The functional structure of IPs and ICs does not allow agricultural production facilities to operate; The location and scale of IPs and ICs have not been selected or calculated to be suitable for local conditions; Industrial Clusters are located close to residential areas; Land subdivision solutions exceed the land leasing capacity of most local production facilities.

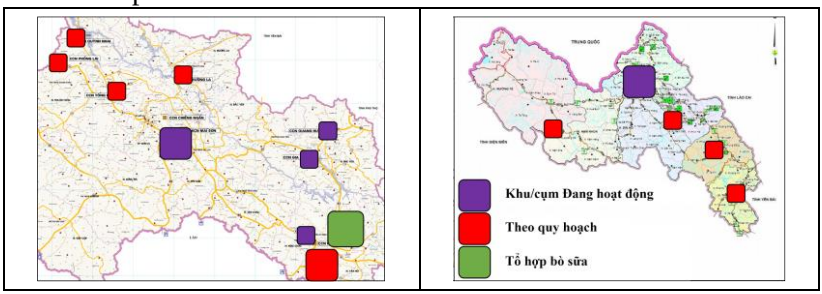

Figure 1.1 Planning of IPs and ICs to 2020 in Son La and Lai Chau provinces

- *Existence in industrial production facility (IPF) architecture*

+ The majority of IPFs are small and very small in scale, located

within residential areas.

+ The number of medium and large-scale IPFs does not meet production demands. Most of these PFs are located outside the planned IPs and ICs.

+ There is no comprehensive technical infrastructure system invested in, leading to easy discharge of hazardous waste into the environment.

- *Existence in the Agricultural production facility (APF) architecture*

Many livestock PFs are intermingled with residential areas. Spontaneously constructed PFs lack synchronized infrastructure systems; Lack of production support services (commerce, logistics, etc.);

The scale of many PFs is insufficient to independently organize necessary functions.

The distance from PFs to neighboring functional facilities does not meet technical standards.

Technical infrastructure is inadequately invested in, particularly waste treatment, causing environmental pollution.

1.4. Related Research on SOAIP

AIPs share common characteristics with IPs and can inherit research results related to SO IPs.

Regarding the architecture of IPFs, there is much attention and research results, as well as scientific publications:

Concerning the architecture of APFs, there is less emphasis, with only a few related documents currently available.

1.5. Issues to Research

Systematize natural-economic-political-social databases to

identify factors influencing SOAIPs and architecture of AIPFs in the Northwest.

Systematize theoretical foundations and lessons learned about SOAIPs, architecture of AIPFs.

Develop viewpoints and criteria to identify characteristic features of AIPs and AIPFs in the Northwest.

Propose solutions for SOAIP and architecture of AIPFs in the Northwest.

CHAPTER 2 : SCIENTIFIC BASIS OF SOAIPS IN THE NORTHWEST

2.1. Legal Basis on SOAIPs and Architecture of AIPFs in the Northwest

Development of AIPs model consistent with the orientation and policy of the State; AIPs model suitable for the strategy, planning of Northwest development; Legal system regarding industrial zones, agricultural zones is still incomplete; There is no legal document on AIPs; Lack of specialized design standards for APFs.

2.2. Theoretical Basis on SOAIPs and Architecture of AIPFs in the Northwest

The thesis inherits research results on IPs for application to AIPs: + Principles of site selection, methods of determining scale, functional structure; + Method of design master plan; + Method of organizing transportation systems; + Method of organizing landscape architecture; + Method of environmental pollution prevention;

The thesis is based on studies of architecture of IPFs-APFs, studies on agricultural value chains (Figure 2.2), and legal regulations; constructing theories on: technical infrastructure design requirements

for AIPs; types of AIPFs and their architecture.

Different characteristics of AIPs compared to IPs:

+ Crop PF (indoors) do not require high external conditions, they are flexible and easy to arrange; Livestock PF need to be organized away from sources of pollution and limit the maximum number of animals in a group to prevent disease spread.

+ Technical infrastructure system in AIPs: Irrigation system for crop production can utilize some wastewater sources, rainwater treated before use; agricultural waste is recycled at organic waste treatment areas into other useful substances.

Characteristics of the architecture of AIPFs:

+ Both IPFs and APFs share common characteristics in organizing production to create products, but they also have unique features due to different technologies, processes, and target productions.

+ Spaces within AIPFs are typically divided into the following four zones: Administrative-service zone consisting of spaces for labor activities; Production zone; Auxiliary production zone; Technical infrastructure and waste treatment zone.

2.3. Characteristic factors influencing SOAIPs and the architecture of AIPFs in the Northwest

Export agricultural supply chains in the Northwest are facing the following issues: + Spontaneous and chaotic development; + Household producers mainly sell raw materials to traders (foreign); + Combined collection and export forms have emerged, but with small, unstable scales; + On-site processing forms do not involve export activities - Still developing, and there are very few facilities;+ Most profits go to foreign countries – managing the later stages of the supply chain.

AIPs are organized as places of concentration for many components in agricultural supply chains and need to perform the following tasks: + Production, support, and linkage of agricultural and industrial production; + Promoting the development of modern AIPFs; + Creating a social welfare environment; + Minimizing waste volume; + Preventing the spread of disease; + Limiting the impact of climate change on production.

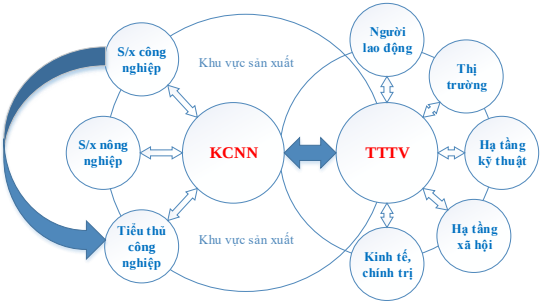

Figure 2.1 Diagram of the role of the AIPs with internal links

AIP serves as the focal point for building value chains: agriculture, industry, and cottage industry, integrating all production and service activities within the service area (Figure 2.3).

Prominent characteristics in the Northwest affecting the development of AIPs and the architecture of AIPFs: remote location from major economic centers; relatively flat production land with limited availability; climate and soil suitable for large-scale animal husbandry and high-value industrial crops, heavily impacted by climate change; economic and agricultural production: low production capacity, processing industry not meeting the region's needs; population and labor force consisting of over 20 ethnic groups, unevenly distributed, with 70% of the workforce engaged in agriculture, forestry, and aquaculture, with low labor skills; technical

infrastructure: underdeveloped transportation, relatively abundant hydropower sources; large water reserves, lacking centralized wastewater treatment facilities and solid waste disposal for the entire region.

2.4. Lessons learned from SOAIPs and the architecture of AIPFs

Regarding production organization forms, AIPs have four basic production organization forms that can be considered for application: + Dispersed AIPFs; + Clustered/Complex: AIPFs located close to each other; + Concentrated production area: AIPFs located in the same area; + Concentrated production zone: large area (>1,000 hectares).

Regarding AIPs' production objectives, they are divided into the following groups: + Production–processing of clean agricultural products; + Agricultural production support; + Dissemination of scientific and technological achievements; + Combination of the above objectives.

Regarding cyclic production organization, AIPs aim to maximize waste utilization and product flow from one AIPF as input material for another AIPF.

Regarding land scale, it is limited to a maximum of 150 hectares in the Northwest.

Regarding types of AIPFs, selection is based on the region's strengths.

Regarding the architecture of AIPFs, they are grouped according to function and logically arranged on the land to minimize environmental emissions.

CHAPTER 3 : SOAIPs IN THE NORTHWEST

3.1. Perspectives and Principles of SOAIPFs and architecture of AIPFs in the Northwest

- Perspective 1: Multi-functional centralized production park
- Perspective 2: SO for supporting Production and Processing of agricultural products
- Perspective 3: SO for model APFs
- Perspective 4: Adaptation of SOAIPs and architecture of AIPFs to the Region's characteristics
- Principle 1: SOAIPs suit with Regional Development and Sectoral Planning Strategies.
- Principle 2: SOAIPs and architecture of AIPFs maximize investment resource efficiency.
- Principle 3: SOAIPs and architecture of AIPFs protect the environment and landscape.

3.2. Basic characteristics of AIPs in the Northwest

3.2.1. Characteristics of AIPs in the Northwest

AIPs in the Northwest is a concentrated production area, including agricultural-industrial production facilities and support services within agricultural value chains; organized within a defined maximum scale area of 150 hectares; comprising:

IPFs related to agriculture, using clean production technologies with minimal emissions, falling within pollution levels 3-5.

APFs for crop cultivation, cultivating high-value specialty crops suitable for indoor cultivation, applying modern production technologies.

APFs for livestock farming, raising the region's strong livestock (buffaloes, cows, pigs, chickens) indoors, employing modern

production technologies.

3.2.2. Functional components of AIP in the Northwest

Basic functional components: Agricultural production zone; Industrial production zone and warehouse; Technical infrastructure and greenery zone; Administrative and public center.

Expanded functional components: Research-production experimental zone; Accommodation zone for experts and trainees; Exhibition zone, ecotourism..

3.2.3. AIP types in the Northwest

TT	Type	Minimum scale	Area (min)	Types of production	Labors / ha	Modul
1	APFs for crop cultivation	≥1 ha	1 ha	Flowers, vegetables, medicinal plants	5-7	1 ha; 2 ha
2	APFs for livestock	≥30 ĐVVN	0,25-0,3 ha	buffaloes, cows, pigs, chickens	7-10	0,25-0,3 ha; 0,5-1 ha
3	IPFs	≥10 labors (small) ≥50 labors (medium)	300-500 m2 1.000-2.000 m2	related to agriculture	70-90	500-1.000m2; 3.000-5.000 m2

3.2.4. Classification of AIP Models in the Northwest

- Classification of AIPs by production objectives: AIP for clean agricultural production objectives; Supportive AIP; Technology AIP - Research, Development, and Technology Dissemination; Mixed AIP - Combining the aforementioned objectives.
- Classification of AIPs by 4 development level
- Classification of AIPs by land occupation scale: + Small-scale AIP, with an area <30 hectares; + Medium-scale AIP, with an area of 30-75 hectares; + Large-scale AIP, with an area of 75-150 hectares.
- Classification of AIPs by production organization level, consisting of 4 types: AIP with independent AIPF operations; AIP

with AIPFs belonging to the same agricultural value chain; AIP with AIPFs belonging to multiple agricultural value chains; AIP with AIPFs belonging to multiple agricultural value chains - with interwoven organizational combinations in an ecological manner.

3.3. SOAIP in the Northwest

3.3.1. AIP's site and sacle selection

- Step 1: Identifying potential areas for AIP on advantageous zoning

Zone	Conditions	Role	Types of AIP
1	Urban influence zones types I and II	Pole growth	Hi-tech, Mixed AIPs
2	Urban influence zones types III, IV	Point growth	Manufactoring and Supporting AIPs
3	Urban influence zones types V (or near main roads)	Axis growth	Manufactoring and Mixed AIPs
4	Other zones		Not suitable for AIP

- Step 2: preliminary evaluation of potential AIP's areas using scoring methods based on criteria specific to each area's characteristics.
- Step 3: determining the scale and functional structure of AIP concurrently through multiple methods, then selecting the most feasible results.

TT	Types	Min area (ha)	Max area (ha)
1	Manufactoring AIP	30	120
2	Supporting AIP	20	85
3	Hi-tech AIP	40	150
4	Mixed AIP	20	150

- Step 4: detailed evaluation of AIP construction sites using a scoring method with 6 criterion groups.

3.3.2. Master plan organization of AIP

3.3.2.1 Organization of Sub-areas

- *Relationship diagram between functional zones (Figure 3.1)*

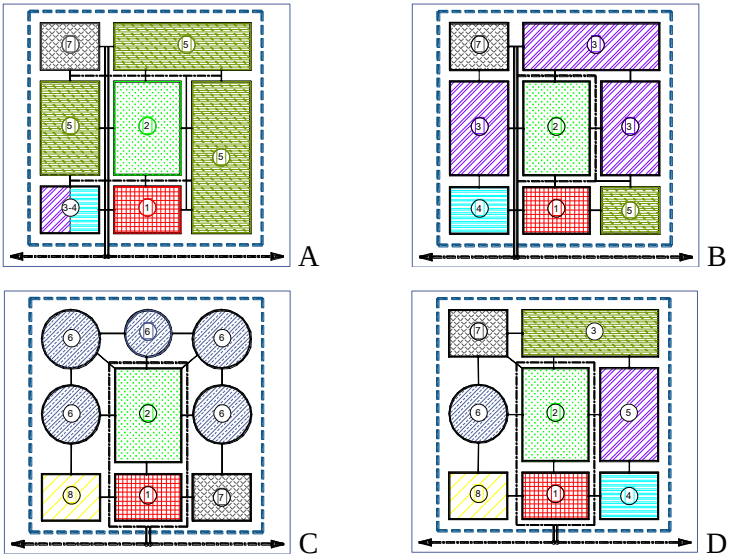

Figure 3.1 Relationship diagram between functional zones in AIPs
a, Manufacturing AIP b, Supporting AIP c, Hi-tech AIP d, Mixed AIP

1. Administrative and public center 2. Green zone 3. Industrial production zone 4. Warehouse & logistic 5. Agricultural production zone 6. Research-production experimental zone 7. Technical infrastructure zone 8. Accommodation zone for experts and trainees

- *Proportion of functional zones in AIPs*

TT	Types	Tỷ trọng	Khu trung tâm	Nông nghiệp	Công nghiệp và kho tàng	Nghiên cứu - thực nghiệm	Lưu trú chuyên gia	Đất cây xanh	Đất giao thông	Công trình hạ tầng kỹ thuật
1	Manufacturing AIP	100%	1-5%	50-60%	5-10%			10-15%	10-15%	1-5%
2	Supporting AIP	100%	1-5%	1-10%	40-50%			15-20%	15-20%	1-5%
3	Hi-tech AIP	100%	5-10%			40-45%	3-5%	20-30%	10-15%	1-5%

- Group AIPFs according to toxicity level in 5 levels and organize the location of construction groups according to terrain elevation (slope range <5%) from high to low and according to main wind direction with decreasing toxicity level.

3.3.2.2 Organization of transportation and technical infrastructure systems

Organization of Transportation System

The width of transportation roads should be a minimum of 2.75-4 meters per lane (with a maximum speed of 40-60 km/h). Land plots are divided into basic modules as follows:

+ Industrial production zone: 500-1,000 square meters; 3,000-5,000 square meters.

+ Livestock farming zone: 2,500-3,000 square meters; 5,000-10,000 square meters.

+ Crop cultivation zone: 10,000 square meters; 20,000 square meters.

+ Research-experimentation zone: 5,000 square meters; 10,000 square meters.

Administrative, healthcare, educational, and commercial facilities: 500 square meters; 1,000 square meters; 2,000 square meters; 5,000 square meters.

- *Organization of other technical infrastructure systems*

Electricity supply, water supply, communication, and drainage systems are built with pipeline networks, routes following transportation roads, and centralized facilities located at suitable positions.

Wastewater and solid waste treatment areas should be separated into two zones: one for inorganic substances that are difficult to recycle and one for organic substances that can be recycled into fertilizers, irrigation water, and biogas.

3.3.2.3 Organization of landscape architecture in AIP

The landscape in AIP is divided into two main groups: + General

landscape - for all users; + Landscape within functional land plots - for specific activities within the land plots.

Greenery serves multiple functions: Climate regulation, shading, reduction of radiation, windbreak; Pollution control: dust filtration, absorption of harmful gases; Aesthetic enhancement: Improving the aesthetic appeal of the general landscape.

Water bodies serve as natural reservoirs to provide sufficient water for production during periods of drought. Additionally, they act as transit points for regulating rainfall runoff, clean wastewater reuse, or discharge into the common drainage system of the area.

Terrain is classified into two main types: + Large-scale terrain; + Small-scale terrain.

3.4. Architecture of AIPFs in AIP

- *Functional Zoning*

The scale of AIPFs focuses on small and medium-sized models, so there is a tendency to maximize the application of multifunctional integrated solutions to save land area and reduce construction costs.

Tablet 3.1 Proportion of functional zones in AIPFs

TT	Types	Proportion of functional zones **(100%)**			
		Administrative zone	*Production zone*	*Production support zone*	*Technical infrastructure zone*
1	APFs for crop cultivation	5-10%	60-70%	10-20%	5-10%
2	APFs for livestock	3-5%	80-90%	5-10%	
3	IPFs	15-20%	60-70%		5-10%

Tablet 3.2 Land use criteria for AIPFs

TT	Types	**Building density**	**Average height**	**Green area**	**Traffic area**
		%	***floors***	***%***	***%***
1	APFs for crop cultivation	50-60%	1-2	25-30%	10-15%

TT	Types	Building density	Average height	Green area	Traffic area
		%	*floors*	*%*	*%*
2	APFs for livestock	70-80%	1	10%	10-15%
3	IPFs	50-60%	1-3	25-30%	10-15%

- *Organization of master plan for AIPF*

The organization follows integrated solutions, functional zoning, and closed spatial combinations (loop circuits, central directions) (Figure 3.2).

Infrastructure systems and waste treatment are separately organized and connected to the common network of AIP.

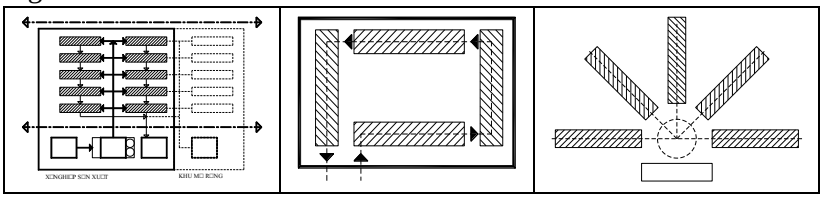

Figure 3.2 Plan of AIPFs: functional zoning and closed spatial combinations

- *Design architectural shapes*

The characteristic of AIPF's architectural shapes is the integration of structures with exposed technical equipment and surrounding landscapes. Layouts of AIPs include central focus, panoramic, and axial (line) styles (Figure 3.3).

Central focus	*Panoramic*	*Axial/Line*

Figure 3.3 Illustration of various types of layouts

Some architectural techniques include combining structures, repetitive organization, using focal points, and creating composite shapes according to the surrounding landscape.

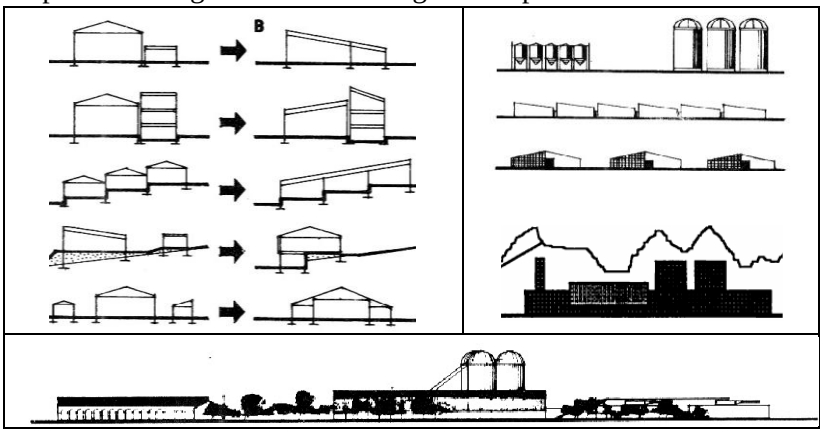

Figure 3.4 Illustration of architectural techniques

- *Architectural design for production facilities (PFs)*

Production facility layouts typically consist of basic shapes to meet technological requirements. The orientation of structures should be chosen based on natural lighting and ventilation.

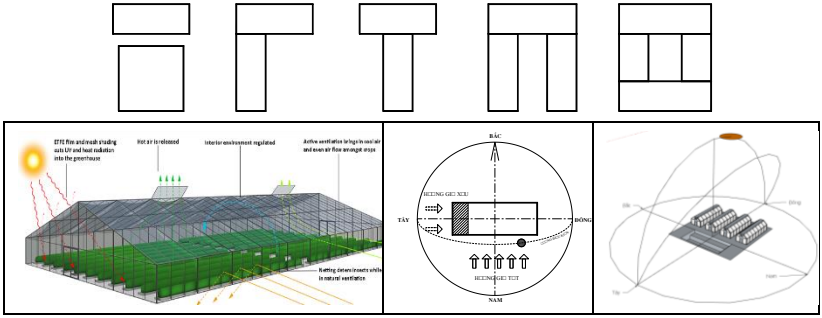

Figure 3.5 Choose the lighting direction of the project

Typical structural frameworks for livestock and industrial buildings: Steel frameworks should be used, 1-2 stories high, with lightweight, flexible enclosures that can be opened or closed as

needed. For greenhouse buildings, galvanized steel frameworks are recommended, as they are the most prevalent type currently used worldwide.

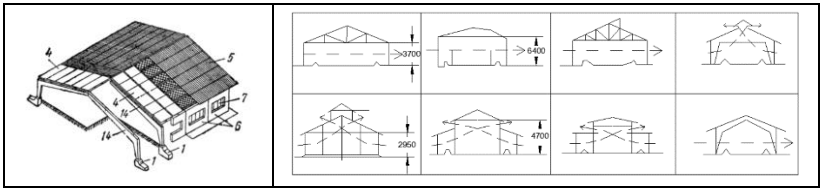

Figure 3.6 Types of structural frameworks for livestock and industrial buildings

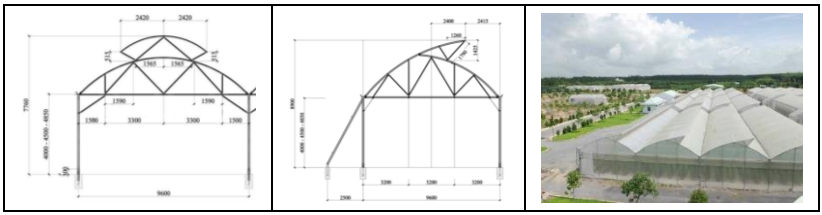

Figure 3.7 Types of structural frameworks for greenhouses

Creating aesthetically pleasing structures using techniques such as contouring, surface partitioning, focal points combined with color, and material selection.

Figure 3.8 Illustration of architectural techniques

3.5. Applying SOAIPs solutions and architectural of AIPFs in Sơn La province

- *Results of identifying potential AIPF development areas in sơn la (Figure 3.6):*

+ Potential for new AIP in Sốp Cộp town (urban type 5).

+ Potential for replacement with AIP at: Vân Hồ Industrial Park, Industry Clusters (Hoàng Văn Thụ, Tông Cọ, Mường Giàng, Lóng Luông, Sặp Vặt, Cò Nòi, Huy Tân, Tân Lang, Phiêng Ban, Mường Bon, Nà Nghịu, Mường La).

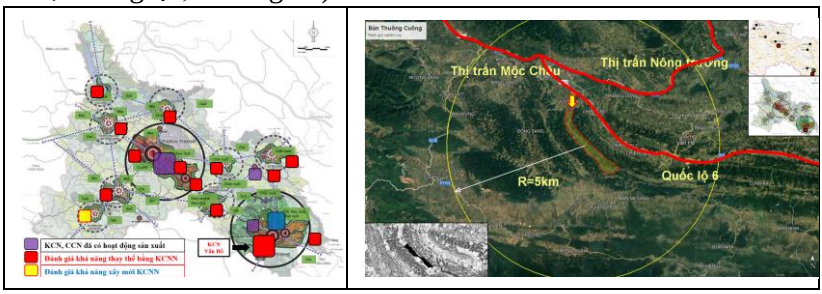

Figure 3.9 Overlay map to define the AIP development areas

- *Preliminary assessment of AIP construction areas in Thuông Cuông village. Favorable results for organizing the AIP model here.*
- *Identification of AIP production type and scale of 115 hectares in Thuông Cuông.*

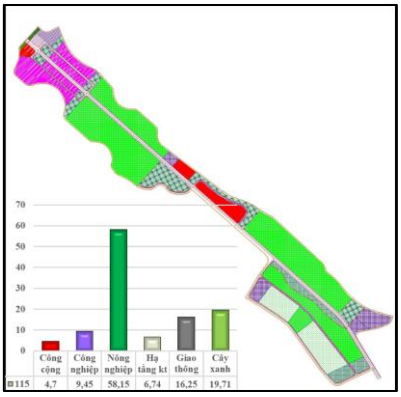

Figure 3.10 Manufacturing AIP 115 ha

- *AIP master plan, 115 hectares*

The land area is 115 hectares, with a length of 3,400 meters, widest width of 500 meters, highest elevation of 1,025 meters, and lowest elevation of 985 meters. Divided into multiple layers - strips of land - with elevation levels separated by green belts, with a slope of less than 5% for each land strip.

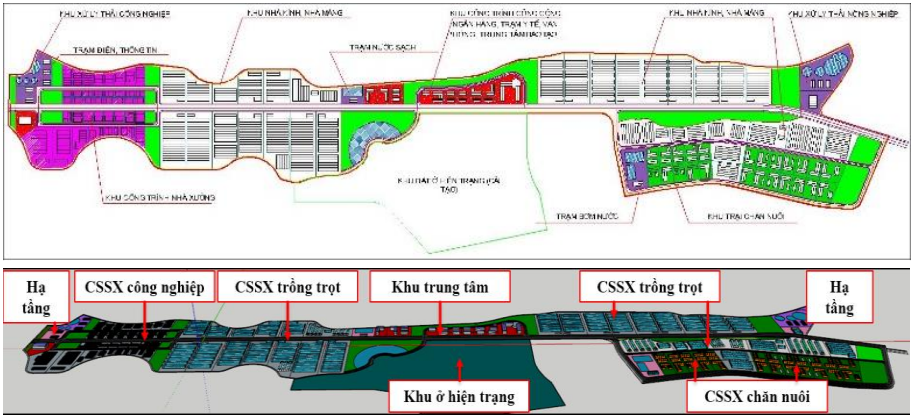

Figure 3.11 Master plan of AIP in Thuông Cuông, Sơn La

3.6. Discussion of Research Results

Discussion on the feasibility of successfully building AIP in the Northwest: The global trend and in Vietnam is towards developing production along value chains, integrating various sectors of production and services. The Northwest converges factors ensuring the successful development of the AIPF model.

Discussion on the applicability of SOAIP solutions and architectural designs of AIPFs for other areas in Vietnam: AIP is suitable for development in many localities. SOAIPs and architectural AIPFs need to be adapted to suit the conditions of different regions.

Discussion on the organization and management of AIPF: Based on the specific characteristics of each AIP, authorities choose the most

effective management and investment form.

Discussion on the limitations of the thesis and future research directions: The research results of the thesis are limited in the architectural field and lack specific experimental conditions on real projects. AIP needs to be further researched and improved.

CONCLUSION

1. The AIPs has the purpose of promoting agricultural production in the direction of industrialization and modernization, forming agricultural value chains, towards ecological circular production. AIPs have been widely applied and achieved success in many countries around the world, and have initially demonstrated their suitability for countries with an agricultural background like Vietnam.

2. The Northwest is in urgent need of building concentrated production zones as the nucleus to promote economic development of the entire region, but is facing many difficulties: The planned network of IPs and ICs cannot be implemented and is difficult to collect. attract investment; Large and medium-sized IPFs are built spontaneously, outside of planned locations; New, modern APFs do not have centralized production space, operate alone ineffectively and cause environmental pollution;

3. Research on the SOAIPs and architecture of AIPFs still has many limitations.

4. SOAIPs in the Northwest, in accordance with the policies, strategies and master plan for socio-economic development and environmental protection of the government.

5. Based on the theoretical foundation of industrial parks and industrial enterprises, applied to the design and construction of AIPs

and AIPFs in the Northwest; to adapt to the practical conditions of agricultural and industrial production, natural and social characteristics. association-economics.

6. The thesis proposes 4 perspectives and 3 principles, thereby determining the unique characteristics of the Northwest's AIPs in terms of characteristics, roles, tasks, functional components, types of AIPs and AIPFs.

7. Classify 4 types of AIPs according to different production goals, as a basis for determining the functional structure and organization of agricultural parks:

+ Manufactoring AIP: the goal of producing and processing clean agricultural products.

+ Supporting AIP: promoting the development of existing local agricultural and industrial production.

+ Hi-tech AIP: research, develop and spread new production technology.

+ Mixed AIP: specific goals are not clearly defined, a combination of the goals mentioned above.

8. Solutions for SOAIPs:

+ The solution for selecting location and scale; proceeds in 4 steps.

+ Solution for design master plan of AIPs: organizing subdivisions according to function, organizing traffic systems and technical infrastructure, organizing landscape architecture.

9. Architectural solutions for AIPFs:

+ Functional zones, master plan, architectural shape combination.

+ Main production building architecture: plan, cross-section, structural frame and cover, aesthetically shaping the building.

10. The AIP model is an inevitable development trend of

agricultural and industrial production in mountainous and rural areas. And through research in the main area in Son La, organizing the AIP model in the Northwest has proven to be completely feasible and appropriate. With the advantages of flexible functional structure, diverse scale, and many production goals suitable for different production needs; AIPs can be completely applied to many localities throughout the country with changes in input calculation data.

RECOMMENDATIONS

For state-level management agencies, it is necessary to supplement legal documents and regulations to clarify the functions and tasks of AIP; standards and criteria for planning, architecture, and construction of AIP and AIPF.

For provincial-level management agencies in the Northwest, it is essential to survey the needs of production enterprises; organize pilot implementation of AIP models; establish mechanisms, preferential policies, and incentives to invest in infrastructure and production within AIP.

For infrastructure investment enterprises and agricultural production enterprises, it is crucial to invest in applying new, green, and clean production technologies; enhance cooperation and connectivity among enterprises, local AIPF, and form value chains.

For scientists and researchers, it is important to conduct further research to supplement and improve the theoretical system for sustainable AIP development and architecture of AIPF; develop theories on housing for AIP workers and adapt sustainable AIP development and architecture to different regions.

LIST OF PUBLISHED SCIENTIFIC WORKS OF THE AUTHOR RELATED TO THE DISSERTATION

Scientific article

1. Tran Quang Huy (2023), *Agro-industrial park – Mô hình phát triển sản xuất tỉnh Sơn La,* Science Journal of Construction and Urban 90.2023 (ISSN 1859-3119)

Scientific conference

1. Tran Quang Huy (2019), *Opinions about agro-industrial park model in Vietnam,* International conference on architecture and civil engineering ICACE 2019: Education intergration & sustainable development (ISBN: 978-604-67-1456-9)