

No: /QD-BNN-TCLN

Ha Noi, (date) 2017

DECISION

Guidelines for reviewing coastal protection forest planning

MINISTER OF AGRICULTURE AND RURAL DEVELOPMENT

Pursuant to the Government's Decree No. 15/2017/ND-CP dated February 17, 2017 defining the functions, missions, authority and organizational structure of the Ministry of Agriculture and Rural Development;

Pursuant to the Government's Decree No. 119/2016/ND-CP of 2016 on a number of policies for management, protection and sustainable development of coastal forests in response to climate change for the 2016-2020 period;

Pursuant to the Prime Minister's Decision No. 17/2015/QD-TTg of June 9, 2015 promulgating the regulation on management of protection forests;

At the proposal of the Director of the Vietnam Administration of Forestry and the Director of the Department of Science, Technology and Environment,

DECIDES:

Article 1. To promulgate together with this Decision the "Guidelines on reviewing coastal protective forest planning".

Article 2. This Decision takes effect from the date of its signing.

Article 3. The Director of the Ministry 's Office, the General Director of the Vietnam Administration of Forestry, the Director of the Planning Department, the Director of the Science, Technology and Environment Department, the Director of the Forest Inventory and Planning Institute, the People's Committees of the provinces and centrally-run cities, and heads of concerned organizations and individuals shall implement this Decision

Recipients:

- As Article 3;
- Minister (for reporting);
- DARDs in provinces and cities;
- Filing: Office, Vietnam Administration of Forestry.

**ON BEHALF OF THE MINISTER
VICE MINISTER**

Hà Công Tuấn

GUIDELINES ON REVIEWING COASTAL PROTECTION FOREST PLANNING

*(Issued together with the Decision No./QD-BNN- TCLN dated 2017 of the
Minister of Agriculture and Rural Development)*

PART 1. GENERAL PROVISIONS

1. Objectives

This document guides provinces and cities to review coastal protection forest planning to better manage and improve the protection function of forests and the response to climate change in accordance with the Decree No. 119/2016/ND-CP of the Government.

2. Scope and subject of application

a. Scope: Forests and forest land that are planned as coastal protection forests. Coastal protection forests include breakwater and sea encroachment protection forests; and wind- and sand-shielding protection forests.

b. Subjects of application: Organizations, households, individuals and provinces and cities that cover coastal protection forests.

3. Principles for reviewing the coastal protection forest planning

a. The projects on reviewing the coastal protection forest planning shall be inherited and consistent with other plans and the current legal documents, with the focus on coastal protection, responding to climate change.

b. The review of coastal protection forest planning shall be in line with natural conditions, coastal characteristics, socio-economic conditions, dyke protection requirements and coastal protection demand in response to climate change of each province or city.

c. The coastal mudflats, which are favourable for mangroves, are prioritized to plan for breakwater and sea encroachment protection forests. The natural vegetation in coastal zones must be planned as protection forests.

d. In coastal areas that are currently eroded or affected seriously by mobile sand, it is required to review and evaluate coastal land planned for production forests or other uses for the conversion to coastal protection forests.

e. Projects that have current or potential impacts on the protection function of coastal forests must be reviewed, evaluated and proposed to be removed away from the area planned for highly critical coastal protection forests.

f. The reviewing process of coastal protection forest planning must include a consultation with relevant organizations and individuals, and governments at all levels to assess, analyse and identify environmental, social and economic impacts and solutions to adequately address impacts arising from the implementation of coastal protection forest planning.

PART II PLANNING CRITERIA OF COASTAL PROTECTION FORESTS

1. Planning criteria of breakwater and sea encroachment protection forests

a. The belt width of breakwater and sea encroachment protection forests shall be calculated using to the following formula (¹):

- Width of forest belts $X = -\ln(K_t)/r$ (1)

- K_t is the transmission coefficient in mangrove belts. K_t is calculated by formula (2), as follows:

$$K_t = \frac{H_{sr}}{H_o} \quad (2)$$

- In formula (2):

+ H_{sr} is the wave height behind forest belts;

+ H_o is the wave height in front of mangrove belts;

+ r is the transmission coefficient; $r = 0.004$ for coastal mangrove, and $r = 0.007$ for coastal mangroves in lagoons.

b. Based on the resilience of sea dykes, the width of forest belts planted for coastal protection shall be determined as follows (see details in Annexes 2 and 3):

In northern coastal provinces (namely Quang Ninh, Hai Phong, Thai Binh and Nam Dinh), the width of forest belts in breakwater and sea encroachment protection forests shall be at least 300 meters. Where there are no sea dykes or dykes are located further inland, forest belts must be at least 800 meters wide.

In central coastal provinces (namely Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue, Da Nang, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan), the width of forest belts in breakwater and sea encroachment protection forests shall be at least 300 meters. Where there are no sea dykes or dykes are located further inland, forest belts must be at least 500 meters wide.

In southeast coastal provinces (namely Ba Ria Vung Tau and Ho Chi Minh City), the width of forest belts in breakwater andIt sea encroachment protection forests shall be at least 300 meters. Where there are no sea dykes or dykes are located further inland, forest belts must be at least 500 meters wide.

In the eastern coast of southwest provinces (namely Long An, Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu and Ca Mau), the width of forest belts in breakwater and

¹ The determination of forest width in mangroves for protecting sea dykes and coaslines is subject to the National Standard TCVN 10405 "Irrigation Works - Breakwater Green Belt - Survey and Design".

sea encroachment protection forests shall be at least 600 meters. Where there are no sea dykes or dykes are located further inland, forest belts must be at least 1,000 meters wide.

In the western coast of southwest provinces (namely Ca Mau and Kien Giang), the width of forest belts in breakwater and sea encroachment protection forests shall be at least 500 meters. Where there are no sea dykes or dykes are located further inland, forest belts must be at least 900 meters wide.

c. In strongly eroded coastal zones, sea dykes should be built in combination with breaking-wave embankment to protect the coastline and nourish the mudflats for mangrove rehabilitation. The forest belts in breakwater and sea encroachment protection forests shall be built from dyke foot to embankment, with a width ranging from 150 to 200 meters.

d. In central coastal lagoons, where dykes are available, the width of forest belts in breakwater and sea encroachment protection forests shall be at least 100 meters. Where there is no dyke, the width of forest belts is at least 230 meters.

e. In estuaries, where dykes were built, forest tree strips for wave breaking and sea encroachment shall be at least 20 meters. In eroded estuaries without dykes, at least 5 rows of trees should be planted to protect river banks and riverine works. In accreted estuaries without dykes, protection forest belts shall be established from riverside to the upper average annual tide levels ⁽²⁾.

2. Classification of critical level for breakwater and sea encroachment protection forests

a. Breakwater and sea encroachment protection forests are classified into highly critical and critical protection forests. The critical level of breakwater and sea encroachment protection forests is determined based on the extent of erosion or accretion in coastlines, estuaries and lagoons.

b. Critical protection forests are mangrove belts in coastal zones, estuaries and lagoons prone to stable sedimentation.

c. Highly critical protection forests are mangrove belts in coastal zones, estuaries and lagoons prone to erosion or unstable sedimentation.

3. Planning criteria of wind- and sand-shielding protection forests

a. The forest belts of wind- and sand-shielding protection forests are established from highest annual tide elevation towards the mainland.

b. The width of forest belts for wind mitigation is determined as follows:

- In sandy beaches with the average slope of less than 15 degrees, the width of forest belts shall be at least 20 meters;

- In sandy beaches with the average slope between 15 to 25 degrees, or sand dunes in an area of less than 100 hectares, the width of forest belts shall be at least 30 meters.

- In sandy beaches with the average slope exceeding 25 degrees, or sand dunes covering more than 100 hectares, the width of forest belts shall be at least 40 meters.

² The level of upper average annual tide is determined by the Decision No. 487/QD-BTNMT dated 10 March 2016 issued by the Ministry of Natural Resources and Environment.

c. To enable the protection function in wind- and sand-shielding protection forests, the belts are designed perpendicular to the main wind direction. Where there are several wind directions, the forest belts are designed to be perpendicular as the chessboard. In areas heavily impacted by storms and mobile sand, the belts are designed perpendicular to the main wind direction; the distance between forest belts shall not exceed 20 times the height of wood trees. Where the slope is over 15 degrees, or sand dunes covering more than 100 hectares, the distance between forest belts shall not exceed 10 times the height of forest canopy.

d. The forest belt should have multiple layers, including vegetation, intercropping, and subsidiary trees with the main species. In particular, the main species will be selected from indigenous species, with mature trees having height, fast growth, hard and wind resistant stem, deep roots, drought tolerance and dense canopy.

4. Classification of critical level for wind- and sand-shielding protection forests

a. Coastal wind- and sand-shielding protection forests are classified into highly critical and critical protection forests. The critical level of wind- and sand-shielding protection forests is determined based on the extent of erosion or accretion in coastlines, slope and area of sandy zones.

b. Highly critical protection forests are established in eroded coastal areas or mobile dunes; areas adjacent to mobile dunes; sandy beaches with a slope exceeding 25 degrees; sandy beaches and sand dunes covering more than 100 hectares.

c. Critical protection forests are established at the back of highly critical protection forests protection belt; stable sandy beaches and fixed sand dunes with a slope less than 25 degrees; and fixed sand dunes covering less than 100 hectares.

PART III

REVIEW OF PLANNING ON THE MANAGEMENT AND PROTECTION OF COASTAL PROTECTION FORESTS

1. Preparation

a. Establish a technical team to review the planning for protection and development of coastal protection forests led by a leader in the Department of Agriculture and Rural Development. Other team members include representatives of relevant provincial departments and agencies.

b. Develop outlines, estimate costs and make plan for the review of coastal protection forest planning and submit them to competent authorities for approval.

c. Collect documents, data and maps related to the evolution of coastal protection forest resources (in the past five years and the next five years), including:

- Documents, data and maps on the planning of three coastal forest categories, results of forest survey and inventory taking; land inventory and the latest land use planning by the planning review date;

- Documents, data, maps of socio-economic development master plan, planning of fisheries, agriculture, irrigation, construction, transport, tourism, mining and other sectors related to coastal zones;

- Documents, data and maps on the current and planned sea dykes and river dykes, including sea dyke protection structures.

- Documents, data and maps on planned coastal protection corridors and integrated coastal zone management, plans on natural disaster management in response to climate change and sea level rise, and tide statistics.

- Data, maps, remote sensing images on the evolution of coastal erosion and sedimentation.

2. Mapping the planning of coastal protection forests

a. Make use of data and digital maps, edit maps on current status of coastal protection forests. Map should include all information layers on landforms; land uses and types of forest and forest land.

b. Interpret the latest satellite images, in combination with the existing maps to adjust and supplement the forest mapping as the basis for reviewing coastal protection forests.

b. Based on the criteria set out in this Guideline, it is required to overlay and process the maps; determine the boundaries and the criticality of coastal protection forests; and identify the areas planned for coastal protection forests. Apart from the layer of planned protection forests, the maps must include sufficient information on landforms; land uses and other types of forest and forest land such as special use forest and production forest.

c. Visit 10% of coastal protection forests to complete information layers on current stock of forests and land, using the criteria as forest type, land type and forest quality as the basis for proposed measures of forest protection, rehabilitation and development.

d. To survey and assess overlapping areas, overlay the information layers collected from planning maps and sectoral socio-economic development projects to identify areas that overlap the planned coastal protection forest. To survey the field and assess the overlapping areas in the planned coastal protection forests.

3. Consultation with related parties to review the planning of coastal protection forest

a. Based on selected and collected secondary data, analyse the current forests and forest land evolutions, results of forest protection and development activities, and identify the stakeholders involved in forest protection and development. In addition, discover the causes of forest deforestation and degradation, as well as the barriers to management, protection and development of coastal forests.

b. Organize province-level conferences to collectively discuss and agree on the direct and indirect causes, as well as the barriers to management, protection and development of coastal forests with the participation from concerned stakeholders.

c. Organize district-level conferences to consult with stakeholders on how to address overlapping areas in the planned coastal protection forests. Organizations, enterprises and projects located in the planned coastal protection forests must commit on protecting the existing forests, neither expanding their area, nor degrading or destroying the forests. At

the same time, they are responsible for replanting trees in overlapping areas in accordance with current regulations.³

d. Households and individuals, who are living or cultivating in the planned highly critical coastal protection forests, must be relocated following participatory plans. If they settled in critical protection forests, there should be a planning on their stable settlement in consistent with the planning of protection forests; the residents must commit to protect the existing forests, neither expand their coverage nor degrade or destroy the forests, and participate in the protection and development of coastal protection forests.

e. In the coastal land that was previously planned for production forest or other land types, currently eroded or affected by heavy mobile sand, and allocated to households and business organizations, and now planned as coastal protection forests, it is required to determine the solutions to recover, acquire or compensate for the assets invested by these households or organizations according to the legal provisions, and plan to convert the land to coastal protection forests.⁴

4. Reporting on the review of coastal protection forest planning

a. Assess the current planning of three forest types, especially coastal protection forests, with regards to boundaries, current stock and land uses; the implementation results of planning and SWOT analysis with regards to management, protection and development of protection forests in five years before the planning date.

b. Assess the current and planned socio-economic development related to coastal protection forests, with a specific attention to the current and planned development in other sectors and projects in the planned coastal protection forests, coastal construction works, residential areas, industrial parks, tourist service areas that affect the planning of coastal protection forests.

c. Assess the current stock and predict coastal accretion or erosion in the planned areas, identifying causes of coastal deposition and erosion.

d. Evaluate the resilience of sea dykes, estuarial dykes and wave-breaking embankment.

e. Make plan of coastal protection forests; classify the critical level of coastal protection forests; review and assess the current and planned forests, clarify the existing forest coverage and quality, in addition to other land areas, and reasons of conversion into planned coastal protection forests.

f. Evaluate the current livelihoods, the dependence of residents on coastal protection forests, and the current land use by various sectors and projects in the planned coastal protection forests.

g. On the basis of consultation with stakeholders and coastal communities, identify solutions to harmonize the land use needs of institutions and local communities in the planning review for protection and development of coastal protection forests. Develop solutions to enable the participation of communities and stakeholders in the protection and

³ Referred to the Circular No. 05/VBHN-BNNPTNT dated 25 April 2016 of the Ministry of Agriculture and Rural Development.

⁴ Referred to the Decree No. 119/2016/ND-CP dated August 23, 2016, on a number of policies to manage, protect and develop coastal forests responding to climate change.

development of coastal protection forests, by contracting to communities in accordance with current regulations.⁵

h. Determine actions on forest management, protection and development, limiting the forest deforestation and degradation; solutions for improved protection capacity of forest, along with other hard structural options.

e. Identify monitoring and evaluation solutions, including indicators and arrangement.

f. Taking into account the current national and sub-national regulations, estimate the investment need for projected activities, and aggregate the investment demand by sources, including (i) state budget (central and local); (ii) ODA; (iii) enterprises; (iv) communities and individuals; (v) forest environmental services; and (vi) others. Also, aggregate the investment demand in each period, subsequent 5-year and 10-year phases.

6. Deliverables of a coastal protection forest planning review

The deliverables of a coastal protection forest planning review in each province shall include:

a. A report on the review of coastal protection forest planning, using the template provided in Annex 1.

b. Maps by dates prior to the planning review, after the planning review, and orientations for the next five-year and 10-year periods. The maps are built at a scale of 1/50,000 based on the topographic map and VN2000 coordinates, presenting information layers on terrain, land uses, forest status, and boundaries by administration, forest managers, coastal protection forests; highly critical and critical forests.

c. Database of coastal protection forests.

d. Draft report and draft decision on the review of planning.

PART IV

IMPLEMENTATION ARRANGEMENT

1. Responsibilities of the Vietnam Administration of Forestry

a. To assume the prime responsibility for evaluating the plan for reviewing coastal protection forest planning upon local proposals.

b. To coordinate with the concerned ministries in monitoring and accelerating provinces and cities to implement the planning.

c. To consolidate results of the nationwide review of coastal protection forest planning.

⁵ Referred to the Decree No. 168/2016/ND-CP dated December 27, 2016 of the Government regulating the contracting of forests, orchards and water surface areas in the management boards of special-use forests, protection forests and the one-member limited liability Agriculture and Forestry Company, and coastal co-management policies and the Decree 119/2016/ND-CP dated 23 August 2016 regulating a number of policies for managing, protecting and developing coastal forests in response to climate change.

d. To study and promulgate specific policies and regulations on the organization and management of standards with regards to plantation, management, protection and use of coastal protection forests.

e. To elaborate and concretize the criteria and standards with regards to plantation, tending techniques of trees and protection forests along the coasts.

2. Responsibilities of the People's Committees in provinces and centrally-run cities

a. To direct and assign the provincial/municipal Department of Agriculture and Rural Development to assume the prime responsibility together with the concerned departments, the district People's Committees and forest owners in working out plans for reviewing the planning of coastal protection forests, and stabilizing the planning of coastal protection forests after adjustment.

b. To approve the plan for reviewing the planning of coastal protection forests after obtaining appraisal opinions from the Ministry of Agriculture and Rural Development.

c. To develop a mechanism for strengthening the public participation and supervision on the protection and care of coastal protection forests.

d. To train human resources with scientific knowledge and experience in planning and development of forest and trees for coastal protection.

3. Responsibilities of Departments of Agriculture and Rural Development

- To assume the prime responsibility for reviewing and planning of coastal protection forests under supervision of the provincial People's Committees.

- To direct the attached functional agencies, in accordance with their assigned functions and tasks, to review and plan coastal protection forests.

- To elaborate and promulgate documents guiding the plan implementation in accordance with their competence or submit plans to the competent authorities for approval.

- To develop annual and periodic plans.

- To coordinate with the Department of Natural Resources and Environment and relevant departments and agencies in reviewing and finalizing coastal protection forest planning in line with the land use planning in coastal zones.

- To supervise, monitor and evaluate the plan implementation; and enable organizations, enterprises, households, individuals and communities to participate in monitoring and evaluating the plan implementation in local coastal protection forests.

- To carry out the information, education and communication (IEC) activities.

4. Responsibilities of district-level People's Committees

- To coordinate with the Department of Agriculture and Rural Development in reviewing and planning local coastal protection forests.

- To plan the coastal protection forests after adjustments for conversion are made.

- To monitor the evolution of coastal protection forest resources and the progress of coastal forest planning.

- To allocate and lease forests, acquire forests and change forest use purposes to forest owners, who are households, individuals and communities, and compile profiles for coastal protection forest management.

- To protect forests, disseminate laws and regulations, inspect law observance and handle violations on forest protection and development.

- To direct commune-level People's Committees, forest owners and involved parties in reviewing and planning protection forests in their localities, and implementing the planning as well as the management and development of coastal protection forests.

ON BEHALF OF THE MINISTER

ANNEXES
**CRITERIA AND GUIDANCE FOR REVIEWING FOREST COASTAL FOREST
PLANNING**

*(Attached to the Decision No. .../QD-BNN-TCLN dated ... /.../2017 of the Minister of
Agriculture and Rural Development)*

Annex 1. Review report template of the planning for protection and development of coastal protection forests in the province in the period, with a vision to

Introduction: Overview of the context and the rationale to review the planning of coastal protection forests

Part I. Stocktaking of the protection and development in coastal protection forests

1. Overview of the natural, social and economic characteristics in the coastal areas of the province
2. Protection and development of coastal forests (in the last five years)
 - 2.1. Current land use in the areas planned for coastal protection forest
 - Current land uses
 - Current forest uses (including protection, special use and production forests)
 - Current coastal forests
 - Current non-forest forestry land
 - 2.2. Results, opportunities and challenges

Presentation of planning results; forest management organization; results of protection, zoning for regeneration, afforestation; and enforcement of law and policies in forest protection and development.
 - 2.2. Causes of deforestation, forest degradation and barriers to management, protection and development of coastal protection forests.
 - 2.3. Methods of planning and classification of coastal protection forests.
 - 2.4. Solutions to adjust the planning for protection and development of coastal protection forests.

Part II. Coastal protection forest planning

1. Objectives
 - 1.1. General objectives
 - 1.2. Specific objectives
 - 1.3. Specific objectives by phases
2. Results of reviewing and adjusting the coastal protection forest planning
 - 2.1. Planning the scope, boundaries and classification of coastal protection forests

Determination of boundaries in coastal protection forests, specifying the area by land categories and forest types, which are subject to be added or removed from protection forest planning.

2.2. Actions on protection and development of coastal protection forests

They are forest protection, restoration, zoning for regeneration, planting, tending; dispersal tree planting; construction of silvicultural works, including those to create mudflats for regeneration and protection of mangroves.

4. Solutions for protection and development of coastal protection forests

4.1. Limiting the loss of coastal protection forests

Implementation of planning; monitoring the conversion of forested land; forest allocation and contracting; livelihood improvement; improving farming practices; establishment of a small-scale community credit fund; and strengthening the law enforcement.

4.2. Limiting the degradation of coastal protection forests

Restrict and prevent the illegal use of natural forest timber; public communication and awareness raising; developing linkages with the private sector, seeking markets for non-timber forest products; supporting the development of regulations, conventions and commitments to law enforcement and forest protection; implementing job creating programs for households that are engaging in livelihood activities in the planned area for protection forest; and improving forest governance capacity of forest owners.

4.3. Improving forest protection capacity

Research and application of high technology in the production of seedlings, which are tolerant to diseases and adverse climate changes; enriching natural forests, diversifying the structure of coastal protection forests; combining biodiversity conservation in protection forest with exploiting the value of forest environmental services; developing non-timber forest products and ecotourism; improving the reforestation in previously devastated forests and mining land; and rehabilitation of degraded mangroves.

5. Solutions for implementation of coastal protection forest planning

Policies; organizational arrangement; management; socio-economic development; fund raising; and others.

6. Aggregate financial demand

6.1. Aggregate financial demand categorized each activity, each component and all expected activities;

6.2. Aggregate financial demand categorized by sources, including (i) State budget (central and local budget); (ii) ODA; (iii) enterprises; (iv) communities and individuals; (v) forest environmental services; and (vi) others.

6.3. Aggregate financial demand categorized by stages of planning implementation

Part III. Implementation arrangement

1. Planning disclosure

2. Planning implementation

3. Planning monitoring and evaluation

Conclusions and recommendations.

Annexes and maps.

Annex 2. Methods for determining the width of forest belt in mangroves for protecting sea dykes and coastlines

1. Determination of the forest belt width by grade of dykes

Using the formulas (1) and (2) described in Item a, Clause 1, Part II, the determination of the minimum width of dyke protection belts subject to dyke grades shall be carried out in the following steps:

- (1) Identify dyke grade and elevation, and wave height behind forest belts (H_d), by using the design documentation of dykes at the local irrigation sub-department;
- (2) Identify water level according to the designed frequency curve and grade of wind and storm of each area to calculate the wave height in front of mangrove belt (H_0);
- (3) Determine the transmission coefficient K_t by using the formula (2) and calculate $\ln(K_t)$. It is possible to determine the minimum forest belt width to protect the corresponding dyke level by using the parameter $r = 0.004$.

The value of variables as dyke levels and elevation, and wave height behind forest belts in some localities can be found in Annex 3 attached to this Decision.

2. Determination of the forest belt width in strongly eroded zones

The mangrove forest belts to protect dykes and embankments in strongly eroded zones ranges from the sea dyke foot to the wave-breaking and accretion-creating embankment. The forest belt is between 150 and 200 meters, from the dyke foot to the embankment.

3. Determination of the forest belt width in places without sea dykes, or dykes located further inland

+ The wave height in front of mangrove belt (H_0) is determined based on the water level calculated by 10% frequency curve and the grade of wind and storm of each area.

+ The coast where there is no dyke is only resilient to wave height of 0.1 meters. Therefore, the default wave height is 0.1 meters (or $H_d = 0.1$ meters).

+ It is possible to determine the forest belt width according to formulas (1) and (2) in some cases as follows:

Example 1: In the eastern coast of Ca Mau province, the wave height in front of mangrove belt (H_0), based on the water level calculated by 10% frequency curve and the storm grade of 10, is $H_0 = 2.86\text{m}$.

Replacing the values of H_0 , H_d and r into formula (1), the minimum belt width of mangrove is $X = -\ln(0.1/2.86)/0.004 = 838$ meters.

Example 2: In the western coast of Ca Mau province, the wave height in front of mangrove belt (H_0), based on the water level calculated by 10% frequency curve and the storm grade of 10, is $H_0 = 2.4$ meters. Then, the minimum belt width of mangrove is $X = -\ln(0.1/2.4)/0.004 = 794$ meters.

4. Determination of the minimum mangrove belt width for lagoon protection

The highest wave near lagoons in the central region is 0.5 meters, therefore, $H_0 = 0.5$ meters.

If the dykes along lagoons is resilient to wave, which is up to 0.25 meters, the minimum belt width of the dyke protection forest is $X = -\ln(0.25/0.5)/0.007 = 100$ meters.

If there are no dykes in lagoons and the lagoon coast is only resilient to wave, which is up to 0.1 meters, the minimum belt width of the dyke protection forest is $X = -\ln(0.1/0.5)/0.007 = 230$ meters.

5. Determination of the forest belt width in estuaries

The minimum width of mangrove belt to protect dykes in coastal estuaries is the width of dyke protection corridor, which is at least 20 meters (Article 23 - Dyke Law No. 79/2006/QH11).

6. Determination of the forest belt width in estuaries and coastal zones without dykes

- In estuaries and mudflats without dykes, it is required to establish a protective belt with the width ranging from the riverbank to the upper average tide level recorded in multiple years. The upper average tide level in multiple years is recorded, taking into account the typical points of water level in the coastal zone and the technical guidelines for determination of the upper average tide level and the lower average tide level in multiple years (Decision No. 487/QD-BTNMT dated March 10, 2016 of MONRE).

- In eroded estuaries without dykes, at least three rows of trees must be planted to protect river banks and riverine works.

Annex 3. Minimum mangrove belt width (X) based on the resilience of dyke and shoreline at different storm grades in selected coastal areas of Vietnam, $r = 0.004$

Grade of entering wind	Area		Storm grade	Current dyke grade	H _o	H _a	X
					(m)	(m)	(m)
Level 12	Quảng Ninh	Quảng Yên Town	10	III	4.05	1.96	181
			9	IV	4.05	1.66	223
		Móng Cái City	9	V	3.69	1.47	230
			9	IV	4.06	1.78	206
		Tiên Yên District	9	V	3.70	1.48	229
			9	IV	4.07	1.79	206
			9	V	3.70	1.48	229
		Đầm Hà District	9	V	3.71	1.49	228
		Hải Hà District	9	IV	4.00	1.73	209
			9	V	3.66	1.45	232
		Hoành Bồ District	9	IV	3.91	1.66	214
			9	V	3.54	1.34	243
	Vân Đồn District	9	V	3.59	1.39	238	
	Hạ Long City	9	V	3.54	1.34	242	
	Hải Phòng	Sea dyke I	10	III	4.03	1.95	182
			10	IV	3.90	1.82	190
		Sea dyke II	10	II	4.30	2.18	170
			10	III	4.03	1.95	182
		Sea dyke III	10	III	4.03	1.95	182
			10	IV	3.90	1.82	190
			10	IV	3.97	1.89	186
		Hải Phòng City	10	IV	3.99	1.91	184
			10	III	4.11	2.02	178
			10	IV	3.97	1.89	186
	Thái Bình	Sea dyke 5	10	III	3.93	1.86	187
		Sea dyke 6	10	III	3.93	1.86	187
		Sea dyke 7	10	III	4.02	1.93	183
		Sea dyke 8	10	III	4.02	1.93	183
			10	IV	3.88	1.80	192
	Nam Định	Giao Thủy	10	III	3.78	1.72	197
		Hải Hậu	10	III	3.94	1.86	188
		Nghĩa Hưng	10	III	3.98	1.90	185
	Ninh Bình	Dyke Bình Minh II	10	III	4.06	1.97	181
		Dyke Bình Minh III, IV	9	V	4.06	1.78	206
	Thanh Hóa	Nga Sơn	10	IV	3.89	1.82	190
		Hậu Lộc	10	III	4.06	1.97	181
		Hoàng Hóa	10	IV	3.91	1.83	190
		Sầm Sơn	10	IV	3.91	1.83	190

Grade of entering wind	Area	Storm grade	Current dyke grade	H _o	H _d	X
				(m)	(m)	(m)
	Quảng Xương	10	IV	3.90	1.82	190
	Tĩnh Gia	10	IV	3.83	1.76	195
Nghệ An	Hoàng Mai	10	V	3.42	1.37	229
	Quỳnh Lưu	10	V	3.42	1.37	229
	Diễn Châu	10	V	3.46	1.41	225
	Nghị Xuân	10	IV	3.72	1.66	202
10		V	3.34	1.30	236	
Hà Tĩnh	Lộc Hà	10	IV	3.63	1.57	209
	Thạch Hà	10	IV	3.63	1.57	209
10		V	3.26	1.22	246	
	Đông Môn	10	IV	3.63	1.57	209
	Cẩm Xuyên	10	V	3.20	1.15	256
	Kỳ Anh	10	V	3.03	0.99	280
	River Gianh	9	IV	3.35	1.18	261
V			3.03	0.89	306	
Quảng Bình	River Nhật Lệ	9	IV	3.27	1.11	270
			V	2.98	0.84	317
	River Lệ Kỳ	9	IV	3.35	1.18	261
	River Ly Hòa	9	V	3.03	0.89	306
Quảng Trị	Vĩnh Thái	9	IV	3.14	0.99	288
	Gio Linh			3.11	0.96	294
	Triệu An	9	IV	3.11	0.96	294
	Triệu Lăng			3.11	0.96	294
Huế	Điền Lộc	9	V	2.29	0.70	296
	Hải Dương			2.27	0.68	301
	Phú Diên	9	V	2.24	0.66	305
	Vinh Hải			2.22	0.64	311
Đà Nẵng	Lăng Cô	9	V	2.20	0.62	316
	Liên Chiểu			10	V	2.21
Sơn Trà	9	V	2.21	0.63	313	
	Hội An	10	V	1.73	0.71	223
Quảng Nam	Others	9	V	2.19	0.61	320
		10	V	2.26	0.75	276
9		2.26		0.68	301	
Quảng Ngãi		10	IV	2.33	0.82	261
		9		2.33	0.75	284
Bình Định		10	V	2.33	0.79	270
		9		2.33	0.71	297
		10	IV	2.34	0.83	259
		9		2.34	0.75	285
Phú Yên		10	V	2.33	0.79	270
		9		2.33	0.71	297

Grade of entering wind	Area		Storm grade	Current dyke grade	H _o	H _d	X	
					(m)	(m)	(m)	
Level 10			10	IV	2.35	0.84	257	
			9		2.35	0.76	282	
	Khánh Hòa			10	V	2.29	0.76	276
				9		2.29	0.69	300
				10	IV	2.32	0.81	263
				9		2.32	0.73	289
	Ninh Thuận			10	V	2.28	0.76	275
				9		2.28	0.69	299
				10	IV	2.30	0.79	268
				9		2.30	0.72	291
	Bình Thuận			10	V	2.35	0.84	257
				9		2.35	0.76	282
				10	IV	2.56	1.05	223
				9		2.56	0.94	250
	Vũng Tàu			10	V	2.70	0.92	269
				9		2.70	0.84	292
				10	IV	2.89	1.11	239
				9		2.89	1.00	265
	Cần Giờ			10	V	3.24	1.20	249
				9		3.24	1.08	275
				10	IV	3.47	1.42	223
				9		3.47	1.28	249
	Level 10	Tiền Giang		6	V	2.77	0.72	337
				5		2.77	0.60	383
3				polder	2.77	0.30	556	
6				IV	3.01	0.90	302	
5					3.01	0.74	351	
3				polder	3.01	0.34	546	
Bến Tre				6	V	2.75	0.69	346
				5		2.75	0.57	393
			3	polder	2.75	0.29	562	
			6	IV	2.98	0.87	308	
			5		2.98	0.72	355	
			3	polder	2.98	0.33	550	
Trà Vinh				6	V	2.74	0.68	348
				5		2.74	0.56	397
			3	polder	2.74	0.29	561	
			6	IV	2.94	0.85	310	
			5		2.94	0.70	359	
			3	polder	2.94	0.33	547	
				6	V	2.80	0.71	343

Grade of entering wind	Area		Storm grade	Current dyke grade	H _o	H _d	X
					(m)	(m)	(m)
	Sóc Trăng		5		2.80	0.59	389
			3		polder	2.80	0.30
	Bạc Liêu		6	V	2.85	0.74	337
			5		2.85	0.61	385
			3	polder	2.85	0.31	554
	Cà Mau	Eastern sea	6	V	2.86	0.61	386
			5		2.86	0.51	431
			3	polder	2.86	0.32	548
			2		2.86	0.07	928
		Western sea	6	V	2.40	0.36	475
			5		2.40	0.30	520
			3	polder	2.40	0.21	609
			2		2.40	0.07	884
	Kiên Giang		6	V	2.39	0.39	453
			5		2.39	0.32	503
			3	polder	2.39	0.20	620
2			2.39		0.07	883	