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MARE Research Framework

Explaining the cross-cutting research themes

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The coordinating lead author:

Dr. Anton Shkaruba, Estonian University of Life Sciences, Estonia

Authors:

Prof. Kalev Sepp, Estonian University of Life Sciences, Estonia

Dr. Igor Novopashenny, University of Bremen, Germany

Dr. Daniela La Rosa, University of Catania, Italy

Dr. Vincenzo Maccarrone, CNR IRBIM of Mazara del Vallo

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Introduction

The advancement of knowledge and expertise in maritime engineering, oceanography, marine ecology, and environmental sciences is pivotal for the sustainable development of coastal regions in Malaysia and Vietnam. Doctoral students in these fields play a critical role in addressing the multidimensional challenges faced by marine ecosystems. To guide these scholars effectively, a robust research framework is indispensable, facilitating the identification of multidisciplinary and policy-relevant topics.

Understanding the European Union's extensive experience in research, policy, and management is of paramount importance for these doctoral students. The EU has been at the forefront of innovative approaches to address marine and coastal sustainability challenges. Therefore, integrating EU insights into the education and research of students in Malaysia and Vietnam provides a valuable global perspective.

The EU Erasmus+ project MARE emerges as a transformative initiative in this context. By offering a comprehensive research framework, MARE empowers doctoral students to navigate and contribute meaningfully to the evolving landscape of marine and environmental sciences. Through collaborative efforts with European partners, MARE facilitates the exchange of knowledge, best practices, and research methodologies. This project serves as a bridge connecting the rich experiences of the EU with the academic and scientific aspirations of doctoral students in Malaysia and Vietnam, fostering a holistic and globally informed approach to marine and coastal sustainability.

This report has been developed under the EU Erasmus+ MARE project (WP2.2) and its purpose is to provide research trainees at MARE partner universities in Malaysia and Vietnam with concise guidance on the context of MARE cross-cutting themes, as well as policy relevant research questions that may be explored within the themes.



MARE crosscutting themes: relevance and research directions

Theme 1: Coastal science and management

Malaysia

Coastal science and management are highly relevant to Malaysia due to the country's extensive coastline, rich marine biodiversity, and the significant role that coastal areas play in its socio-economic development. Several key aspects highlight the relevance of coastal science and management for Malaysia:

1. **Biodiversity and Land-Sea Interactions:** Malaysia's coastal zones are ecologically diverse and serve as critical habitats for various species. Research in coastal science can focus on understanding and conserving biodiversity, considering the intricate interactions between land and sea. This includes studying the impacts of human activities, climate change, and land-use practices on coastal ecosystems.
2. **Adaptive Co-management and Adaptation Plans:** Given the vulnerability of coastal areas to climate change and natural disasters, research can delve into adaptive co-management strategies. This involves collaborative efforts among stakeholders to sustainably manage coastal resources. Exploring policy and technological innovations that support adaptation plans is crucial for enhancing resilience against sea-level rise, extreme weather events, and other climate-related challenges.
3. **Tourism and Urbanization:** Malaysia's coastal regions often experience rapid urbanization and tourism development. Research can investigate the environmental impacts of these processes, including habitat loss, pollution, and disruption of local ecosystems. Additionally, understanding the socio-economic implications, such as the benefits and challenges of tourism, is vital for sustainable coastal development.
4. **Integrative Solutions:** Coastal management requires integrated solutions that consider the complex interactions between environmental, social, and economic factors. Research topics can explore holistic approaches to address challenges like balancing conservation and development goals, promoting sustainable resource use, and fostering community engagement in decision-making processes.

Policy Relevant Research Topics:

1. **Integrated Coastal Zone Management (ICZM):** Assessing the effectiveness of ICZM strategies in mitigating the impacts of climate change and promoting sustainable development.
2. **Community-Based Conservation:** Investigating the role of local communities in coastal conservation efforts and the development of community-based management plans.
3. **Tourism Sustainability:** Analyzing the ecological and socio-economic impacts of tourism in coastal areas and proposing policies for sustainable tourism practices.
4. **Urban Planning for Coastal Resilience:** Examining urbanization trends along the coastlines and proposing policies for resilient urban planning to mitigate environmental risks.

5. **Technological Innovation for Adaptation:** Researching the feasibility and effectiveness of innovative technologies, such as sea barriers and ecosystem restoration, in supporting adaptation plans for coastal areas.
6. **Policy Instruments for Sustainable Fisheries:** Evaluating existing policies and proposing new instruments to promote sustainable fisheries practices and protect marine biodiversity.

By addressing these research topics, Malaysia can enhance its coastal science and management practices, contributing to the sustainable development and resilience of its coastal regions.

Vietnam

The relevance of coastal science and management for Vietnam is substantial, given its extensive coastline and the economic, ecological, and social significance of coastal areas. Here are several key aspects and potential policy-relevant research topics:

1. **Land-Sea Interactions:**
 - Investigating the dynamics of land-sea interactions, including sediment transport, nutrient cycling, and their impacts on coastal ecosystems.
 - Assessing the influence of upstream land use on coastal processes, particularly in the context of river deltas and their vulnerability to changes in land management practices.
2. **Adaptive Co-Management and Policy Innovation:**
 - Evaluating the effectiveness of adaptive co-management strategies in enhancing resilience to climate change and mitigating the impacts of natural disasters on coastal communities.
 - Exploring innovative policy frameworks and technological solutions that support adaptation plans, with a focus on sustainable resource management and community engagement.
3. **Tourism and Urbanization:**
 - Examining the environmental and socio-economic impacts of coastal tourism and urbanization, including issues related to infrastructure development, waste management, and changes in land use.
 - Developing strategies for sustainable coastal tourism that balance economic development with environmental conservation and community well-being.
4. **Integrated Solutions:**
 - Proposing integrative solutions for addressing the challenges posed by rapid urbanization and tourism development, such as green infrastructure planning, smart city initiatives, and community-based conservation approaches.
 - Assessing the potential of nature-based solutions in coastal areas, considering their role in climate change adaptation, biodiversity conservation, and community resilience.
5. **Community Engagement and Social Equity:**

- Investigating the role of community-based approaches in coastal governance, ensuring that policies are inclusive, participatory, and considerate of local knowledge and perspectives.
 - Assessing the social equity implications of coastal policies, particularly in vulnerable communities, and proposing measures to address disparities in resource access and decision-making.
6. **Blue Economy and Sustainable Fisheries:**
- Exploring opportunities for a sustainable blue economy, emphasizing the responsible use of marine resources and the development of eco-friendly industries.
 - Investigating policies and technologies that promote sustainable fisheries practices, reduce overfishing, and enhance the livelihoods of coastal communities.

These research topics align with the broader goal of ensuring the sustainable development of Vietnam's coastal areas, taking into account environmental conservation, community well-being, and long-term resilience in the face of ongoing global changes.

Theme 2: Delta science and management

Vietnam

The relevance of delta science and management, with a specific focus on the Mekong and Red River deltas in Vietnam, is of utmost importance due to the unique challenges and opportunities presented by these regions. The Mekong Delta, in particular, holds significant global importance for several reasons.

1. **Biodiversity and Ecosystem Services:** The Mekong Delta is a biodiversity hotspot, supporting a wide array of flora and fauna. Its diverse ecosystems provide essential ecosystem services such as water purification, flood regulation, and habitat for numerous species. Understanding and managing these services are crucial for maintaining ecological balance and sustaining the livelihoods of local communities.
2. **Food Security:** The Mekong Delta is often referred to as the "Rice Bowl" of Asia, as it plays a critical role in global food production. Sustainable agriculture and aquaculture practices are vital for ensuring food security not only for Vietnam but also for the international community. Research in this area can address challenges related to climate change, land use, and water management.
3. **Urbanization and Regional Planning:** With increasing urbanization, there is a need for sustainable regional and urban planning in the Mekong Delta. This includes considerations of infrastructure development, housing, and industrial growth while maintaining ecological balance. Effective planning can contribute to resilient and livable urban areas, ensuring the well-being of the growing population.
4. **Pollution Prevention and Control:** As economic activities intensify, pollution prevention and control become critical. Research in this area can focus on sustainable practices, waste management, and pollution control measures to safeguard the delta's ecosystems and water resources.

5. **Climate Change Resilience:** The Mekong Delta is highly vulnerable to the impacts of climate change, including sea-level rise and extreme weather events. Policy-relevant research can explore adaptive strategies, early warning systems, and climate-resilient infrastructure to mitigate the risks associated with climate change.

Policy-relevant research topics could include:

- **Integrated Water Management:** Develop policies that integrate water management strategies, considering both agricultural and urban needs while preserving ecosystem functions.
- **Ecosystem-Based Adaptation:** Explore policies that promote ecosystem-based adaptation approaches to enhance climate resilience and biodiversity conservation.
- **Land-Use Planning:** Formulate policies for sustainable land-use planning that balance agricultural expansion with environmental conservation.
- **Community Engagement:** Design policies that encourage community participation and awareness in sustainable practices, fostering a sense of environmental stewardship.
- **Green Infrastructure:** Advocate for policies that incorporate nature-based solutions and green infrastructure to address urbanization challenges sustainably.

By addressing these issues through comprehensive policy research and management strategies, Vietnam can contribute not only to the well-being of its citizens but also to global efforts toward sustainable development and climate resilience.

Theme 3: Area-based management

Malaysia

Area-based management is highly relevant for Malaysia, given its extensive coastline and rich marine biodiversity. The focus on policy and management instruments, such as marine protected areas, pollution control zones, and fisheries closures, aligns with the imperative of sustainable governance of marine resources. Malaysia faces challenges such as overfishing, habitat degradation, and pollution, necessitating effective strategies to balance economic development with environmental conservation.

Policy-Relevant Research Topics:

1. **Marine Protected Areas (MPAs):**
 - Assessing the effectiveness of existing MPAs in preserving biodiversity and supporting fisheries.
 - Designing and implementing new MPAs based on ecological and socioeconomic considerations.
 - Analyzing the socioeconomic impacts of MPAs on local communities and fisheries.
2. **Pollution Control Zones:**
 - Investigating the sources and impacts of marine pollution in designated zones.
 - Evaluating the efficiency of pollution control measures and their compliance.



- Proposing innovative technologies for reducing marine pollution.
- 3. **Fisheries Closures:**
 - Assessing the ecological and economic outcomes of fisheries closures.
 - Studying the effectiveness of alternative livelihood programs for affected communities.
 - Exploring adaptive management approaches for sustainable fisheries.
- 4. **Institutional Frameworks:**
 - Analyzing the effectiveness of existing institutional frameworks for marine resource governance.
 - Recommending improvements to enhance coordination and enforcement.
 - Investigating the role of community participation in marine resource management.
- 5. **Marine Spatial Management Tools:**
 - Developing and implementing tools for integrated marine spatial planning.
 - Assessing the impacts of climate change on marine spatial management.
 - Exploring the potential of technology, such as Geographic Information System (GIS), for spatial decision-making.

Relevance of EU Experience: The EU has valuable experience in developing and implementing area-based management strategies. Collaborative research can draw upon EU expertise to:

- Understand the design and effectiveness of the Natura 2000 network for biodiversity conservation.
- Learn from the EU's Blue Growth Strategy, integrating economic activities with marine conservation.
- Explore the European Maritime and Fisheries Fund (EMFF) as a financial mechanism for sustainable fisheries management.
- Evaluate the EU's Marine Strategy Framework Directive for holistic marine ecosystem management.

By incorporating lessons from EU practices, Malaysia can enhance its capacity for sustainable marine governance and strengthen its policies for the benefit of both ecosystems and communities.

Vietnam

Area-based management is highly relevant for Vietnam, given its extensive coastline and dependence on marine resources. The concept emphasizes the implementation of policy and management instruments to sustainably govern marine resources and mitigate potential conflicts. The application of marine protected areas, pollution control zones, fisheries closures, and other institutional frameworks aligns with Vietnam's need for effective tools to manage its diverse marine ecosystems.

Relevance to Vietnam:

1. **Biodiversity Conservation:** Area-based management, especially through marine protected areas, contributes to biodiversity conservation. Given Vietnam's rich marine biodiversity, preserving key habitats ensures the sustainability of marine ecosystems and the protection of endangered species.
2. **Fisheries Management:** Fisheries closures and spatial management tools are crucial for sustaining fish stocks. Vietnam's reliance on fisheries as a primary source of livelihood necessitates effective management strategies to prevent overexploitation and ensure long-term resource availability.
3. **Pollution Control:** Controlling pollution through designated zones is essential for safeguarding marine environments. Vietnam, facing challenges related to industrial and coastal pollution, can benefit from tailored policies and spatial management approaches to address pollution concerns.
4. **Conflict Prevention:** By clearly defining marine zones and resource management rules, area-based management helps prevent conflicts among various users, such as fishermen, industries, and conservationists. This is particularly relevant for Vietnam's coastal areas with diverse stakeholder interests.

Policy-Relevant Research Topics for Vietnam:

1. **Evaluating the Effectiveness of Existing Marine Protected Areas:** Assess the ecological and socioeconomic impacts of current marine protected areas to enhance their effectiveness in biodiversity conservation and fisheries management.
2. **Optimizing Fisheries Closures:** Investigate the ecological and economic outcomes of fisheries closures, considering different closure durations and their implications for local communities and the fishing industry.
3. **Spatial Planning for Sustainable Aquaculture:** Explore spatial management strategies for aquaculture to minimize environmental impacts and conflicts with other marine uses.
4. **Institutional Frameworks for Integrated Coastal Management:** Examine the institutional structures and governance frameworks for integrated coastal management, drawing on EU experiences with successful coastal zone management models.
5. **Community Engagement in Area-Based Management:** Investigate the role of local communities in the planning and management of area-based approaches, learning from EU practices that emphasize community participation.
6. **Climate Change Adaptation in Marine Spatial Planning:** Research on integrating climate change considerations into marine spatial planning to enhance the resilience of coastal communities and ecosystems.

Drawing on EU Experience: Vietnamese researchers could benefit from studying the EU's successful implementation of area-based management strategies. Examining case studies from EU countries with similar coastal challenges could offer insights into effective governance structures, stakeholder engagement, and adaptive management practices. Additionally, understanding how the EU navigates the complexities of managing transboundary marine areas could provide valuable lessons for Vietnam in addressing shared marine resources and collaborative governance.

Theme 4: Area-based management

Malaysia

In the context of Malaysia, the themes of "Fisheries, seabed resources & food security" hold immense relevance and significance, encompassing various dimensions that are critical for the country's sustainable development.

1. Sustainable Fisheries Management:

- **Relevance:** Malaysia relies significantly on fisheries as a crucial component of its economy and a primary source of protein for its population.
- **Policy Research Topics:** Explore innovative science, management, and policy frameworks for sustainable fisheries, considering the ecological impact, technological advancements, and socio-economic dimensions. Learn from EU experiences in implementing sustainable fisheries policies, including quota systems, ecosystem-based management, and participatory approaches.

2. Seabed Resource Management:

- **Relevance:** Malaysia's seabed resources, including minerals and energy, are integral to its economic growth.
- **Policy Research Topics:** Investigate sustainable seabed management strategies that balance economic exploitation with environmental conservation. Consider EU practices in regulating deep-sea mining, addressing biodiversity concerns, and ensuring responsible resource extraction.

3. Food Security and Trade-offs:

- **Relevance:** Ensuring food security is a critical aspect of Malaysia's development, and this is intricately linked to its fisheries and seabed resources.
- **Policy Research Topics:** Examine the trade-offs involved in sustainable fisheries and seabed management, particularly in relation to aquaculture, biodiversity conservation, urbanization, tourism, and infrastructure development. Learn from EU policies that address similar trade-offs, emphasizing integrated and cross-sectoral approaches.

4. Governance Aspects and Stakeholder Interactions:

- **Relevance:** Effective governance is essential for sustainable marine resource management, involving various stakeholders with diverse interests.
- **Policy Research Topics:** Analyze the interactions among different actors in Malaysia's marine sector, identifying drivers and impacts relevant to sustainable resource management. Explore EU governance models that promote stakeholder engagement, participatory decision-making, and successful co-management practices.

5. Technology for Sustainable Practices:

- **Relevance:** Embracing technology is crucial for optimizing fisheries and seabed management practices.
- **Policy Research Topics:** Investigate the role of technology in enhancing sustainability, including innovations in fishing gear, real-time monitoring, and data-driven decision-making. Draw insights from EU initiatives that integrate technology for sustainable fisheries and marine resource management.

6. Harmonizing Development with Conservation:

- **Relevance:** Balancing economic development with conservation imperatives is a key challenge.
- **Policy Research Topics:** Explore policies that harmonize infrastructure development, urbanization, and tourism with biodiversity conservation goals. EU experiences in integrated coastal zone management and sustainable tourism can provide valuable lessons.

In aligning with EU experiences, Malaysia can draw inspiration from successful policies and frameworks that promote the sustainable use of marine resources, ensuring the long-term ecological health and socio-economic benefits for its citizens.

Vietnam

In the context of Vietnam, the thematic areas of fisheries, seabed resources, and food security are highly pertinent due to the country's extensive coastline and reliance on marine resources. The sustainable management of these resources is crucial for ensuring food security, economic stability, and environmental conservation. Here are some expanded points on the relevance and potential policy research topics:

1. Fisheries Management:

- *Relevance:* Vietnam's fisheries sector is a cornerstone of its economy, providing livelihoods for millions. Sustainable fisheries management is vital to prevent overexploitation, ensure long-term resource availability, and support the well-being of coastal communities.
- *Research Topics:*
 - Assessment of the effectiveness of existing fisheries management policies and regulations.
 - Evaluation of community-based fisheries management models.
 - Impact of climate change on fish stocks and implications for adaptive management strategies.
 - Integration of traditional ecological knowledge into modern fisheries management.

2. Seabed Resources:

- *Relevance:* Sustainable seabed management is critical for maintaining ecosystem health, preserving biodiversity, and supporting responsible resource extraction activities.
- *Research Topics:*
 - Environmental impact assessments of seabed mining and extraction activities.
 - Evaluation of the effectiveness of marine protected areas in safeguarding seabed biodiversity.
 - Governance mechanisms for preventing illegal, unreported, and unregulated (IUU) fishing practices.

- Technological innovations for sustainable seabed exploration and exploitation.
3. **Food Security:**
- *Relevance:* Ensuring a stable and nutritious food supply from marine sources is essential for addressing food security challenges in Vietnam.
 - *Research Topics:*
 - Assessing the contribution of marine resources to overall food security.
 - Impact of climate change on the availability and quality of marine food resources.
 - Policy frameworks for promoting sustainable aquaculture practices.
 - Innovations in post-harvest technologies to reduce food loss and waste.
4. **Governance Aspects:**
- *Relevance:* Effective governance is critical for balancing competing interests and ensuring sustainable resource use.
 - *Research Topics:*
 - Analysis of the interactions between different stakeholders in marine resource management.
 - Trade-offs between aquaculture development, biodiversity conservation, and urbanization.
 - Sustainable tourism practices and their impact on marine ecosystems.
 - Integrated coastal zone management approaches for balancing development and conservation.
5. **Policy Relevant Research Topics in Relation to EU Experience:**
- *European Union Experience:* Drawing insights from the EU's experience in sustainable fisheries management, integrated coastal zone management, and conservation practices.
 - *Research Topics:*
 - Comparative analysis of EU and Vietnamese fisheries management policies.
 - Lessons learned from EU initiatives in sustainable seabed management.
 - Governance models in the EU for addressing trade-offs in marine resource use.
 - Policy transferability and adaptation from successful EU practices to the Vietnamese context.

By addressing these research topics, Vietnam can enhance its capacity for evidence-based policymaking, aligning its strategies with global best practices and contributing to the sustainable development of its marine and coastal resources.

Theme 5: Offshore exploration and mining

Malaysia

The relevance of offshore exploration and mining for Malaysia is multifaceted, encompassing scientific, management, technological, and policy dimensions. Malaysia, with its extensive coastline and maritime territory, holds significant potential for offshore mining activities,

particularly in the exploration and extraction of valuable resources. Recognizing the scale and importance of this issue in Malaysia, it becomes imperative to delve into various aspects to ensure sustainable and responsible practices.

Scientific Dimension: Understanding the marine ecosystems, biodiversity, and geology associated with offshore areas is crucial. Research can focus on assessing the environmental impact of offshore mining activities, studying the resilience of marine ecosystems, and identifying potential risks to biodiversity.

Management Perspective: Developing effective management strategies for offshore exploration and mining requires comprehensive research on regulatory frameworks, licensing mechanisms, and monitoring protocols. Research can explore best practices in sustainable management, drawing from EU experiences, to inform the development of robust governance structures in Malaysia.

Technological Innovation: Research on cutting-edge technologies applicable to offshore mining is essential. This includes advancements in exploration techniques, extraction methods, and waste management technologies. Evaluating the feasibility of integrating environmentally friendly technologies and minimizing the ecological footprint of mining operations is crucial.

Policy Frameworks: The policy dimension is crucial for establishing a balance between economic interests and environmental preservation. Research can focus on crafting policies that encourage sustainable offshore mining practices, taking into account the socio-economic benefits while safeguarding marine ecosystems. Exploring EU policies on offshore mining can provide valuable insights into effective regulatory frameworks.

Interactions with Other MARE Themes: Given the interdisciplinary nature of marine and coastal sustainability, it is essential to examine the interactions and trade-offs with other MARE themes. For example, exploring how offshore mining may impact biodiversity, fisheries, or coastal communities, and finding ways to mitigate potential conflicts.

Policy-Relevant Research Topics:

1. **Environmental Impact Assessment (EIA):** Evaluating the effectiveness of EIAs in predicting and mitigating the environmental impact of offshore mining activities.
2. **Community Engagement and Social Impact:** Investigating the social implications of offshore mining on local communities, including livelihoods, cultural aspects, and community well-being.
3. **Regulatory Mechanisms:** Analyzing the efficiency of existing regulatory frameworks and proposing improvements based on international best practices, with a focus on the EU experience.
4. **Technological Solutions for Sustainable Mining:** Researching and promoting innovative technologies that minimize environmental impact, reduce waste, and enhance overall sustainability.

5. **Ecosystem Resilience:** Studying the resilience of marine ecosystems to understand their capacity to recover from the disturbances caused by offshore mining.
6. **Best Practices from EU:** Drawing lessons from the EU's experience in offshore mining to inform Malaysia's policy and management strategies, considering both successes and challenges.

By addressing these research topics, Malaysia can develop a robust understanding of offshore exploration and mining, informed by global best practices, particularly those derived from the EU's experiences in sustainable marine resource management.

Vietnam

Offshore exploration and mining hold significant relevance for Vietnam due to the country's increasing interest and potential in harnessing offshore resources. Understanding the complexities of science, management, technology, and policy in support of sustainable offshore mining and exploration is crucial for Vietnam's socio-economic development. Here are some key points highlighting the relevance of this theme for Vietnam:

1. **Economic Potential:** Vietnam's offshore areas harbor substantial mineral and energy resources, including oil, gas, and minerals. Exploring and mining these offshore resources can contribute significantly to the country's economic growth, energy security, and industrial development.
2. **Energy Security:** Offshore exploration is integral to securing energy resources. With a growing demand for energy, Vietnam can benefit from offshore oil and gas exploration, reducing dependence on imports and enhancing energy security.
3. **Mineral Resources:** Offshore mining of minerals such as sand, gravel, and rare earth elements has economic implications. Sustainable management is essential to prevent environmental degradation and ensure long-term resource availability.
4. **Environmental Considerations:** Balancing the economic benefits of offshore exploration with environmental sustainability is crucial. Research should focus on minimizing ecological impacts, preserving biodiversity, and implementing effective environmental management practices.
5. **Interactions with Other MARE Themes:** Recognizing the interconnected nature of marine and coastal systems, research should explore interactions and trade-offs between offshore exploration and other MARE themes. This includes understanding how offshore activities may impact ecosystems, fisheries, and coastal communities.
6. **EU Experience:** Examining the European Union's experience in offshore exploration and mining provides valuable insights for Vietnam. Research topics could include studying EU policies, regulations, and best practices related to sustainable offshore resource utilization. Lessons learned from the EU can inform the development of effective governance structures and environmental safeguards.

Policy-Relevant Research Topics:

1. **Environmental Impact Assessment:** Develop comprehensive frameworks for assessing the environmental impact of offshore exploration and mining, drawing on EU practices to ensure sustainability.
2. **Legal and Regulatory Frameworks:** Analyze and recommend improvements to existing legal and regulatory frameworks governing offshore activities, aligning them with EU standards for effective governance.
3. **Community Engagement:** Investigate strategies for inclusive community engagement in decision-making processes related to offshore exploration, learning from EU experiences in fostering stakeholder participation.
4. **Technological Innovation:** Explore cutting-edge technologies for sustainable offshore mining and exploration, considering EU advancements in minimizing environmental impact and maximizing resource recovery.
5. **Integrated Coastal Zone Management:** Develop integrated approaches to coastal zone management, considering the implications of offshore activities on broader marine and coastal ecosystems.

By addressing these research topics, Vietnam can enhance its capacity to responsibly exploit offshore resources, contributing to sustainable development while mitigating potential environmental and social impacts.

Theme 6: Marine pollution control and management

Malaysia

In the context of Malaysia, marine pollution control and management are crucial considerations given the nation's extensive coastline and reliance on marine resources. Several key aspects are particularly relevant:

1. **Fossil Fuel Pollution:** Malaysia, being a major player in the global palm oil industry, faces challenges related to oil spills and pollution in its coastal areas. Policy-relevant research could focus on advanced technologies for the early detection and efficient cleanup of oil spills, drawing insights from EU countries that have implemented successful measures in this regard.
2. **Plastic Pollution:** The pervasive issue of plastic pollution in Malaysian waters necessitates comprehensive research on effective waste management, recycling strategies, and policy frameworks. Learning from the EU's experiences in implementing successful plastic waste reduction policies and fostering circular economies can offer valuable insights for Malaysia.
3. **Ecosystem Remediation and Restoration:** Research into innovative approaches for ecosystem restoration following pollution incidents is crucial. Topics may include the development of artificial reefs, mangrove restoration, and sustainable aquaculture practices that contribute to ecosystem rehabilitation. Collaborating with EU countries experienced in ecosystem restoration can provide valuable lessons for Malaysia.
4. **Science, Technology, and Policy Integration:** Effective marine pollution control requires a multidisciplinary approach integrating science, technology, and policy measures. Research topics could explore ways to enhance collaboration between

scientific communities, technological innovators, and policymakers to formulate and implement effective marine pollution management strategies. Learning from the EU's integrated approaches would be beneficial.

5. **Community Involvement and Awareness:** Engaging local communities in marine conservation efforts is critical. Research topics may focus on developing community-based programs, education initiatives, and awareness campaigns to reduce marine pollution at the grassroots level. Exploring successful EU models that involve communities in marine protection can inform strategies for Malaysia.
6. **Legal and Regulatory Frameworks:** Investigating and refining legal and regulatory frameworks related to marine pollution control is vital. Research can explore the effectiveness of existing policies, propose amendments, and develop new regulations to strengthen Malaysia's capacity for addressing marine pollution. Insights from the EU's regulatory approaches can be insightful for adapting best practices.

In summary, addressing marine pollution in Malaysia requires a holistic approach that integrates scientific advancements, technological innovations, and effective policy measures. Drawing on the experiences of the European Union in successfully managing and mitigating marine pollution can significantly contribute to the development of robust and sustainable solutions for Malaysia.

Vietnam

In the context of Vietnam, addressing marine pollution is crucial due to its extensive coastline and reliance on marine resources. The relevance of marine pollution control and management encompasses various dimensions such as science, management, technology, and policy measures. Given the specific focus on fossil fuels and plastics, the following policy-relevant research topics could be explored, drawing insights from the relevant experience of the European Union (EU):

1. **Plastic Waste Management:**
 - Assessing the effectiveness of existing plastic waste management policies and practices.
 - Exploring innovative technologies for plastic waste reduction and recycling.
 - Analyzing the socio-economic impact of plastic pollution on coastal communities.
2. **Fossil Fuel Contamination:**
 - Investigating the sources and pathways of fossil fuel contamination in marine ecosystems.
 - Assessing the impact of oil spills on marine biodiversity and fisheries.
 - Developing and evaluating technologies for the efficient cleanup of oil-contaminated areas.
3. **Policy and Legal Frameworks:**
 - Evaluating the comprehensiveness and enforcement of existing policies related to marine pollution.
 - Recommending amendments or new policies to enhance pollution control and management.

- Analyzing the effectiveness of regulatory measures in deterring polluting activities.
- 4. **Community Engagement and Awareness:**
 - Assessing the awareness levels of coastal communities regarding marine pollution.
 - Designing and implementing community-based programs for marine pollution education.
 - Evaluating the role of community participation in pollution monitoring and reporting.
- 5. **Ecosystem Remediation and Restoration:**
 - Investigating the feasibility and success of ecosystem restoration projects.
 - Developing strategies for the rehabilitation of degraded marine habitats.
 - Assessing the long-term ecological impacts of pollution on marine ecosystems.
- 6. **International Collaboration and Knowledge Transfer:**
 - Exploring avenues for international collaboration on marine pollution research.
 - Examining the EU experience in implementing transboundary pollution control measures.
 - Identifying best practices and lessons learned from EU initiatives for potential application in Vietnam.
- 7. **Technological Innovations:**
 - Researching and adopting cutting-edge technologies for real-time monitoring of marine pollution.
 - Assessing the feasibility of emerging technologies in pollution prevention and control.
 - Investigating the economic viability of implementing advanced pollution management technologies.

By delving into these research topics, Vietnam can align its marine pollution control and management efforts with international best practices, leveraging the wealth of experience accumulated by the EU in this critical domain. This collaborative approach will contribute to the development of effective and sustainable solutions for safeguarding Vietnam's marine ecosystems and coastal communities.

Conclusions

In the context of the EU Erasmus+ MARE project, the establishment of a research framework for the investigation of marine, coastal, and delta sustainability has led to the formulation of the following conclusions:"

1. Coastal Science and Management:

- **Importance:** Coastal zones are vital ecosystems facing threats from urbanization and tourism. Doctoral research should focus on adaptive co-management, policy innovation, and technology for effective adaptation plans.
- **EU Perspective:** Learning from the EU's experience in managing coastal challenges, integrating solutions, and balancing urbanization and tourism will provide valuable insights.

2. Delta Science and Management:

- **Importance:** Deltas, especially the Mekong and Red River, confront issues like urbanization and sustainable agriculture. Doctoral exploration should center on sustainable planning, pollution control, and leveraging ecosystem services.
- **EU Perspective:** Studying EU approaches to sustainable regional and urban planning, as well as utilizing nature-based solutions, offers lessons applicable to delta management.

3. Area-Based Management:

- **Importance:** Sustainable governance demands effective policy instruments like marine protected areas. Doctoral students should explore the development and implementation of marine spatial management tools.
- **EU Perspective:** EU's experience in developing and utilizing marine protected areas and pollution control zones provides a model for effective area-based management.

4. Fisheries, Seabed Resources & Food Security:

- **Importance:** Sustainable fisheries and seabed management are critical for food security. Doctoral research should delve into governance structures, trade-offs, and impacts on biodiversity, aquaculture, and urbanization.
- **EU Perspective:** Learning from the EU's sustainable fisheries practices, governance mechanisms, and approaches to balancing trade-offs will enrich research in Malaysia and Vietnam.

5. Offshore Exploration & Mining:

- **Importance:** With growing importance in Vietnam and Malaysia, sustainable offshore mining requires in-depth study. Doctoral exploration should address interactions and trade-offs with other MARE themes.
- **EU Perspective:** Examining the EU's policies and technologies in sustainable offshore mining will provide insights into best practices and avoiding potential conflicts.

6. Marine Pollution Control and Management:

- **Importance:** Preventing, controlling, and mitigating marine pollution, particularly from fossil fuels and plastic, is imperative. Doctoral students should focus on innovative policies, technologies, and ecosystem restoration.



- **EU Perspective:** Leveraging the EU's experience in implementing policies for marine pollution control, especially in areas like plastic waste management, will offer valuable guidance.

In conclusion, exploring these research themes aligns with the sustainable development goals of Malaysia and Vietnam. Considering the EU's rich research, policy, and management experience will provide doctoral students with valuable comparative insights, fostering innovation and sustainable solutions in their respective contexts. The exchange of knowledge and best practices will contribute significantly to addressing pressing marine and coastal challenges in Malaysia and Vietnam.