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## Regional convergence in environmental policy arrangements: A transformation towards regional environmental governance for West and Central African ports?



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### ABSTRACT

Environmental policy-making in West and Central Africa, with implications for the region's ports, is usually dominated by state actors that also represent the nation-states at regional inter-governmental co-operation. The ports share common and transboundary environmental problems, but fall under diverse political and decentralisation systems. Also, in spite of regional inter-governmental co-operation there is disagreement between regional environmental policies and those for the ports at sub-national level. The port authorities are largely absent in environmental negotiations with outcomes ignoring their contributions. However, institutional reform of the ports from the year 2000 onwards has seen the port authorities gaining greater autonomy as public non-state actors and beginning to involve in environmental policy-making. This paper seeks to understand how environmental policy-making and governance is transforming in West and Central African ports. By combining the policy arrangement approach, the main analytical tool for the paper, with the concept of regional convergence, interaction processes among key actors involved in port environmental policy-making in West and Central Africa are studied. The study finds a developing innovation of joint environmental policy-making arrangement in which West and Central African port authorities, from sub-national level, are engaging directly with regional inter-governmental and Environmental Non-Governmental Organisation actors. The developing innovation by-passes institutionalised state-led environmental policy-making arrangements, with the potential for transforming environmental governance of West and Central African ports. It is concluded that non-state actors, when given flexible manoeuvring, can be innovative in overcoming diverse statist political dynamics in dealing coherently with transboundary environmental issues within a territorial region. However, state actors remain key as linking pins in transboundary environmental policy and governance.

### 1. Introduction

Africa has become reckoned as the world's fastest growing continent (AfDB, 2013: 3; AfDB et al., 2015). Sustaining this economic progress has necessitated institutional and governance reforms (Joseph, 2016) to signal 'readiness for business' by the continent's governments. The reforms have led to a better business climate with investors blending in private/public-private arrangements that are building patterns for addressing real societal needs (see Mahajan, 2009; Radelet, 2010a, 2010b) and transforming policy and governance.

West and Central Africa (WCA) tends to be the most positive and optimistic Africa region (Hofmeyr, 2013). The region, understood as a territorial confine, has multiple national jurisdictions and institutional constructs to deal with environmental issues. The region is dependent

on export of cash crops and other bulk natural resources to sustain economic growth. Ports are thus crucial for the region and have also become impacted by unfolding economic and political governance. Most WCA ports have undergone institutional reforms since the year 2000, with increasing public-private partnership dominated by multinational terminal operators (Pálsson et al., 2007; Drewry, 2008; AfDB, 2010), particularly A.P. Moeller-Maersk and Bollorè groups, to enhance their operational efficiency. The port authorities have thus assumed a public non-state character with greater autonomy from the state. They have hitherto been showing high growth in productivity with fastest growth rates in the world for the period between 1995 and 2005. During this period, container traffic for the ports grew 400% in ten years from 1,035,400 to 4,802,000 twenty equivalent units (TEUs) at 14.7% per annum (Ocean, 2009; Foster and Briceño-Garmendia, 2010;

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**Table 1**  
Overview of environmental issues for WCA ports.  
Source: Barnes-Dabban et al. (2017).

Port Area Generated			Shipping Generated
Water	Air	Soil	
<ul style="list-style-type: none"> <li>● Rainwater</li> <li>● Port garbage</li> <li>● Industrial effluent</li> <li>● Municipal waste</li> <li>● Washing water from warehouses/workshops</li> <li>● Runoff from wharves, stockpile of bulk cargo such as manganese, bauxite, iron ore, shea-butter etc.</li> </ul>	<ul style="list-style-type: none"> <li>● Industrial emissions</li> <li>● Odour</li> <li>● Ship blasting</li> <li>● Trucks/cargo handling equipment emissions</li> <li>● Dust from bulk cargo such as manganese, bauxite, iron ore, wheat, clinker etc.</li> </ul>	<ul style="list-style-type: none"> <li>● Oil spill/leakage from tank farms</li> <li>● Chemical spills</li> <li>● Dredged material</li> <li>● Port garbage</li> <li>● Washing water from terminals</li> <li>● Pipeline punctures</li> <li>● Sewage overflow</li> </ul>	<ul style="list-style-type: none"> <li>● Ships' wastes</li> <li>● Ballast water</li> <li>● Oil spill</li> <li>● Biofouling</li> <li>● Hazardous waste</li> <li>● Accidental collision</li> <li>● Ships' emission</li> </ul>

see also Harding et al., 2007). Over the same period, general cargo grew at 10.2% per annum from 23.12 to 61.23 million metric tons yearly (Ocean, 2009). The region's ports are expected to continue growing with forecasts of 7.8% per annum between 2013 and 2018 (Drewry, 2015).

While WCA ports are recording positive changes in productivity, their environmental policy is also transforming. Like ports globally, WCA ports are confronted with two types of environmental problems - those that are port area generated and those that are shipping generated. An overview of common environmental issues facing WCA ports, with impact on air, water, and soil, is shown in Table 1. Some of these issues, including, oil spill, ballast water, ships' waste, port garbage/waste, and air pollution from carbon emissions, are beginning to receive attention in the ports (Barnes-Dabban et al., 2017). This paper however, focuses on oil spill response and ballast water management from shipping and the regional policies and regulations which govern these environmental problems. The regional policies and regulations are based upon IMO (International Maritime Organisation) regulations. The transposition of these regional and international policies and regulations in national law is the mandate of party-states. However, lack of commitment makes implementation rather inadequate.

WCA ports are however beginning to take up environmental roles, with the port authorities establishing specialised environment units. The multinational terminal operators have also brought along global environmental practices. Additionally, the port authorities are beginning to talk to each other on their shared and common environmental problems.

There have also been a number of regional developments. Inter-governmental actors from regional institutions are beginning to engage with port environmental issues. The Port Management Association of West and Central Africa (PMAWCA) has integrated environment into its technical committees. The Regional Co-ordinating Unit (RCU) of the region's Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment for the West, Central and Southern Africa Region, referred to as the Abidjan Convention,<sup>1</sup> is also beginning to deal directly with the port authorities. Additionally, there has been the emergence of Environmental Non-Governmental Organisations (ENGOS), particularly the Ports Environmental Network-Africa (PENAF), working with ports across the region

<sup>1</sup> Adopted in 1981 as a comprehensive legal framework agreement for marine pollution prevention in WCA (amended in 2008 to include Southern Africa) region through inter-governmental co-operation.

on environmental issues. State actors are therefore no longer dominant initiators of environmental policy in WCA ports.

WCA ports fall under diverse political and decentralisation systems (Table 3) (Barnes-Dabban et al., 2017). The WCA region is itself part of a continent best described as one of 'diversity and contrasting trajectories' (Michailof, 2013). The governments realise the potential of co-operation (Julian, 2012). They have in the last decades developed a variety of state-led regional co-operation arrangements (Sakyi and Opoku, 2014) that subject the ports to multiple actor-multiple level dynamics. However, the disagreement between regional and national environmental policies at the level of the ports can be rather puzzling. Many of the states have several different arrangements, sometimes with conflicting goals (Aryeetey, 2001). Power remains concentrated at national level, leaving both sub-national and regional levels with limited authority (Collier, 2014). Therefore, how non-state actors from multiple levels are involving themselves in environmental policy of WCA ports and transforming environmental governance of the ports require a more adequate understanding.

Studies on WCA's marine environment have mainly focused on status of biodiversity (Polidoro et al., 2017), sustainable fisheries (Ukwe et al., 2006; Agbeja, 2016), impact of climate change (Donkor and Abe, 2012), valuing the region's large marine ecosystem (Chukwuone et al., 2009) and transboundary pollution management (Ukwe and Ibe, 2010). This paper adds to this body of literature with insights in environmental policy interactions between WCA port authorities as sub-national actors, regional inter-governmental actors, and ENGOS working across nation-states beyond institutionalised state-led policy arrangements.

The aim of this paper is, first, to investigate the regional systems and arrangements which are emerging for environmental policy-making in WCA and the implications for WCA ports, and second, to identify the factors that are enabling or restraining emergent arrangements in transforming environmental governance for WCA ports.

Environmental interactions of four WCA ports - Abidjan, Douala, Lagos, and Tema, with state actors, RCU, PMAWCA, and PENAF as well as their regional setting are used as comparative case studies within a territorial regional geo-political context. The ports were selected using judgemental and purposive sampling based on their undergoing environmental reform (see Barnes-Dabban et al., 2017). Primary data was collected at both port and regional levels through a mix of face-to-face semi-structured in-depth interviews, closed and open-ended questionnaires, and participatory observation over the period of 2010–2015. Interviews were made with 63 key informants, selected on the basis of their involvement in environmental policy-making in WCA and their experience of port environmental interests, as investigated in this paper. These were, environmental managers and private port operators of the four selected ports; officials of environment ministries and agencies, and maritime administrations of countries of the selected ports; officials of International Maritime Organisation's (IMO) Regional Office in Accra, PMAWCA, and RCU and its National Focal Points (NFPs) for countries of the selected ports. Some empirical data were also gathered through participatory observation during the first West and Central Africa Ports Environment Conference<sup>2</sup>; the First Panel of Experts' Meeting on Strategic Assessment of Port Environmental Issues Policies and Programs (SAPEIPP)<sup>3</sup> in West, Central and Southern Africa; and Abidjan Convention's Ninth and Tenth Conference of Parties<sup>4</sup> meetings. Most respondents preferred to be anonymous and not to be recorded. Hand notes were therefore summarised and checked with respondents if they had been interpreted correctly. Interview

<sup>2</sup> Corresponding author in his PENAF role organised this conference in Tema in June 2010.

<sup>3</sup> Corresponding author in his PENAF role co-organised this meeting with Abidjan Convention Secretariat held in Abidjan 2015

<sup>4</sup> Corresponding author's role in PENAF facilitated his participation in COP 9 & 10 meetings held in Accra (2011) and Pointe Noire 2012 respectively.

narratives, notes from observation, and minutes of meetings were transcribed and together with questionnaire responses, labelled and coded under themes that synchronised with analytical elements of the theoretical concepts used for the study. Secondary information was obtained through literature review, newsletters, management and operational reports, and relevant working documents of institutions involved. These were reviewed by systematic reading to determine and assign texts to appropriate narratives and elements. Information from both primary and secondary sources were processed by looking for precise descriptions and developing extraction tables for accurate coding.

The next section introduces the conceptual framework for the study, followed by an analysis of regional environmental policy arrangements in WCA and their implications for WCA ports. Subsequently, factors influencing or restraining the transformation of environmental governance for WCA ports by emergent regional environmental arrangements are discussed. Finally, conclusions for the study are drawn.

## 2. Environmental governance transformation: policy arrangements approach

### 2.1. Conceptual framework

In this study, the concept of policy arrangements as the main analytical tool (Van Tatenhove et al., 2000; Arts and Van Tatenhove, 2006), is complemented with the regional convergence concept. A policy arrangement is defined as a temporary stabilisation of the organisation and substance of policy processes. It refers to the way in which a given policy domain is shaped by the interplay of four distinguished analytical dimensions: *actors*, *resources*, *rules* and *discourses* (Arts and Buizer, 2009). The *actors* dimension relates to key players involved in the policy domain, such as state officials, businesses and organisations, NGOs, etc. from different levels of governance. *Resources* refer to assets as knowledge, finance, mandate, technology, and even social conscience that actors can mobilize in order to achieve desired outcomes. The *rules* dimension consists of mutually agreed regulations, formal procedures and informal routines of interaction within the policy domain. Rules define the way the arrangement should be organised, by way of norms and procedures (Arts and Buizer, 2009). *Discourses* are the collection of ideas, concepts, and narratives that give meaning to the organisation and substance of policy issues in the policy domain or a certain real world phenomenon (Hajer, 1995; Dryzek, 1997). The sustainability discourse, for instance, brings about the notion of integrating economy, ecology and society in a win-win situation. The dimensions are interrelated with each other. A change in one dimension will result in a change in another.

Policy arrangements can grow at different governance levels: sub-national, national, and regional (Arts and Van Tatenhove, 2004). The complexities of environmental problems, particularly transboundary ones, and the desire of diverse actors to achieve preferred solutions leave environmental policy arrangements susceptible to new linkages with capabilities of being negotiated and transformed (see Beck, 1996). Multiple level policy arrangements can jointly and interdependently co-determine policy outcomes through complex processes of participation and decision-making (see Kohler-Kock and Eising, 1999; Hooghe and Marks, 2001a; Held and McGrew, 2002) in new steering mechanisms (see Van Leeuwen, 2010).

Within a territorial region, interactions among multiple level environmental policy arrangements offer potential for transforming environmental governance in a regional convergence through processes of *co-operation* and *integration*. Using insights from extant literature (Kaiser and Prange, 2002; Varjopuro et al., 2008; Bosch-Sijtsema and Postma, 2009; Lockwood et al., 2010; Kolařík et al., 2014; Soma et al., 2015), regional convergence is defined here as the trend towards multiple actors from multiple levels across multiple nation-states in a territorial region becoming enmeshed in harmonising policies, activities and

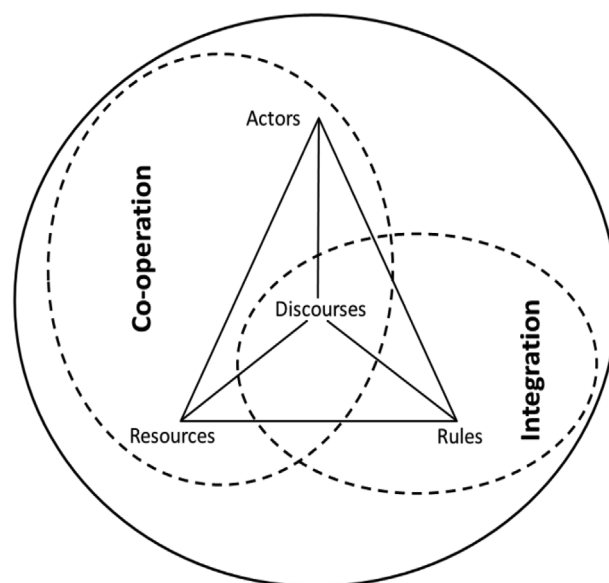


Fig. 1. Dimensions of policy arrangements in relationship with processes of regional convergence.

Source: Authors' own elaboration

actions. Co-operation and integration become key. Co-operation refers to organisational aspects of the interaction processes, particularly of actors and their resources while integration refers to the substantive aspects, particularly rules. In both co-operation and integration discourses, which are also a substantive aspect of policy arrangements, play a crucial role. This is depicted in Fig. 1 above. Through co-operation, actors co-determine common policy outcomes in participatory and communicative interaction characterised by mutual exchange of arguments. Actors willingly co-operate when collective goals bring about communal benefits (Bosch-Sijtsema and Postma, 2009). They pool their resources together (see Varjopuro et al., 2008) to mutually interdepend on each other in jointly addressing common problems. These characteristics open the way for integration in which different rules, plans, priorities, and activities of the multiple actors from multiple nation-states and levels get amalgamated in a co-ordinated agreeable procedure (see Lockwood et al., 2010). Through integration, differences in perception and definition of problems become unified with unanimous rule-making (see Kaiser and Prange, 2002; see also Kolařík et al., 2014) as opposed to self-interests and divergent norms. Co-operation and integration make the behaviour of actors and their rules of procedure compatible and structured in a coherent way. They both become supported and guided by shared discourses, which motivate actors' co-operative organisational behaviour and integrative rules of procedure. A shared discourse on governance steering in which no actors impose their preference on others will for instance bring about non-hierarchical participatory interaction and communication. Similarly, shared discourses on sustainability for instance, will define the character of common problems, causes, possible solutions and norms (see Liefferink, 2006) as well as common vision. Co-operation and integration can therefore be mutually inclusive. Through co-operation, multiple actors come together to interact. Moreover, co-operation can be a strategy necessary for integration (see Soma et al., 2015) of rules that give meaning to their policy pursuits. Deepening of co-operation and integration in a regional convergence has the potential of transforming environmental governance in a regional vein.

## 3. Regional environmental policy arrangements in west and Central Africa and implications for the region's ports

The state through its competent environmental ministries and

agencies has been the pivotal actor for environmental policy in WCA ports. However, with the port authorities having gained greater autonomy from their institutional reforms since the year 2000 onwards, two multiple level environmental policy arrangements have become identifiable for them. First, there is a state-based regional environmental policy arrangement among the region's nation-states in which the states agree on environmental policies and regulations at the regional level but differ in implementation at sub-national level of the ports. Second, there is a developing joint environmental policy arrangement among the port authorities, as sub-national actors, the multiple nation-states, and other regional and ENGO actors. Using the conceptual framework for this paper, this section analyses interactions in the two environmental policy arrangements. The analysis proceeds, first, with the state-based regional environmental policy arrangement and divergent situations in four WCA ports – Abidjan, Douala, Lagos, and Tema - and then, with the development of the new, joint environmental policy arrangement. In addition, specifically, key *actors*, their *resources*, *rules*, and *discourses* are analysed. Simultaneously, how the policy arrangements are transforming environmental governance of the ports through *co-operation* and *integration* processes are also scrutinised.

### 3.1. State-based regional environmental policy arrangement

WCA has the Abidjan Convention as its regional environmental co-operation agreement. Regarding the actors dimension of this arrangement, party-states (nation-states) and the RCU, which is the Convention's secretariat, are the key *actors*. The nation-states are represented by state actors, primarily state environmental ministries and agencies, referred to as national focal points. The RCU is made up of regional (international) civil servants, recruited from WCA party-states of the Abidjan Convention, as regional inter-governmental actors. The national focal points and RCU interact under a hierarchical arrangement that has the Conference of Parties as its highest decision making body. The Conference of Parties interacts biennially to discuss, negotiate and adopt policy decisions, regulatory directives, and recommendations or agreements. Co-operation in communicative interaction and mutual exchange of arguments is among limited key actors, being national focal points and the RCU.

With the *resources* dimension, the national focal points come from diverse national political systems but together with the RCU, they interdepend on each other's resources. They interdependently use their mandate, knowledge and finance to commonly pursue the Convention's objective of 'taking appropriate measures to prevent, reduce, combat and control pollution of the region's marine environment' (UNEP, 2005). National focal points on one hand have legal mandate embedded in state obligations under international law (see Gray, 2003) to manage and intervene in environmental problems and their effects on their national jurisdictions. The RCU on another hand has the mandate of the nation-states to support and strengthen national regulatory measures for implementing the Convention's action plan. In these respects, national focal points are required to provide guidance, technical and scientific advice while the RCU generates knowledge and information on marine pollution issues to inform policy recommendations and adoption. Pollution from shipping is one of the sources listed by the Convention as requiring policy control (UNEP, 1981; UNEP, 2005). However, most national focal points do not have sufficient shipping and marine environment background to be able to provide the needed technical and scientific advice. This weakens the knowledge resource base of the Convention. Furthermore, achieving the Convention's objective rests on financial resources. Party-states are thus obliged to make financial contributions to the Convention's trust fund to support activities of the Convention's action plan. They have however failed to honour this. In effect, while there is interdependence on resources as mandate and knowledge, pooling of finance remains a mirage. This lack of financial commitment has led to a slow and staggering performance

of the convention (UNEP, 2005) and weakens the regional environmental policy arrangement's co-operation.

Turning to the *rules* dimension, national focal points together with the RCU, have initiated three new regional policy guidelines and rules of procedure for preventing and dealing with shipping pollution. These relate to ports, being sites where shipping begin and end. There has first, been the revision of the Convention's flagship protocol, the protocol concerning co-operation in combating marine pollution in cases of emergency (UNEP, 2011a). This is tied to the second, the regional oil spill contingency plan (ROSCP) (UNEP, 2011b). Both are regional counterpart of IMO's international convention on oil pollution preparedness, response, and co-operation (OPRC) and were adopted by the Ninth Conference of Parties in 2011 in Accra. The third is, the regional strategic action plan on ballast water (RSAP) (IGCC, 2009a), a regional framework for minimizing the transfer of invasive aquatic organisms in line with IMO's international convention on the management of ships' ballast water and sediments (BWMC), which entered into force on September 8, 2017. This was adopted in 2009 in Abidjan (IGCC, 2009b) and revised in Lomé in 2011 (GCLME, 2011) under the convention's Guinea Current Large Marine Ecosystem (GCLME) project. It is yet to receive official adoption by the Convention's Conference of Parties. Developing the new rules have been mostly through RCU's access to financial resources from UNEP and other multilateral partners including Globallast,<sup>5</sup> IOC/ODINAFRICA,<sup>6</sup> and GIWACAF<sup>7</sup> among others. These financial resources have hugely impacted on the rules dimension of the state-based regional environmental policy arrangement and boosted its relevance. The Convention requires the nation-states to deal with their environmental problems in an integrated way, with Article four obliging them to harmonise (sub)national policies with those of the regional (UNEP, 1981). However, the new rules are not harmonised coherently in the region's ports.

The *discourse* dimension of the regional environmental policy arrangement is reflected in the new ideas and concepts connected with and guiding its comprehensive review and revitalisation since the year 2000 (UNEP, 2005; UNEP, 2008; UNEP, 2009). The revitalisation aims at broad-based participation in interactive knowledge exchange and problem-solving to integrate economic growth and social development with environmental action (UNEP, 2005: 3). This is a shift from state-centrism toward multiple actor approach to achieve sustainable development in line with 'governance steering' and 'sustainability' discourses. The revised flagship protocol, new ROSCP and RSAP, also substantiate shared sustainability discourse to protect the sustenance base of the region's marine environment. Operationalising these governance steering and sustainability discourses effectively should impact the actor dimension of the regional environmental policy arrangement, by opening it up to actors other than the state and mobilize new resources for the new rules of their game. However, participation of non-state actors to give meaning to the steering governance discourse seem yet to be effected.

Put together, as summarised in Table 2, the state-based regional environmental policy arrangement has limited actors, state and RCU, interacting across limited multiple levels of national (central government and regional). They are interacting communicatively and inter-dependently co-operatively on resources as mandate and knowledge. However, they are not pooling financial resources and therefore weakening their co-operation. Their interactive behaviour and policies seem premised on sustainability and governance steering discourses, but governance steering is yet to be given effect. Additionally, they have developed three new common policies and rules that are

<sup>5</sup> A joint programme between GEF, UNDP and IMO to assist developing countries reduce transfer of harmful aquatic organisms in ships' ballast water.

<sup>6</sup> The Ocean Data and Information Network for Africa project of the Inter-governmental Oceanographic Commission of UNESCO.

<sup>7</sup> Partnership between IMO and IPIECA (the global oil and gas industry association for environmental and social issues).

**Table 2**  
Regional environmental policy arrangements for WCA and its ports.

Policy Arrangement	Policy Arrangement Dimensions				Regional convergence Process	
	Actors	Resources	Rules	Discourses	Co-operation	Integration
State-based Regional Environmental Policy Arrangement	NFPs (State) RCU	Mandate; Knowledge; Finance;	Protocol for co-operation in cases of marine pollution emergency <sup>a</sup> ; Regional Oil Spill Contingency Plan <sup>a</sup> ; Strategic Regional Ballast Water Action Plan;	Governance steering; Sustainability;	Limited actors; mutual communication; Less multiple level coverage; Limited resource pooling;	Less coherence;
Developing Innovation of Joint Environmental Policy-Making Arrangement	Port authorities PMAWCA RCU	Mandate; Finance;	Routines of procedure for ballast water, ships' waste, port/municipal waste, and air pollution; PERS Certification;	Governance steering; Sustainability; Transnational governance;	Expanded multiple actors; Communicative non-hierarchical interaction; Expanded multiple level coverage; Resource pooling;	Common action plan harmonising routines of procedure coherently across multiple levels and multiple nation-states;
	PENAF	Knowledge; Finance; Knowledge; Social conscience;				
	NFPs (State)	Mandate;				

<sup>a</sup> Denotes rules of the same policy.

**Table 3**  
Divergences in environmental policies of WCA ports under state-based regional arrangement.

Port (Nation-state)	Political System	Policy Arrangement Dimensions				Implementation of Regional Policies (Regional Convergence)	
		Actors	Resources	Rules	Discourses	Regional Oil Spill Contingency Plan	Strategic Regional Ballast Water Action Plan
Abidjan (Ivory Coast)	Political hybrid; Centralised and compartmentalised;	MinEEF; CIAPOL; PA <sup>a</sup> ; PO <sup>b</sup> ;	Mandate; knowledge; technological equipment finance;	Undocumented national oil spill plan;	Regulated governance steering; sustainability;		<sup>c</sup>
Douala (Cameroon)	Political hybrid; Hierarchical, and compartmentalised;	MinENP; Mint; NPA; NHG; PA <sup>a</sup> ; PO <sup>b</sup> ;	Mandate; knowledge; technological equipment finance;	Draft national oil spill plan;	Limited governance steering;		<sup>c</sup>
Lagos (Nigeria)	Political fragmentation; Decentralised and compartmentalised	NEASREA; NIMASA; NOSDRA; PA <sup>a</sup> ; PO <sup>b</sup> ;	Mandate; knowledge; technological equipment finance;	National oil spill plan; port-level oil spill plan; ballast water discharge;	Regulated co-management governance steering;		<sup>d</sup>
Tema (Ghana)	Political integration Decentralised and inclusive;	EPA; GMA; PA <sup>a</sup> ; PO <sup>b</sup> ;	Mandate; knowledge; technological equipment finance;	National oil spill plan; port-level oil spill plan; ballast water discharge;	Co-management governance steering; sustainability;		<sup>d</sup>

<sup>a</sup> Denotes port authority.

<sup>b</sup> Denotes private operators.

<sup>c</sup> Denotes no real implementation status.

<sup>d</sup> Denotes real implementation status.

divergently and less coherently integrated at sub-national level of ports across the nation-states. The divergences are discussed in the next subsection.

### 3.1.1. Divergences in environmental policies of WCA ports

Approaches to the implementation of mutually agreed regional policies by nation-states of the state-based regional environmental policy arrangement have generally been contingent on national political systems and decentralisation processes. These are mostly top-down, and command-and-control in a 'regulatory governance' discourse (King, 2009) with differences in implementation typified among the four case study ports in this paper, and summarised in Table 3.

**Abidjan port.** The Ministry of Environment, Water and Forests (MinEEF) and its agency, Ivorian Anti-pollution Centre (CIAPOL) are key actors together with the port authority and private operators in a centralised and compartmentalised system under Ivory Coast's (Cote d'Ivoire in French) political hybrid (see Ottaway, 2003). In the resource dimension, the port authority has finance and mandate that is exercised under state regulatory control mechanisms. Private operators have knowledge, while CIAPOL controls oil spill response equipment and technology. CIAPOL has nine oil pollution vessels fitted with booms, skimmers, pumps, and inflatable storage barges on which the port authority depend. In the rules dimension, the monistic approach (see Jackson, 1992) to domesticating external regulations is applicable. Negotiated external regulations, and in this case regional, become implementable without requirement for legislative action after being ratified or acceded to by the state. This means the port authority can for instance easily adapt regional environmental policies, yet this is not the case. Adoption and implementation is dependent on state actors. No documented formal regulations for the implementation and enforcement of the RCOSP in the required two tiers of national contingency plan (NCP) and port level contingency plan (PCP), could be sighted during this study. Information however had it that, an old plan was being updated. CIAPOL also has responsibility for ballast water discharge. With this also, no policy documentation for implementing the RSAP was available. On discourses, state actors follow participatory engagement with the port authority in a seeming governance steering discourse, but regulated and controlled by the state actors. The port authority has since 2015 become ISO 9001 and 14001 certified pursuant to sustainability discourse that enable proactive interventions to prevent and mitigate adverse environmental impacts of port activities while enhancing environmental benefits.

**Douala port.** The Ministry of Environment and Nature Protection (MinENP), Ministry of Transport (MinT), National Ports Authority (NPA) and National Hydrocarbons Company (NHC) are key actors together with the port authority and private operators in a hierarchical, overlapping, and compartmentalised system under Cameroon's political hybrid (see Ottaway, 2003). In the resources dimension, the Douala port authority has finance and environmental mandate but barely exercises it without formal state control. The private operators have knowledge and the National Hydrocarbons Company under the Prime Minister's office has mandate for oil spill response with equipment and technology owned by oil companies. In the rules dimension, the monistic approach (see Jackson, 1992) applies just like Abidjan port, with external regulations requiring no counterpart domestic regulation after state accession. But here also, the port authority depends on state actors to adopt regional environmental policies relating to them. There is a draft oil spill response policy in line with ROSCP but no real implementation status. Ballast water, with regard to RSAP, is not addressed with any regulation or inspection and yet the port authority is unable to initiate its own. With the discourse dimension, MinENP regulates a limited form of participatory engagement with the Douala port authority and private operators in a seemingly governance steering discourse.

**Lagos port.** The Nigeria Environmental Standards Regulatory and Enforcement Agency (NESREA), National Oil Spill Detection and Response Agency (NOSDRA), and Nigeria Maritime Administration and

Safety Agency (NIMASA) are key actors, also together with the port authority and private operators. They operate a decentralised but compartmentalised system under Nigeria's political fragmentation (see also Ottaway, 2003). In the resources dimension, there are some interdependencies but not without overlaps and conflicts. NIMASA has mandate for ballast water and oil spill response three nautical miles offshore. NOSDRA has mandate for inland oil spills while the port authority for Lagos has finance and mandate for oil spills within the port enclave, which could be seen as inland. The port authority and state agencies independently control equipment and technology for oil spill but they also depend on private operators, Clean Nigeria Associates,<sup>8</sup> for same depending on magnitude of spill. The private operators have knowledge. In the rules dimension, the dualistic approach (see also Jackson, 1992) to internalising external regulations is applicable. With this approach, negotiated external rules must necessarily be domesticated through a counterpart national legislation. Adopting regional environmental policies is therefore dependent on state actors. Both RSCOP and RSAP have been internalised with regulations and policy guidelines by relevant state actors. The National Oil Spill Detection and Response Agency (NOSDRA) has adopted a national oil spill contingency plan while Lagos port authority has also developed a port-level oil spill response plan, both in line with ROSCP. The Nigeria Maritime Administration and Safety Agency (NIMASA) has also legislated the Nigerian Merchant Shipping (Ballast Water Management) Regulations, 2012, towards the implementation of RSAP with elaborate procedural requirements (Ojesanmi et al., 2016) to guide Lagos port authority. For discourses, state actors collaboratively interact with the port authority for Lagos in a form of co-management that follows governance steering discourse while the adoption of the oil spill and ballast water rules follow sustainability discourse. Their collaborative interaction is however fraught with some form of regulatory control in which state actors impose regulations on environmental behaviour of the port.

**Tema port.** The Environmental Protection Agency (EPA) and Ghana Maritime Authority (GMA) are key actors, also together with the port authority and private operators. They operate in a decentralised and yet inclusive and interactive system under Ghana's political integration (also see Ottaway, 2003). In the resources dimension, state actors have mandate but depend on the port authority, which has finance and mandate, for equipment and technological resources in responding to oil spill. Like CIAPOL for Abidjan, the port authority for Tema also has pollution control boat fitted with relevant accessories for oil spill response. The private operators here also have knowledge. In the rules dimension, the dualistic approach (see also Jackson, 1992) requiring domestic counterpart legislation for negotiated external regulations apply, as it is for Lagos port. However, the port authority for Tema directly adopts regional environmental agreements ahead of state regulations. Ideally, this situation is what should have prevailed for Abidjan and Douala with monistic rule-making. Like the case of Lagos port, the Environmental Protection Agency has developed a national oil spill contingency plan with the port authority for Tema also having a port-level oil spill contingency plan in line with ROSCP. But regarding RSAP, the port authority for Tema adopted it in 2011 in the absence of a national ballast water regulatory framework, which was only drafted later in 2013 by the Ghana Maritime Authority. The port authority went ahead of the state to initiate port biological surveys to establish a baseline for the characteristics and quality of its waters as required by the RSAP as a ballast water monitoring programme (GPHA/UoG, 2011). For discourses, the Environmental Protection Agency pursues a co-management approach, like state actors do for the Lagos port authority, in a governance steering discourse. But here, initiatives of the port authority and operators are implicitly tolerated, supported and acknowledged by the EPA. Also, the port authority for Tema, like Abidjan,

<sup>8</sup> Clean Nigeria Associates (CNA) is a second tier Oil Spill Response Co-operative established by the Nigerian Petroleum Industry.

follows the sustainability discourse in becoming ISO 9001 and 14001 certified in 2016. The sustainability discourse goes also for their oil spill response and ballast water discharge rules.

In sum, the common policies and regulations of the state-based regional environmental policy arrangement remain at the regional level, without intersecting coherently and harmoniously at sub-national level of the ports across the multiple WCA states. Additionally, there is limited pooling of financial resources among the states. Co-operation and integration processes of the regional policy arrangement therefore remain weak.

### 3.2. Developing innovation of joint environmental policy-making arrangement

As mentioned earlier, the 2000s has been marked by institutional reform of WCA ports in which the port authorities have gained greater autonomy as public non-state actors. The port authorities are having their own budgets and not relying on state subvention. They are generating revenue from which they pay dividend to the state, their 100% shareholder (see GNA, 2009 for the case of Tema port, Ghana).

In an innovative twist, the different port authorities are beginning to connect directly with regional and ENGO actors in finding ways of jointly addressing common environmental problems facing WCA ports. The port authorities are co-operating with their regional management association, PMAWCA, to directly identify themselves with regional inter-governmental actors, the RCU, and the ENGO, PENAF, which has interest in environmental health of African ports. State actors are participating, but, as only one of the actors, with no dominance. The Multiple actors involved are creating and upscaling interdependent non-state driven interaction to the regional level in a joint environmental policy-making for WCA ports. The actors are seeking to harmonise port environmental solutions and approaches through mutual exchange of environmental information and best practice. This began with the organisation of the first WCA ports environment conference in Tema in 2010. The RCU was then represented by the Interim Guinea Current Commission (IGCC) under the GCLME project.<sup>9</sup> The RCU became directly involved later through a collaborative arrangement with PENAF to support environmental capacity building of WCA ports (UNEP, 2012). The RCU sought approval for this collaboration from the Ninth and Tenth Conference of Party meetings of the Abidjan Convention's held in Accra and Pointe Noire in 2011 and 2012 respectively.

With regard to *resources*, the key actors: the port authorities, PMAWCA, RCU, PENAF, and national focal points have unequal access. The port authorities have an environmental mandate for their ports and access to finance. Nonetheless, they lack environmental knowledge. PMAWCA has regional mandate to strengthen the relationship between WCA ports and to co-ordinate regional harmonisation (PMAWCA, 1972). It however, lacks environmental knowledge and finance. Additionally, PMAWCA relies on the port authorities for its budget. The RCU, like PMAWCA, has regional mandate to support and strengthen national environmental regulatory policies and measures of Abidjan Convention parties (UNEP, 2005). It also has environmental knowledge and access to finance. PENAF has environmental knowledge and acts as social conscience. It however, lacks finance or any formal mandate. The national focal points, as state actors, have national mandate but also for the region as a whole. In organising the 2010 conference in Tema, the multiple actors interdependent on each other's resources. The port authority for Tema hosted with the IGCC and PENAF providing knowledge. The conference declaration (PENAF, 2010) gave impetus for further action and culminated in the multiple actors organising the first

panel of experts' meeting on Strategic Assessment of Port Environmental Issues Policies and Programs (SAPEIPP) in West, Central and Southern Africa, in Abidjan in April 2015 (Green Ports, 2015)<sup>10</sup>. The multiple actors, again, co-operatively pooled resources from their multiple levels across multiple states to reduce their variability and behave like a single body. The port authorities supported with their mandates, with the port authority for Abidjan hosting the event. The RCU provided financial resources and also together with PMAWCA supported with their regional mandates. The RCU further provided knowledge together with PENAF. In both the 2010 conference and 2015 SAPEIPP, state actors participated with their national and also collective regional mandates. Deliberations were held in a non-hierarchical way. The multiple actors interacted as equitable partners, refraining from strong and self-interest interventions in an expression of governance steering discourse.

In the *rules* dimension, actors through mutual exchange of arguments at the 2015 SAPEIPP meeting developed common rules of procedure by which their game should be played. The rules covered ballast water discharge, ships' waste, port/municipal waste, and air pollution, which were agreed on and prioritised as common issues with mutual benefit if addressed in a coherent manner. They were integrated into an action plan to harmonise routines and procedures for dealing with them within a regional frame. Targets in measurable or quantifiable terms were however not set, leaving room for manoeuvre by the individual ports. The actors also proposed the adoption of EcoPort environmental review system (PERS) certification, a port sector specific environmental management standard developed by seaports and for seaports (ESPO/EcoPorts, 2016), as common environmental management system across WCA ports. This decision demonstrates the institutionalisation of sustainability and accompanying rule of certification, emphasising voluntary commitment to systematic identification and management of environmental aspects of port operational activities. This is different from port policy in WCA before year 2000, when the idea of environment in the ports resonated basically with sanitation and cleanliness. Furthermore, the multiple actors issued a declaration of intent (UNEP, 2015) calling for a new context of port environmental steering at the regional level in an inter-port environmental co-operation on non-legally binding common procedures and norms, sharing of common database, and harmonised policy guidelines. This sought to facilitate the consolidation of the behaviour of the actors towards a common vision. Finally, each port authority identified a port contact person to work closely with their respective national focal points to the Abidjan Convention on agreed measures. PMAWCA consulted with its council on the declaration at the 2015 PMAWCA council meeting in Abidjan and got it approved (PMAWCA, 2015). PMAWCA council is made up of chief executives of WCA port authorities. These are politically appointed.

Regarding *discourses*, the non-hierarchical interaction of the actors and adoption of environmental management system already come up as expression of governance steering and sustainability discourses respectively. However, the developing innovation of joint environmental policy-making arrangement, being non-state and state actors, together, generating principles, norms, rules and decision-making procedures, beyond legally binding agreements negotiated by statist inter-governmental co-operation, for implementation across multiple jurisdictions expresses transnational governance discourse (see Espach, 2009; cf. Pattberg, 2012).

Put together, as summarised in Table 2, the developing innovation of non-state driven environmental policy-making arrangement for WCA ports is only emergent with more diverse actors from more levels across multiple nation-states with WCA's regional territorial confine. The multiple actors are interacting communicatively and co-operatively pooling their resources as mandate, knowledge and finance to jointly

<sup>9</sup> A GEF-funded ecosystem-based effort to assist the sixteen countries adjacent to West and Central Africa's Guinea Current Ecosystem achieve resource and environmental sustainability. It had components for improving sustainability of fisheries and reducing land and sea-based pollution.

<sup>10</sup> <http://www.greenport.com/news101/africa/homing-in-on-environmental-management> Accessed 28/03/2017.

address common environmental problems facing WCA ports. The multiple actors are also integrating their rules and procedures harmoniously and coherently across multiple levels of the multiple nation-states. Their organisation and behaviour is guided by shared governance steering, sustainability and transnational governance discourses.

#### 4. Environmental governance for West and Central African ports in a transformation

Globalisation processes have been accompanied by a 'new politics of pollution' (Weale, 1992) that has faded conventional statist environmental policy arrangements (Biermann and Dingwerth, 2004; Arts et al., 2006). It has brought about new conceptualisations and practices for ports in finding possible solutions to their environmental problems (Lam and Notteboom, 2014) in new arrangements of public-private actors (Bendell, 2000; Glasbergen et al., 2007). Moreover, the transboundary nature of port environmental problems reduces the effectiveness of conventional statist arrangements alone to address. The empirical analysis of regional environmental policy arrangements in WCA and implications for WCA ports, distinguishes two forms of regionalisation. The first form shows co-operation among state actors from multiple WCA nation-states at the regional level in a state-based regional environmental policy arrangement. The second form shows organisation and co-operation among sub-national public non-state actors (port authorities), regional inter-governmental actors, and ENGO actors, with participation of state actors in a state-non-state interaction at the regional level, circumventing WCA nation-states in a developing innovation of joint environmental policy-making arrangement. The two forms reflect Hooghe and Marks' (2001b; 2003) Type I and Type II multiple level governance arrangements. The first form, being a territorially mutually exclusive state actors' policy arrangement with limited governance levels reflects Type I multiple level governance, while the second form, being a territorially non-tiered flexible arrangement with more diverse actors from overlapping governance levels reflects Type II multiple level governance. The developing innovation of Type II multiple level governance, in a joint environmental policy-making arrangement, also reflects transnational governance (see Pattberg et al., 2011; Biermann and Pattberg, 2012; Duffy, 2013). The development can be seen as WCA port authorities moving beyond their Type I state-based environmental policy arrangement to generate collective problem solving in an environmental sub-politics fashion. The multiple actors involved in the innovation are trying to overcome WCA's diverse national political dynamics and divergent port environmental policies as well as alienation of the port authorities from the state-based Type I regional environmental policy arrangement. Nonetheless, state actors play an important role in WCA's environmental policy arrangements. Statist arrangements remain important, particularly, in transboundary environmental arrangements as they necessitate co-operation among nation-states (Reed and Bruyneel, 2010) represented by state actors. Therefore, for the developing Type II innovative joint environmental policy-making arrangement to stabilise as a transformative view of environmental governance for WCA ports, agreed measures must resonate with state actors in the Type I state-based environmental policy arrangement. This could only be visibly manifest by the extent to which diverse national approaches and rules for environmental policy of WCA ports get shaped or influenced by multiple actors involved in the developing innovative arrangement. Pursuant to this, two mutually supportive influencing factors: *institutional alignment* and *political communication and consultation*, become visible. These however get nuanced by *state passivity* as a restraining factor.

##### 4.1. Institutional alignment

Fulfilling the coherence goal of the emergent innovative joint policy-making arrangement for WCA ports explicitly requires implementation of mutual agreements at sub-national level of the ports

across the region's multiple states. As indicated above, state actors remain key in transboundary environmental protection and policy. They retain the means to facilitate or hinder rule-making and can defect from or fail to comply with measures that go against their interest (Bellamy, 2003). Therefore, the appointment of port contact persons to work closely with their national focal points to the Abidjan Convention expresses a deliberate move towards getting the goal and action plan of the developing innovative arrangement to resonate with state actors. While policies from the state-based regional environmental policy arrangement are not harmonised in WCA ports, the move to work closely together becomes substantial evidence of actors in the innovative joint environmental policy-making arrangement getting to align with and influence how institutions of their individual nation-states organise port environmental policy. The institutional alignment has three potential aspects that inure to the transformation of environmental governance of WCA ports. First, it establishes the developing innovative policy-making arrangement as a site of port environmental policy innovation and change, with the port contact persons as new and continued source of national attention for port environment. Second, it can re-orientate the handling of port environmental policy from individual state-centeredness towards a regional perspective. Port contact persons will be enabled to inform and input into port environmental policy in their individual nation-states by expressing collective positions of the innovative policy-making arrangement. And third, it has the propensity of encouraging the expansion of the state-based arrangement with new capacity and dedicated focus for ports environment that can be co-ordinated coherently in a regional environmental convergence.

These are not to suggest that state actors will abandon national devotion for the goals of the developing innovative joint environmental policy-making arrangement. Rather, all actors (state and non-state) will become closely linked with realities of social transformation from the changing relationship between ports and the environment in an era of globalisation. This will strengthen the role of state actors and statist policy arrangements while making place for a new role for the developing innovative environmental policy-making arrangement as a steering mechanism for environmental governance of WCA ports in a regional environmental convergence. Environmental governance of WCA ports could then be transformed in the 'local (sub-national) going regional and regional acceding to the local (sub-national)'.

##### 4.2. Political communication and consultation

Political approval for the declaration at the 2015 SAPEIPP meeting in Abidjan was fundamental if the innovative pursuits of the multiple actors involved was to become a reality. In this regard, PMAWCA Council, made of up national political actors, was consulted. This kind of communication and consultation with national political actors is also evident in RCU's consultation with national focal points at Abidjan Convention's Ninth and Tenth Conference of Party meetings for approval before adopting direct dealings with the region's port authorities and PENAF. The communications and consultations with national political actors and their subsequent approval alludes to their buy-in and acceptance of the developing joint environmental policy-making arrangement innovation as a new regional environmental governance steering mechanism for WCA ports. It lends credence to the defining of environment as a new issue-domain for WCA ports with the assurance of political support to foster coherent environmental reform progress of the ports within the context of a territorial region. Little progress could be made by multiple actors involved in the developing innovative joint environmental policy-making arrangement, if they unilaterally pursue their measures and goals in defiance of existing statist policies and arrangements. Communication and consultation with political actors therefore averts the 'catching by surprise' of relevant statist policy actors, in which case they could block the progress of joint actions of the developing arrangement. However, under the circumstance, political actors are enabled to re-orient themselves in view of the changing



dynamics. The political communication and consultation thus engenders trust in creating conducive conditions for forging ahead with the innovative joint environmental policy-making arrangement as a developing environmental steering mechanism for transforming environmental governance of WCA ports in a regional environmental convergence.

#### 4.3. State passivity

The changing political structure of WCA ports from predominantly state controlled to public-private partnership has certainly left the port authorities with greater autonomy. They are gradually strengthening their position on environmental policy-making in relation to the state. However, direct dealings with regional inter-governmental and ENGO actors undermine state authority and conventional political arrangements. Their innovative joint environmental policy-making arrangement is developing with state actors' participation and also side-by-side the state-based regional environmental policy arrangement. States will remain pivotal in national and supra-national environmental politics. The challenge, however, are drawbacks from passive statist approaches to environmental policy in WCA ports. Multiple actors in the developing innovative joint environmental policy-making arrangement are seen to be having to essentially penetrate statist environmental politics through institutional alignment and political communication and consultation, as discussed above, to become operative and effective towards coherence. However, WCA's differing political and decentralisation systems remain fundamental to the success of the penetration. WCA states, being parties to the Abidjan Convention and having together developed ROSCP and RSAP is expressive of regional co-operation. However, their commitment to policy integration is rather passive and sometimes paradoxical. On one hand, the port authority for Tema for instance, falling under dualistic rule-making that needs domestication of external regulations by the state, voluntarily and independently adopted the RSAP in the absence of national regulation. On another hand, Abidjan and Douala ports falling under monistic rule-making, not necessarily requiring domestication of external regulations, are both yet to have ROSCP and RSAP implemented in the manner required. In effect, state preference relating to national policy styles can enhance or constrain coherence and homogenisation of environmental policy in a regional environmental convergence for WCA ports.

WCA state actors are hardly exploiting their resources. Multiple actors and multiple level interactions on port environmental policy in their state-based regional environmental policy arrangement are limited and policies are not systematically co-ordinated and harmonised coherently by them at sub-national level of the ports. This brings to question, how the 'hard shell with soft belly' (Desai, 2010) character of inter-governmental policies having no binding commitments can create long-term success of regional environmental co-operation (see Haas, 1991; cf. Knecht, 1994). States have the political latitude to follow any procedure and approach to realise set objectives. WCA state actors clearly have their own interests that could pre-supposedly include maximising their autonomous control over port environmental policy-making. Their undeniable legitimacy and pivotal place in the region's environmental politics make them a 'linking pin' in shaping environmental policy for WCA ports. The developing innovation of joint environmental policy-making arrangement for WCA ports is challenging existing statist arrangements and yet, they cannot be escaped. The development reverses the passivity of statist regional environmental policy arrangements in pushing regional environmental convergence through deepened co-operation and integration processes (see Grande, 2001; Hooghe and Marks, 2001a; Kolařík et al., 2014). Actors other than the state are rather beginning to influence regional environmental convergence for WCA ports, with the state playing a role. The passivity of state actors can therefore potentially restrain the developing innovative joint environmental policy-making arrangement from transforming environmental governance of WCA ports in a regional

environmental convergence.

## 5. Conclusions

This paper has complemented the policy arrangements concept with regional convergence concept in a conceptualised analytical framework for understanding regional environmental policy arrangements in WCA Africa and their implications for environmental performance in the region's ports. How the policy arrangements are transforming environmental governance for WCA ports in a regional convergence have been scrutinised. And, factors potentially influencing and restraining the transformation have also been identified. Four WCA ports - Abidjan, Douala, Lagos and Tema - and their regional setting were used as cases. Two forms of regional environmental policy arrangements - a conventional state-based regional policy arrangement and a developing innovation of joint environmental policy-making arrangement with state actors' participation - have been distinguished. The two forms of arrangements are reminiscent of Hooghe and Marks' (2001b; 2003) Type I and Type II multiple level governance and can thus be said to be occurring in the regionalisation of environmental governance of WCA ports in co-existence.

The state-based Type I arrangement has limited multiple actors interacting across limited levels that do not transcend sub-national level of the multiple nation-states. Common regional environmental policies developed by the arrangement and relating ports do not reflect coherently at the sub-national level of the region's ports and leaving the ports with divergent environmental policies. These leave the state-based arrangement's co-operation and integration process short of pushing towards regional convergence. The developing innovation of Type II joint environmental policy-making arrangement has thus emerged with port authorities from sub-national level and their regional association (PMAWCA) connecting directly with regional inter-governmental and ENGO actors. This is happening in a transnational form of governance driven by non-state actors, with state actors participating. Interactions in the developing innovative joint environmental policy-making arrangement spans over enlarged multiple actors from more multiple levels across WCAs multiple nation-states. Co-operation and integration process are more pronounced with resource pooling and harmonised common routines of procedure toward coherent application of environmental policy approaches across the region's ports.

The developing innovative environmental policy-making arrangement signals a new environmental governance steering mechanism with promise for transforming environmental governance for WCA ports in a regional environmental convergence. Actors involved are seeking to achieve this transformation by penetrating statist arrangements with their coherence and harmonising goal. Their two mutually supportive factors, institutional alignment and communication and consultation with political actors, are influencing this. However, these are nuanced by the passivity of state actors, which has the potential of constraining the environmental governance transformation for WCA ports.

While it may be too early to conclude on the developing innovation, it is undeniable that a non-institutional and sub-systemic interaction either next to or as an extension of existing conventional statist environmental policy arrangements has taken place for WCA ports. The developing innovation is therefore more likely to continue and to open up environmental policy in WCA towards collaborative governance steering than ever before. It can therefore be safely assumed that, non-state actors, when given flexible manoeuvring, can be innovative in overcoming diverse statist political dynamics in dealing coherently with transboundary environmental issues, but without escaping state actors. In this sense, this study shows that interactions among broader multiple actors in multiple level policy arrangements across multiple nation-states within a territorial region can transform environmental governance in a regional environmental convergence.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.ocecoaman.2018.06.013>.

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