Crafting a Future Vision for South African and other Global Small Harbours in a Coronavirus, Blue Economy, Digitisation and Climate Change 20 March 2020, (Condensed)

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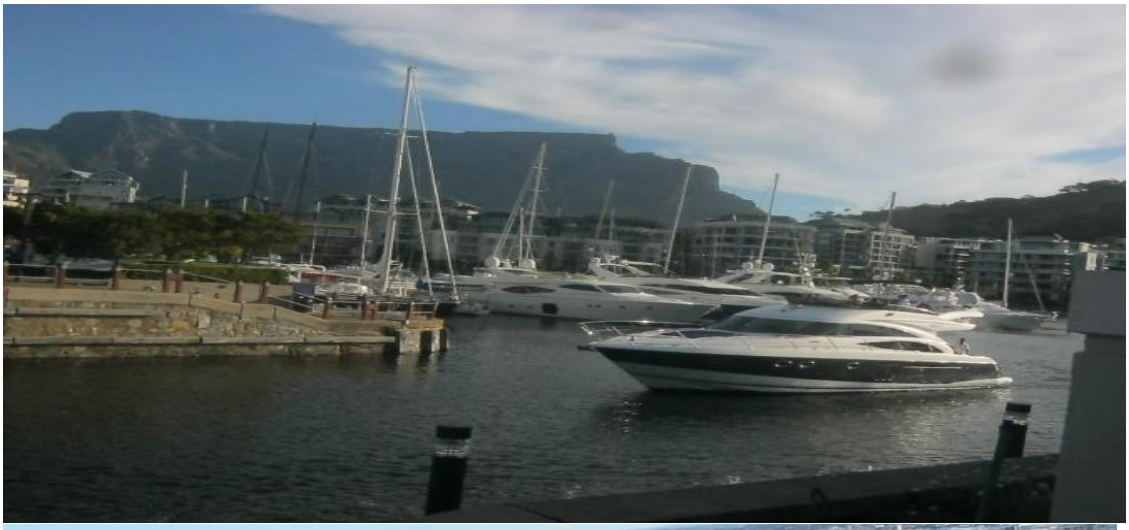

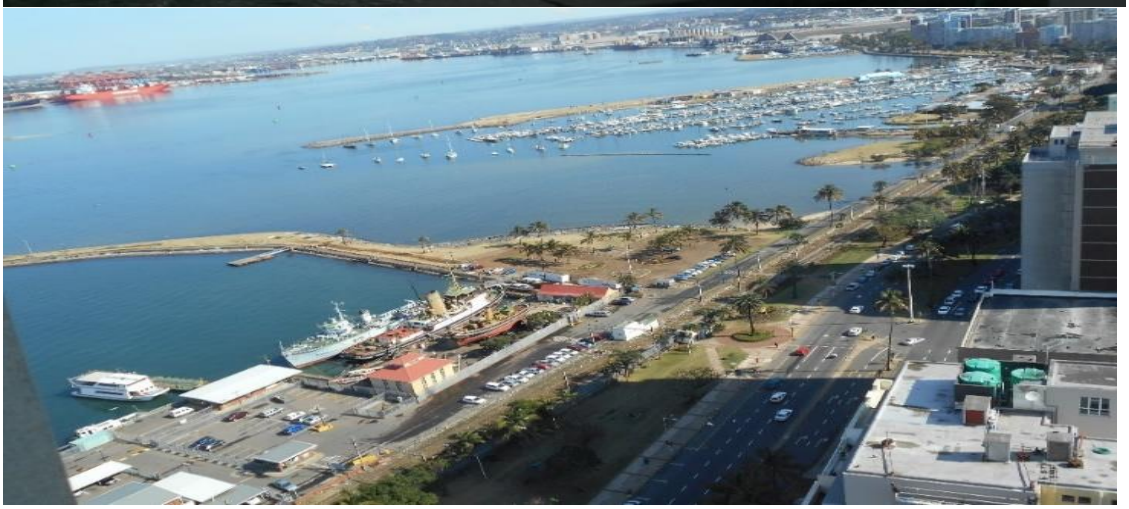

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1.1: Introduction: Small Harbours, the Ocean and Blue Economies

Globally larger ports have consistently been appreciated as conduits of international logistics, the movement of people and cargo across entire supply chains. Over 90% of international trade depends upon these gateways. Whether for commerce, tourism and recreation, oil and gas, fishing and other activities, their purpose and socioeconomic contributions have been extensively chronicled. The world and its more influential stakeholders are increasingly recognizing this contribution via the development of traditional ocean economies. The United Nations (UN) recognise that these ocean assets are valued at over $24 trillion. More government stakeholders, organisations and individual stakeholders wish to benefit from the projected growth from US $1.5 trillion in economic activity and 31,000,000 direct jobs to over $3 trillion and 45,000,000 jobs between 2010-2030. To do so however, they are focusing on the blue economy as a more sustainable transition towards a world reducing its ecological and other scarce resources impact; preserving long term ecosystem functions and biodiversity as much as possible. This is echoed by private sector initiatives such as the World Ocean Council to mobilise global business, the UNEP Sustainable Blue Economy Finance Principles and other efforts for global capital. Recent blue economy initiatives more formally include Operation Phakisa, the African Union Integrated Maritime Strategy, Commonwealth Marine Economies Programme, World Bank PROBLUE, Horizon 2020, INTERREG, and regional/local efforts from WIOMSA and the Benguela Current Commission to Mozambique's Pro-Azul, the Seychelles Blue Economy Prosperity Roadmap and Durban Municipality's Blue Oceans Economic Framework Strategy -the first Southern Hemisphere city effort.

Originally stakeholders defined this blue economy sector as the ocean, maritime or marine economy; which focused on purely extractive, profit-maximising growth for the short, medium and long term. Several ocean economy activity definitions are summarised in Table 1.1. Many define activities geographically lacking a specifically agreed radius, generally with a direct or indirect physical access to the ocean or economically dependent upon the ocean, sea, lake, coastline, port, ecosystem or activity. For example, the United Nations Environmental Programme (UNEP) define the blue economy as a *"vision of improved well-being and social equity, while significantly reducing environmental risks and ecological scarcity."* The World Bank note it as: "*the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, whilst preserving the health of marine and coastal ecosystems."* The Organisation for Economic Cooperation and Development (OECD) definition

includes “economic activities which produce goods, services and research that seeks to reduce environmental damage to primarily marine environments” (Taylor et. al 2017). For example, Australia’s Great Barrier Reef contributes over $5.7 billion to its coastal tourism economy yearly. Aside from ports and trade; the most significant ocean economy sector activities in terms of macroeconomic contribution include fisheries, offshore oil and gas and tourism. Yet these existing sources specifically exclude the contribution of small harbours and marinas which this report will subsequently focus upon.

Table 1.1: Ocean Economy Definitions

Country	Definition
USA	Economic activity which is a) an industry whose definition explicitly ties the activity to the ocean, or b) which is partially related to the ocean and is in a shore-adjacent zip code.
UK	Those activities that involve working on or in the sea. Also those activities that are involved in the production of goods or provision of services directly contributing to activities on or in the sea
Australia	Ocean based activity either because the ocean resource is the main input or because the access to the ocean is a significant factor in the activity
Ireland	Economic activity which directly or indirectly uses the sea as an input
China	The sum of all kinds of activities associated with the development, utilisation and protection of marine resources
Canada	Those industries which are based in Canada’s maritime zones and coastal communities adjoining these ones or are dependent on activities in these areas for their income.
New Zealand	Economic activity that takes place in or uses the marine environment, or produce goods and services necessary for those activities or makes a direct contribution to the national economy
Japan	Industry exclusively responsible for the development, use and conservation of the oceans
Republic of Korea	Economic activity taking place in the ocean including those using ocean resources as inputs

Source: UNCTAD 2018.

Blue economy activities and markets are summarised in Table 1.2. They incorporate fisheries and aquaculture, shipping, transport and ports, marine education, training and research, marine, coastal and cruise tourism with recreation, marine construction, offshore oil and gas, navies, marine insurance, finance and business, marine and cargo services. Other emerging sectors include marine protection, security and ocean governance (including drones), renewable energy, biotechnology and sea-bed mining along with small harbours. Although small harbours and marinas have been an integral part of traditional ocean economy activities especially in fisheries, logistics and recreation; globally and more locally within Southern Africa/Africa there has been comparatively minimal recognition over the more recent few decades of the value that these ports contribute towards less tangible aspects of local heritage, communities, ecosystems, economies and livelihoods. Many have incurred significant divestment, interest, support and priorities across Earth’s coastal communities. As overpopulation,

climate change, digitisation and pandemics threaten not just the larger ports but the smaller ports as well; this research is among the first to truly conceptualise the changing dimensions of how these can contribute towards the blue economy. It therefore specifically crafts a future vision for small harbours, managing these risks and other emerging opportunities as its conceptual contribution. It particularly concentrates on less chartered areas such as African nations and small island developing states.

Table 1.2: Ocean and Blue Economy Activities

Ocean Economy Activities	Emerging Blue Economy Opportunities
Fisheries, Aquaculture	Cabotage
Shipping; Transport and Ports	Marine finance and insurance; Dry Ports
Marine and Cargo Services	Undersea mining/Bioprospecting
Navies - Ocean and Coastal Governance	Drones, Robotics/Marine Protection
Offshore oil and gas	Marine Renewable Energy; Desalination
Marine, Cruise Tourism and Recreation	Marine Biotechnology; Blue Carbon
Education and Training	Maritime research and development, Technology e.g. sensors
Ship Repair	Vessel automation and conversion
Sea Rescue	Small Harbours

Source: This Study based on Dyer 2019.

Although many of these nations have expressed a certain degree of interest in ocean and blue economy approaches; as with most areas these often remain at the conceptual, planning, policy and pilot project or publicity seeking stages. Comparatively limited attention has been drafted practically towards implementation. This research's core aim is to not only conceptualise a vision for how small harbours can contribute actively towards small harbours; whilst reducing pressures on larger ports, ecosystems and communities; but also, to provide more practical guidance towards accomplishing these objectives. For example, Operation Phakisa in South Africa has indicated an interest in small harbours as detailed later but has been operating with a skeleton staff in terms of resources. Other nations, archipelagos and territories across the Caribbean, South Pacific, Canada, Australia and Africa, similarly express challenges as do those investors, communities, individuals, businesses and supply chain stakeholders merely seeking a shorter cut approach to resolving it. Small harbours can also contribute not just to local and regional policies and frameworks but a global attention towards sustainability and sustainable development. Historically, sustainability first evolved from the Brundtland Report "focusing on ensuring development today without compromising the interests of future generations." Sustainable development emerged at the 1992 Rio Summit setting Agenda 21

prior to the Millennium Development Goals. From 2015-2030, the United Nations developed 16 core goals to replace the Millennium Development Goals for poverty reduction and socio-economic advancement at an environmentally sustainable approach for global humanity. More government and maritime stakeholders are increasingly prioritising the transition from direct industrialisation and an extractive ocean economy model, to the emerging "blue economy as catalysts of growth, development, survival and opportunity." United Nation Sustainable Development Goal 14 specifically concentrates on harnessing oceans. This aims for a more sustainable, long term future through exploiting myriad opportunities. Yet aside from this; small harbours can aim to futureproof against digitisation, coronavirus, other pandemics and climate change which this research will be among the first globally to pioneer. It can also help in the transition towards the circular economy and waste minimisation, to recycle, reduce and renew.

Small Harbours are therefore receiving increasing pressures to remain functional, financed and of community interest/value; to reposition themselves as traditional fisheries decline and more favour the blue/green/circular economy as stakeholder pressures, especially in the development world. The scope of blue economy activities is not restricted to selective, direct economic extraction by those with the willingness, capacity and resources to do so. It is globally defined to include equity, socially, environmentally and economically sustainable utilisation of marine ecosystems, environments and opportunities for long term livelihoods and optimal welfare. Part of this encapsulates the notion of direct responsibility for the consequences of human actions; often absent in previous ocean related activities. Refurbishing existing harbours or converting them, reduces pressures to dedicate even more land and marine environments to ecologically devastating human activities such as new or expanded port or industries. This research further extends the concept through the circular economy, which aims to minimise the wasting of finite, scarce resources. It focuses on efficient utilisation. This is especially critical given pressures of a rapidly expanding global population, mass migration movements, economic, social and political fluctuation cycles, pollution and climate change. This challenges stakeholders' capacity to exploit these activities for rapid economic empowerment and ensure effective service delivery. Those pursuing blue economy opportunities, therefore focus on minimising adverse externality costs whilst seizing opportunities including evolving technological developments such as the Fourth Industrial Revolution. Increased coordination, focused engagement and awareness across

stakeholders and activities is paramount to ensuring effective access, governance, security and resource survival.

This blue economy specialist academic focuses on small harbours specifically having previously created scholarship on related climate change, ports, drones and ocean governance; aquaculture and fisheries, cruise and marine tourism; education, entrepreneurship and training; the 4th Industrial Revolution; cabotage; marine biotechnology; pollution and waste reduction or the circular economy, China, African and general marine/blue economy strategies, aside from airships and the space economy. Future insights aim to prioritise seabed mining and marine renewable energy among others. Small Harbours will remain increasingly essential in the need to protect marine ecosystem resources as the foundations of ocean and blue economies. This means safeguarding their ecological and economic functions as much as possible, as Table 1.3 identifies. It includes recognising the need for greater ocean governance, to complement formal ports and navies to ensure sovereignty along with the safety and security of all legitimate users. Globally the scope of blue economy activities encapsulates the fundamental question of sovereignty - ensuring effective awareness of the potential opportunities and status of each resource or value chain. It includes actual control of the resource and enforcement against those perceiving these maritime assets as part of the ocean economy, for more immediate, (frequently short term) self-interest. Those involved in protecting and governing blue economy resources are increasingly recognising their indirect value and contribution towards socio-economic, environmental and other strategic development objectives as Table 1.3 outlines. Although many nations experience significant constraints in prioritising resources, prioritising small harbours can minimise adverse externality, disruption and opportunity costs.

Table 1.3: Ecological/Economic Functions of Oceans and Blue Economies

Ecological	**Economic**
Biomass/Biodiversity Life Formation and Habitat	Life, Food, Material
Conservation	Supply of Natural Resources, Reduced Imports
Biological/Physical/Chemical	Redundancy against Uncertainty
Growth, Reproduction,	Trade, Production, Consumption, Income/Profit
Respiration/Oxygen/Photosynthesis	Greenhouse gas mitigation funding/source sink
Water supply/purification. Food security/Nutrition	
Protection	Protection – Vulnerability and Resilience
Ocean Chemistry, currents, salinity	Risk Identification, Monitoring, Prioritisation, Adaptation
Coral atolls – geographical physical formation, continued growth and survival	Risk Enhancement if Ignored – Legal, Reputational, Insurance, Security, Operational, Impact Costs
Sand formation, nourishment and sediment	Opportunity

Evaporation, Condensation and Absorption	Insurance against Maladaptation,
Climate Regulation –calcification, stratification	Future Sustainability and Survival
Counter eutrophication	Knowledge – Existing and Potential/Spiritual
Detoxification	Stability/Security/ Increased Adaptive Capacity
Population equilibrium	Aesthetic/Cultural/Social
	Tourism

Source: This Study.

Pursuing future growth means understanding and not jeopardising existing stakeholders, ecosystems and marine economies which influence ocean health. Earth's oceans' heath and blue economy progress is frequently threatened by marine pollution, overpopulation, urbanisation, limited blue economy/carbon finance, climate change and psychological unwillingness to act, among other factors. The 2016 World Ocean Assessment recognised that humanity has overexploited the ocean beyond its ecological threshold capacity. Subsequent developments need to prioritise sustainability and resilience. Part of this scope is recognising the need to facilitate increased awareness and appreciation of the significance and value of the blue economy but also the contribution and role of small harbours in safeguarding these interests. The United Nations Food and Agricultural Organisation (FAO) 2015 Blue Growth Initiative especially emphasised food security (FAO 2015) "*Eliminating harmful fishing practises and overfishing, ensuring tailor-made measures that foster cooperation between companies, whilst acting as a catalyst for policy evelopment, investment and innovation in support of food security, poverty reduction and the sustainable use of aquatic resources."*

Small harbours can act as the centre of communities, ensuring cultural and natural heritage are preserved. They can also aid artisanal and industrial fisheries, aquaculture and marine biotechnology along with enforcing marine protected areas. Fisheries contributed over $152 billion in direct economic activity in 2017. The scope of the blue economy is increasingly defined globally in relation to all factors which threaten its effective functioning. Therefore greater attention and resources are being invested in blue carbon sequestation, marine protected areas, climateproofing port infrastructure and other pre-emptive efforts to ensure that this sector can remain contributing towards a city, country and stakeholder's ultimate development and business objectives. Blue carbon sinks are up to five times more effective than global forest counterparts. Offshore renewable energy is increasingly favoured over the emissions of offshoreoil and gas for more conscious consumers and producers. Marine biotechnology with the unknown medicinal/other values of species and sea-bed mining provide further

innovative examples of opportunities only emerging comparatively recently over the past decade. Areas include energy, industry, cosmetics, nutrition and pharmaceuticals.

Small harbours can assist efforts in fightinng against poaching, pollution spills and ecological rehabilitation. They can provide employment and security to areas offering marginal other opportunities. Economist Intelligence Unit echoes others seeking feasible investment strategies, whilst simultaneously preserving coastal governance. It maintains: *"A sustainable ocean economy emerges when economic activity is in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy."* Sources do not agree on the proposed method, timeframe, conditions, assumptions, areas, environment or location necessary as to how small harbours can actively contribute towards the blue economy; hence the need for implementation guidelines; synthesising past guidelines and experience, whilst recognising new opportunities. Nor have existing institutional regulatory frameworks such as the International Seabed Authority; IMO; IAPH, UNCLOS and other international maritime law or stakeholders; evolved to recognise, enforce and secure this evolving paradigm. Many participants still have yet to consider the full risks and possibilities. This is echoed by CARICOM, SPC, SPREP, AU, EU, UN, World Bank, World Ocean Council and various investors/aid donors

It further aims to therefore further reduces asymmetrical information and uncertainty, so stakeholders can partner synergistically to overcome existing knowledge gaps and other issues from an absence of a pathway forward for this emerging sector. It will overcome existing ignorance or reluctance to invest and pursue a sustainable blue economy future via small harbours. The absence of a framework and a clear vision constrains all hypothetical beneficiaries. The need for progress needs to accelerate, as with many areas or at least remain some guidance and measure of policy certainty, to minimise inaction and opportunity costs. Other harbours and marinas may not be viable and need to be released or repositioned towards ecological rehabilitation and other purposes. Other activities have received greater attention without recognising the unique characteristics, limits and opportunities presented by small harbours, marinas and linked communities or supply chains.

The business and investor sectors are equally starting to register the possibilities of a commercially viable and continuous blue economy with multiple co-benefits. Nations such as China are focusing on

decarbonisation of their economy, linking their perceptions of the blue economy to equivalent land based or "green" activities. OECD estimates exceed US$ 90 trillion. Ocean sinks absorb over 30% of emitted carbon emissions. Europe estimates their Blue Economy to produce around 500 billion euros per year, supporting over 5,4 million jobs. Seafood profits exceed $4 billion per year. The global blue biotechnology market contributes $5 billion per year but 5% of the total. Key to this has been the development of several integrated stakeholders, legal certainty, technical transfer and expertise, access to finance, blue economy supportive networks and clusters connecting all users, sound institutional capacity and comprehensive frameworks. Each separate Table 1.2 activity and associated value chain influences between hundreds of millions to billions of people. Yet these activities have lacked holistic blue economy and small harbour future visions as strategies, universally binding on all stakeholders and for many nations.

Many stakeholders concerned or involved for small harbours and marinas contacted; lacked sufficient awareness as to whether their activities constituted part of the blue economy. Others were reluctant to disclose potentially commercially sensitive information. Consultation and engagement highlighted challenges in generating sufficient demand for new products and services, accessing finance, information, market, economic and technical barriers limiting blue economic development. It considered the identification of failures and exchange of best practises as indispensable enablers in developing a successful Future Vision for Small Harbours. Challenges currently exist in how frameworks will address individual, organisation and community expectations, needs and priorities, given finite resources or their awareness. Accurate valuation, chartering, understanding and protection of these resources is imperative to preserve their future and influence effective decision or policy making. Therefore, this research not only prioritises past research; emerging ideas and actual experience but recognises the need for actively interacting with stakeholders.

1.2: Africa, the Blue Economy and Small Harbours

The African continents echoes other regions in insufficiently examining the prospects for small harbours to be an intinsic annd invaluable part of contributing towards the blue economy and goals to systematically aid poverty reduction, sustainable development and macroeconomic performance.

Africa's largely unchartered maritime domain includes over 13,000,000 km^2 of Exclusive Economic Zone as well as 240,000 km^2 of lakes with blue economy potential such as Lake Victoria or the Congo/Nile Rivers. The source estimated Blue Economy activities can contribute up to 27% of East African nations' revenue and 33% of exports. Fisheries support the livelihoods of over 730,000 people. Geopolitically, the 2013 African Union's Agenda 2063 declared:

> *"Africa's blue economy shall be a major contributor to continental transformation and growth, advancing knowledge on marine and aquatic biotechnology, the growth of an Africa-wide shipping industry, the development of sea, river and lake transport and fishing, and exploitation and beneficiation of deep-sea mineral and other resources."*

However, it receives only peripheral attention in existing research for the blue economy as a subsequent literature review will emphasise in Chapter 2.

1.3: South Africa, Operation Phakisa and Investing in Small Harbours.

Comparatively few nations such as Canada and South Africa have specifically prioritised small harbours and marinas not just their commercial, larger scale counterparts as an integral part of their ocean economy framework. South Africa's own response to the global blue economy is pursued under Operation Phakisa, launched by former President Jacob Zuma in 2014. Operation Phakisa aims to generate 1,000,000 maritime related jobs by 2030 from 256,000 in 2010, adding R177 billion to GDP. Four target areas of offshore oil and gas with 30 new oil wells; marine transport and ports; industrial aquaculture; maritime manufacturing with ship repair; tourism and 22 new marine protection services/marine protected areas (MPA's) in 10 years. Opportunities and investments citied under the African Integrated Maritime Strategy and Operation Phakisa including ship repair, maritime education, aquaculture, marine tourism, oil and offshore gas. It claims to maintain and refurbish existing ship repair facilities at all ports. It seeks R2 billion co-funding, targeting 20,000 jobs by 2023 and R6.5 billion projected GDP contribution. Further commitment to the maritime sector, (although not formally defined as a "blue economy strategy" with a specific method framework), is echoed through the 2014 White Paper on National Environmental Management of the Ocean, Comprehensive Maritime Transport Policy 2017 (for marine ecological protection, safety and security); National Transport Master Plan 2050, National Industry Policy Framework (marine manufacturing is especially highlighted), National Transport Policy and KwaZulu-Natal Integrated Maritime Strategy. It extends to the forthcoming

eThekwini Blue Ocean Economic Framework and 2030 National Development Plan and New Growth Path. The South African Maritime Safety Authority proposed utilising African shipping and coastal trade to support infrastructure development and the growth of the African maritime economy. South Africa has also signed a Memorandum of Understanding with China in regard to the ocean economy.

However, the Departments of Public Works along with Agriculture, Forestries and Fisheries and other stakeholders have specifically targeted small harbours and marinas as indispensable to stimulate this sector. This research therefore provides a more South African perspective as a case study although with parallels and guidelines for other stakeholders. It hosted a series of mini labs focusing on four workstreams including the following: These aim to exploit the socioeconomic opportunities of marinas and small harbours, to become less peripheral and more integrated into the general economy, supply chain and community. South Africa last constructed a new small harbour with Port St Johns inn 1960 and has been focusing more on essential maintenance for 34 years since the dissolving of the Fisheries Development Corporation in 1986.

- *Workstream 1*: Establishing new small harbours and development of coastal properties
- *Workstream 2*: Redevelopment and maintenance of small harbours and coastal properties
- *Workstream 3*: Socio-economic impact (Job creation, skills development and enterprise development)
- *Workstream 4: Institutional arrangements (Governance and Operational management)*

As part of this process it seeks to improve arbour maintenance, security, revenue, management and other functions including macroeconomic contributions. It has proposed a Ratings, Awards and Incentives Programme. It recently conducted a tender for a skills needs and capacity building analysis under the South African International Maritime Institute. However, this received no tender service providers and was cancelled. This independent research seeks to resolve the current gaps in a framework, selection criteria, implementation approach based on local and international best practises and standards in Chapters 3 and 4. This includes identifying potential advantages, disadvantages; policies, stakeholders, supply chains and their requirements; risks, constraints and opportunities. Small harbours and marinas need to be repositioned to gain greater appreciation, understanding, awareness and exposure with marketable, investor friendly and ecologically sustainable alternatives. It includes possible identification of necessary funding and other resources necessary. These need to

consider pandemic, the 4th Industrial Revolution and other areas. The initial three pilot projects include Port Nolloth (Northern Cape), Port St Johns (Eastern Cape) and Port Edward (KwaZulu-Natal). However, South Africa has 142 Marine Access Points including 1 private and 9 main commercial ports, 1 proposed port at Boegoebaai, 1 suspended port at the old International Airport site in Durban and only 13 active Small or Fishing Harbours (12 in the Western Cape.

South Africa has conducted several stakeholder workshops towards small harbours along with allocating R8.2 billion for 13 existing and 3 new harbours under the national Department of Public Works responsible for all small ports. This differs from the commercial ports specifically under the Department of Public Enterprises and state company Transnet. Stakeholders have currently identified a number of problems affecting South African small harbour development. These include decision inertia; infrastructure and environmental sustainability; access to land and infrastructure; poor and inconsistent social engagement, lack of capacity; exclusion of previously disadvantaged individuals and SMEs', funding uncertainty and lack of investment incentives. The emphasis remains on "Coastal Community Commons" emphasising the social benefits along with environmental protection, safety, security, job creation, skills and enterprise development. They also need clear roles and responsibilities.

So, why prioritise small harbours and marinas, as catalysts of the blue economy? Precisely because so little research has been focused upon these areas and so many people depend upon them yet lack a coherently guided future as to how to remain relevant and focused in this era; especially from an emerging nation or small island developing state stakeholder perspective? Without a comprehensive vision; these may become increasingly obsolete, decommissioned and of peripheral significance to investors, policy makers, those within the interior and even among coasts themselves. Marine real estate is of increasing value but cannot be perceived just as temporary havens for tourists and the affluent alone; without ignoring the historic, ecological, economic, heritage and other connections. As the world faces increasing global pressures for coastlines; infringing upon existing ecosystems and remaining traditional communities; expanding commercial ports and other roles; this jeopardises current functions and existences.

Small harbours also need more focus if they are to be saved and remain pivotal or relevant amid increasing local and global climate change related risks such as a projected increased frequency, duration and intensity of natural disasters and other events. Increased sea level rise, temperatures, heatwaves, species migration, biodiversity loss, extinction, heatwaves, changes in precipitation, wind, gales, cyclones, tsunamis, storms, floods, droughts, landslides, king waves, coral reef acidification and others continue to threaten the very survival and contributions of minor ports and marinas. They offer radical opportunities to reposition themselves, especially for remoter communities more dependent upon them as more disruptions significantly affect traditional shipping, aviation and even road/rail routes. In an age of climate change and even extended pandemics such as the Coronavirus, they offer greater chances for resource and food security. Greater prospects exist to ensure not only ocean governance and sovereignty of resources but autarchy from import and other trade disruptions for essentials. During the Coronavirus, they offered alternatives to local fleets and recreational vessels as conventional ports experienced quarantine. Their potential to serve as alternative ports of call and supply during an epidemic, humanitarian logistics and otherwise, has yet to be sufficiently examined during past and contemporary research. In a Digitisation and 4th Industrial Revolution Age, ports and marinas can also be reimagined and reengineered to become Smart Ports, with interconnectivity managing the flow of data and information; mitigating and pooling risks. This facilitates trade, management, safety and security with increasingly finite financial, time, labour and other resources.

Chapter 2: Literature Review Existing Characteristics, Experiences, Insights and Failures for Global and Local Small Harbours and Marinas.

2.0: Introduction

This section therefore aims to provide a theoretical approach to pinpoint existing and proposed initiatives, research, methods and case studies related to marinas, small harbours and implications for a sustainable blue economy future globally, regionally and locally. It strives to achieve this via a structured, thematic, issues-based literature review. It first defines characteristics relating to small harbours and marinas, and other related concepts in Section 2.1. It then identifies various global stakeholders, networks and their potential requirements in establishing a viable circular economy/supply chain and sustainable blue/ocean economy future for small harbours and marinas in Section 2.2. It identifies potential global and local policies, guidelines and legislation developed in relation to this emergent area and interrelated aspects in Section 2.3. It then investigates the characteristics of successful global and local small harbour and marina approaches, methods and case studies in Section 2.4. It will also subsequently identify, investigate and assess other formal, informal and equivalent approaches along with case study failures (Section 2.5). It considers an issues-based approach, providing the advantage of a more focused, pertinent and consistently systematic appraisal to assist various stakeholders in implementation. These include communities, governments, port authorities and businesses facing significant financial, time, opportunity cost, resources and capacity constraints when formulating a response to this ocean/blue economy sector. It seeks to minimise these constraints through reviewing pertinent literature, experiences, insights and failures. It aims to identify and evaluate the gaps, strengths and weaknesses of similar research. This will further assist stakeholders facing increasing disruption amid climate change; marine pollution, overfishing, human overpopulation, digitisation/other technology and the Coronavirus/other pandemics.

2.1: Defining Characteristics of Ports Versus Small Ports and Marinas and Supply Chains;

As extensively detailed under previous work on Durban and other Southern Hemisphere port expansions (Dyer 2014) or climate change and Pacific ports (Dyer 2018); small ports and marinas essentially follow larger ports with similar characteristics. Few studies specifically distinguish as to how smaller ports and marinas essentially differ from larger ports; except in terms of scale of physical size;

the extent of availability of port functions and services; less commercially orientated; minimal staff, financial, maintenance and other invested resources and port traffic/productivity statistic indicators. Traditional port related literature can be divided into those specifically focusing on larger ports, which will be primarily excluded from this literature review and those for smaller ports/marinas. One traditional approach is to consider cost-benefit analysis examples, which are often used in constructing new ports; to motivate extending ports, or investing in existing ports. This also extends to technical port planning preparation studies used by those involved in augmenting port performance These traditionally outline projected costs, benefits, stakeholder concerns and technical constraints. It is advised for small harbour and marina motivation studies to therefore consider both.

Understanding the various purposes and characteristics of small ports and marinas is essential to form the most optimal site selection, design, planning and configuration criteria for various stakeholders, including communities, environments, heritage and interlinked maritime supply chains. Existing seaport literature defines ports as "*acting as a gateway through which goods and passengers are transferred between ships and the shore,"* seeking to enhance efficiency while aiming to minimise *"the generalised transport cost of through transport,"* (Dyer 2014), whereas the European Doctrine perceives a port system primarily as a catalyst for employment, expenditure, development and other value-related economic activities. This research identifies several key characteristics common to all port types that can be identified to improve port productivity and efficiency potential, examples of which are summarised in Table 2. These include marine infrastructure and services, cargo infrastructure, cargo handling superstructure and services to facilitate interactions between vessels and land, establishing road and rail transport connections plus other interlinkages with the local hinterland All affect hypothetical constraints to efficiency and expansion in a seaport influencing potential economies or diseconomies of scale and are advised to consider in any project related to small harbours, marinas and their intermediate or extended hinterland.

Table 2.1: A Small Harbour or Marina's Potential Assets, Infrastructure and Services

Marine Infrastructure	Marine Services	Cargo Services	Cargo Infrastructure	Cargo Superstructure
Port Approaches	Pilotage	Stevedoring	Terminals	Cranes
Port Limits, Breakwaters	Mooring	Port Security	Warehousing	Terminal operator vehicles
Fairways	Tugs and towing	Road	Other storage facilities	Stacking equipment

Turning Basins	Salvaging	Rail	Customs transhipment sheds	Mounted Gantries
Water Depth	Drydocks/Repairs	Value added activities – packing etc	Bonded warehouses	Container scanning
Channels	Waste Disposal	Warehousing	Conference facilities	Straddle carriers
Navigational Aids	Synchrolifts	Tracking	Offices	Lifts
Gravity Retaining Wall/Pavement	Water/electricity, communication	Inspection	Cruise Facilities	Reach stackers
Berths	Bunkerage	Freight Forwarding	Reefer points for containerised cargo	Information systems –NAVIS
Quay Walls	Firefighting	Financing	Cargo repair/ surveying facilities	Communications e.g. radios
Docks	Vessel Tracking	Insurance	Backup generators	Truck Appointment System
Port Authority/Customs	Sewerage/waste disposal, gas	Prioritised customs processing	Hazardous cargo Storage zones	Electronic data submission system

Source: This Study.

Other seaport functions identified in literature that need to be considered for improvement in any port development project include: customs border points to ensure trade facilitation, policy implementation, supply chain safety/security and a port revenue source and a port authority to finance, administer and (for South Africa/some others) operate the port along with maintenance or security as a Harbourmaster's traditional function, along with an efficient port layout exploiting locational economies of scale. It is essential to consider a safe haven against elements and source of supplies along with other prime port user requirements that minimise negative externalities. Small harbours and marinas need to be planned to service commercial cargo, vessel and passenger transactions: to equip, repair, maintain and establish a vessel in preparation (plus transfers of technology, materials, knowledge and labour) with minimal financial, time and opportunity cost, maximum throughput efficiency and productivity for all offered facilities and services. Literature has neglected the concept of an idealised ultimate port configuration, presumed impossible to attain given the specific constraints, environment, layout, equipment, potential economies of scale and differing stakeholder perspectives that make each port unique. This research seeks to justify an approach, flexible enough to utilise leading global port solutions, ideas of port users and improvements in literature, address constraints and port performance, to create such.

2.1.1: Site Selection Criteria for Small Harbours and Marinas in a Blue Economy Age

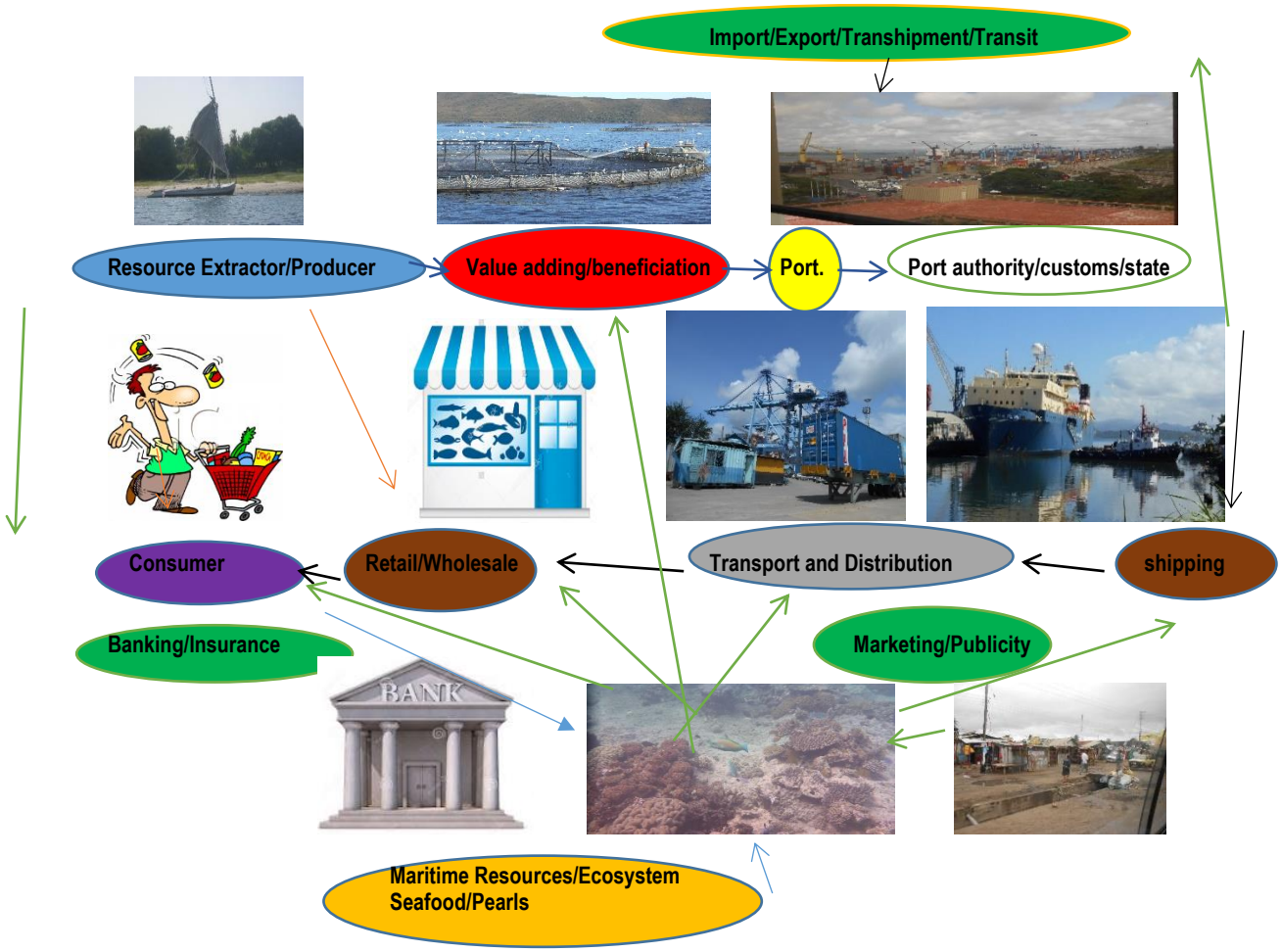
- History/Tradition -culture and heritage/Location, Aesthetics

- Fisheries
- Tourism and recreation
- Environment
- Space/Land Terrain Space and Accessibility for storage etc
- Geology
- Climate Change Risks
- Electricity -aim for renewable energy; Water
- Management, pricing, productivity, efficiency and maintenance
- Waste -recycling, closed loop and reception facilities such as the circular economy including recycling.
- Internet connectivity and availability of technology/4th Industrial Revolution.
- Market Proximity Demand and Supply including Customers
- Land/Zoning Regulations
- Transport/Trade access and connectivity. Facilities available.
- Labour -Skilled and Unskilled and a needs assessment
- Finance, capital and investment incentives
- Legislation
- Hinterland and Supply Chain Access
- Complementary characteristics, needs and requirements for various blue economy activities including desalination, port logistics, trade and transport such as ferries; seabed mining; offshore oil and gas or other exploration; ocean governance, drones and navies; marine renewable energy; biotechnology, aquaculture, heritage and ecotourism; marine protected areas and coastal reserves; marine real estate and blue carbon.

Effective small harbours and marinas need to also consider supply chains and their connections to the greater economy. A supply chain is defined as a system through which a commodity or commodities is produced, transported, processed, distributed, sold and eventually utilised or consumed, (occasionally recycled). It connects initial, producer supply with final consumer demand, through ports, shipping and the associated economic hinterland. For this research's context, an MSC is based on complete dependence on ocean resources from production to consumption and exports. This approach provides a theoretical departure from previous studies which identify the potential ports and small marinas alone without the greater implications. An example of a simple commercial supply chain is presented in Figure 2.1. The concept can be defined for a commodity being traded throughout a port or supply chain; even a minor one and applied to specific examples. A commodity or product is first extracted from its source such as seafood harvested from the ocean in a producer/resource extractor stage. If not sold or transported directly, it can be processed in value-adding (fish oil) or combined with others in manufacturing. Unless illegal; the majority of products directly pass through a port stage to pay customs/port duties and comply with state regulations prior to a shipping stage. A supply chain

commodity is transported via shipping, and road/rail intermodal transport locally; transhipped, imported or exported, before being further processed or sold to retailers. The final stages include the commodity's sale to customers/consumers. Those not completely consumed or utilised can pass to a waste disposal or recycling stage. Throughout all stages including ports and marinas, a commodity's flow is influenced by and influences local and global finance/insurance access and publicity or marketing. This affects consumption, production, economic demand and supply. Through defining a port and supply chain, stakeholders may further appreciate the need to prioritise well executed, multipurpose small harbours and marinas. Even if assets, locations and staff are not exposed directly, other supply chain stages, which they depend upon may be affected.

Figure 2.1: A Maritime Supply Chain including Small Harbours/Ports and Marinas



Source: Author

As investigated in various sources understanding a ports' intended purpose assists in determining how all stages and stakeholders are potentially affected by small harbours and marinas. Consulting relevant stakeholders to determine individual requirements, ensures this approach can be applied, with similar constraints, concerns and risks, at minimal transactional, research and opportunity cost across other local and international examples. Stakeholder consultation and engagement is widely perceived as imperative in all processes towards creating this Future Vision or modifying existing ports. Regardless of emergent risks such as digitisation; the coronavirus 19 pandemic and climate change, these stakeholders require certainty functions will exist with minimal disturbance risk. They expect stakeholders involved are sufficiently informed, prepared and aware. They anticipate they will not lose any functional requirement or be adversely affected by any related supply chain changes;

These functions need to occur with minimal financial, time and opportunity cost, maximum throughput efficiency and productivity for all offered facilities and services. This must apply regardless of the port type, nature and volumes of cargo throughput, vessel/transport type and cargo characteristics serviced, to connect to the local community and broader economy. It requires an organisational structure, resources and capacity capable of efficiency, speed, reliability, flexibility, security and other stakeholder requirements. These requirements or needs examined in Section 2.2 below need to be continuously evolving to adapt the various functions, characteristics and assets of small ports and marinas dynamically to emerging risks and opportunities. It is advised to diminish vulnerability and enhance resilience as much as practically possible, upgraded and adapted consistently as much as possible, maintained or decommissioned. It should minimise time, externality, congestion and user impact costs as much as resources efficiently permit and as sustainable as possible.

2.1.2: Criteria for General and Specific Small Port/Marina Productivity and Efficiency Performance

In order to determine how effectively smaller harbours are performing; this section provides consistent indicators and a systematic set of standardized assessment criteria to evaluate a port's productivity, efficiency, constraints and stakeholder concerns. These may provide further guidelines for those planning improvements in seaport design and augmenting certain port facilities. Literature first defines the concept and then summarizes and endorses key indicators from previous findings for which data

is available in the actual port to be investigated, in order to answer the ideal port physical and operational structure.

General Port Productivity and Efficiency Indicators

- **Vessel Waiting Time for Berths:** This reflects the frequency with which vessels can access facilities and the degree to which sufficient maritime infrastructure and services are provided in existing port capacity for projected port demand versus supply.
- **Average Cargo Dwell/Clearing Time:** The time taken for cargo to be transferred and processed between the vessel via the shore to storage facilities/transport links, is a significant indicator in determining the degree to which sufficient cargo infrastructure and services is provided in existing port capacity and for projected port demand versus supply.
- **Average Customs Clearance Processing Time:** A proxy measure for a historically ignored factor inhibiting a seaport's performance potential, by assessing the time taken to complete customs formalities as an indicator of the extent to which customs procedures enhance or inhibit port user requirements and to which it can be modernised to improve port capacity.
- **Vessel Turnaround/Clearance Time:** This reflects the total waiting, berthing and other port time to a vessel and its operators whilst utilising port facilities as a measure of its potential competitiveness and efficiency against other comparable ports.
- **Road/Rail Turnaround Time.** This measures the total port time taken to collect/deliver cargo consignments as an indicator of the service, reliability, efficiency and quality of port superstructure, storage facilities and surrounding transport interlinkages affecting the dependent economy.
- **Port Road to Rail Ratio.** This measures the share between road and rail for containers leaving the port.
- **Total cost to port users per year.** This indicates how cost efficient the port is over a specific time period compared to its competitors. It reflects port user willingness to pay for facilities and the extent to which a seaport can lower costs along with increasing potential macroeconomic benefits, by enhancing port performance through addressing concerns and constraints.
- **Tonnage of cargo carried per unit of worker/No of potential strikes/days lost:** These are prototype physical estimates of the extent to which labour productivity has the potential to be improved for enhancing port capacity, given the influence of labour costs to total port user costs and potential port activity, historically ignored in port project research studies.
- **Gross crane moves per hour, Tonnage of cargo carried per running metre of quay, Tonnage of cargo carried per unit of cargo employed, Number of containers handled per ship working hour.** These determine the extent to which cargo infrastructure, superstructure and services in terms of technology/capital equipment have the potential to be improved for enhancing current and future port capacity and performance.

PORT ACTIVITY/CAPACITY INDICATORS

- **Average Berth Occupancy Rate:** This establishes optimal berth configuration in projected port designs, and projected marine infrastructure demand.

- **Total Port Capacity and Traffic (TEU's)/(No of vessels):** In aligning projected demand with projected supply and utilisation of facilities and the extent to which ports and their functions can become more efficient to port users, these measures approximate the extent to which modernisation of existing site capacity and layout is a more feasible and cost-efficacious alternative to port expansion developments. This ideally should be divided into different strategic users, reflecting variations in port function requirements, efficiency and cost including dry bulk, container vessels and for cruise vessels ignoring any minimal cargo capacity).
- **Cargo Capacity Utilisation:** Dividing annual TEU activity by estimated total TEU capacity; measures the extent to which potential port capacity is utilised.
- **Number of gate transactions and TEUs per acre/hectare and berth**.

Small Port and Marina Productivity and Efficiency Indicators

Providing indicators should assist users to optimise port configuration, planning and welfare via lowering long-run average costs, maximising profits, augmenting efficiency and facilitating swifter cargo clearance, enhancing commercial opportunities. Locational economies of scale consist of improvements to port layouts as well as the geographic positioning of provided port activities for all cargo and participants of the international supply chain management system They are based on the position/situation of a harbour relative to its physical site and surrounding environment, as distances to different marine and cargo infrastructure and services i.e. berth configuration can affect time, opportunity and other user related costs, directly and indirectly for those dependent upon harbours.
This includes road and rail transport interlinkages plus infrastructure access and capability – to connect into the surrounding municipality, regional and national economy. These require sufficient planning, provision and integration, in considering the most cost efficacious and useful ports, from the outlook of its dependants, to avoid potential trade barriers, time, delay, congestion and other externality costs of insufficient provision. Projects also need to consider the specific functions of all key port users – for all forms of cargo. It is recommended they consult strategic port callers – cruise ships, vessels requiring repairs, coasters, bunkers and transit vessels for their requirements, improving performance and encouraging demand for their port.

Greater locational economies of scale can even extend to facilities including parking, stores, workshops, container scanning facilities and others. This might include the positioning of customs authorities and port health/police stations with the potential to delay commerce and increase costs for regulatory compliance from a port user perspective, if the examination, customs storage and clearance areas are insufficiently integrated into the port structure and lack sufficient capacity. This could entail

congestion or the inefficiency and financial expense to users of facility underutilization. This traditionally results in higher port and cargo dues, as the port authority seeks cost recovery for its flawed planning from a lack of consultation and adequate assessment of the true projected demand for port infrastructure, services and geographical arrangement. This would extend to the location of the harbourmaster itself: planned to strategically lower port pricing costs, in addition to administration, financing, maintenance and operational costs for which they and other port facility providers are directly or indirectly responsible.

By including indicators, this approach aspires to improve existing methodologies in creating a small port design with active user consultation capable of addressing the extent to which existing port productivity and efficiency can be improved. It aims to identify certain port constraints/degree of underutilisation that could potentially enhance existing port efficiency for port functions listed in Table 2.1. These will aid to consider if a port expansion is always necessary to the extent proposed. This is answerable by the extent to which identified stakeholder concerns and requirements are resolved. These also provide historical indicators over time to determine whether or not a marina or small port is becoming more or less competitive, cost-effective, productive, efficient or user considerate. This dissertation also proposes utilising these key performance indicators in comparing a harbour's existing and future port performance to other examples, as these experience similar concerns, port user requirements and constraints to optimising existing efficiency These assist in establishing advised port improvements, encouraging additional port users, vessels and throughput to utilise the port, enhancing port performance and the probability of cost recovery, amid increasing port-inter-competitiveness. It can therefore further substantiate the extent to which a proposed minor port investment is really necessary or to justify any development or lack of development.

From a port user perspective, the cost of utilising port facilities (often segmented into port and cargo dues) is reflected through the port pricing, tariff methodology and structure and the aforementioned indicators; it is paramount in determining their decision to enter ports. The time in port per ship, together with the daily capital and operating cost per TEU incurred by the shipper, the port and others can influence the total shipping cost per TEU. It influences the extent of potential demand and thus the degree to which marine, cargo and other infrastructure and services need to be augmented and expanded. It is essential to ensure asset cost recovery and a reasonable profit margin to finance the

construction and maintenance of these port functions, basing port financing on the principles of equity and efficiency. Following a port's expansion, ports also need to avoid either under or overpricing, which influences the extent to which stakeholders will support or value port investments. Underpricing inhibits potential port efficiency – requiring the opportunity cost of cross-subsidisation from either the state or other port stakeholders, violating the user pays principle. Overpricing reduces potential port efficiency through lowering quantity demanded of port services amid increasing global inter-port competitiveness. The port pricing mechanism can also be calibrated to ensure that the port authority alone is not the sole source of potential harbour-related improvements – both existing and future, but that port users themselves have the incentive and the capacity of creating optimal port performance. This means not just formulating requirements but choosing the most efficient vessels and increasing the frequency of vessels/cargo throughput (especially occasional marginal callers such as cruise, repair, military, transhipment and tramp vessels that infrequently visit ports based on pricing and other incentives).

As Section 3.4 will elaborate; various risks possess the potential to influence the demand and supply of seaport related functions and the profitability/viability of vessels and cargoes for users. They also influence the quantity and type of facilities sought to be economically sustainable, utilised and profitable. Exogenous risk examples that serve as constraints to a port's future include those affecting the global future of shipping and international trade, in the aftermath of the COVID 19 epidemic and other crises. These plus the uncertainty of derived potential revenue that the Harbourmaster Authority requires to finance any modernisation or expansion prospects. Projected demand for seaport functions validating the extent to which a port expansion is necessary is also affected by exogenous factors such as inter-port competitiveness, which ports only possess a limited potential to influence through their port pricing, tariff methodology and structure. It is influenced by relevant international regulations It is also affected by changes in vessel types, technology, seaport purposes and research. Research is an endogenous factor influencing demand – depending on whether a port authority decides to consider investing and researching port improvements, but also exogenous, dependent on the externally influenced pace of technological achievement.

Endogenous factors that serve as constraints to improving existing port capability, throughput and other indicators of port progress include land, labour, capital, management and technology; all of these

have finite prospects for continuously increasing the degree of utilization, productivity and efficiency. Examples include marine and cargo infrastructure. Most marinas and ports have been present for at least a century, therefore suffering from shortages of available land capacity to further extend the provision of these port facilities from surrounding urban creating inadequate port capacity, location and access often at some distance to the port, further increasing port costs to users. Potential constraints to land development also include environmental, zoning, relocation and opportunity costs of any existing facilities, (commercial, industrial and port related) highlighted by stakeholder concerns Port authorities may not be able to alter the impact of tides, river currents and the ocean itself, but they can alter port and cargo infrastructure as well as layout to reduce the effects of these exogenous influences and to assist vessel users. Potential for improving the quantity and quality of labour, capital and management both for port facilities and for associated transport connections, is finite – eventually reaching peak capacity before diminishing returns to scale and congestion costs occur. Labour strikes, insufficient training and deployment provide further constraints to potential port efficiency disrupting port operations. With capital and finance there is always the opportunity cost of alternative usages of that capital and finance. Most existing ports lack modernisation or peak usage of information and other technological advances, operating at suboptimal levels, as another constraint to port and marina growth. Technology is also finite in its prospects for adding to existing port efficiency, rather than the alternative need to physically expand a marina or small harbour.

Other constraints limiting port activity for any current port development that literature summarises include poor maintenance of existing civic and port infrastructure affecting availability and causing limits to port usage. These include stormwater drains, electricity substations, water and oil pumps/pipelines etc from poor equipment condition along with insufficient capacity, professionalism in maintenance, service frequency and quality. Insufficient cargo distribution and storage capacity, not only increases the potential cost to port users but limits the degree of port activity that an existing port handle. Potential port constraints extend to customs clearance, inspection and documentation procedures, opening hours and even ensuring punctuality. Failure to coordinate port users, insufficient capacity and inefficient operations creating congestion or underutilisation of facilities often creates significant opportunity, financial, time, resource, externality and other costs for all port users. Yet literature and port studies have often erroneously used this as a pretext to justify enlarging a port rather than refining harbour efficiency to resolve common stakeholder concerns. The purpose of these

standardised assessment criteria as constraints affecting most ports, is to assist key marina and small harbour users in being able to recommend and implement solutions to the problems affecting them, to port authorities, to improve the feasibility of port performance, operational and technical capability, overcoming current limits and associated cost consequences of idle capacity.

Stakeholder concerns for small harbours and marinas can be classified as economic, traffic congestion, environmental, social, planning/zoning, agrarian, tourism-related and recreational. Economic concerns include those of displaced economic activity costs from port developments and affected communities – especially the opportunity costs of existing economic activity for domestic and international trade and development. However, these also extend to potential for employment and expenditure from subsequent port progress. Traffic and transport consequences frequently recur in literature as a stakeholder concern, not only with the potential for congesting existing finite port capacity, but in developing future railways and roads as commercial interlinkages to the municipal, regional and national economies (especially to connect supply to projected demand). Additional transport infrastructure also increases health problems from discharged emissions, noise for local residents and commercial activity and time/opportunity displacement costs for all experiencing significant traffic volumes, although expected to be less influential for this research's scope of minor ports.

More recent research emphasises not just the community, environment, climate change and technology aspect as in this scholarship but also the human element (Bilski 2015). This element extends to marina location and layout, object equipment and construction of services and facilities based on user needs or requirements such as links to media, whether for fisheries, recreational and cruise tourism or watersporting events and other activities. These may include the need for floating or fixed dock structures, mobile or permanent sewerage treatment plants and pumping stations plus bunkerage services along with mooring berths/points. Unlike commercial ports, pilots and tugs are considered to be less essential and customs regulations and port tariffs or processes are less stringent or expensive when applicable. It mentioned advantages of sea rescue services and helicopter landing.

Port users also wish to ensure the optimal level of facilities are provided in a port to avoid the financial, time, opportunity and other costs of port congestion or underutilisation of port facilities including lost

commercial opportunities from disruption and delays. Another common concern of those affected by the presence of seaports and any related development, include the environmental consequences of a port development), which may reduce the degree of practical port expansion and other site specific criteria identified above. Examples of these include air, geology, water and soil pollution from port activities: shore based, vessels and connecting transport links, biodiversity and the threat to conservation of unique species – with the implications to the ecosystem from loss of habitat/species/numbers. They include problems of waste disposal, land contamination, vessel/other transport emissions and effluent discharged. Stakeholder environmental concerns extend to the operating policies and design of port infrastructure especially the impact of dredging channels on aquatic species, and the energy consumption of/pollution emitted from port functions and facilities. Local universities and laboratories may also depend on conserving the local ecosystem for research, while reducing it may increase potential flooding, reduce water sources etc. To minimise a polluted environment's ecological and other externality costs during design, construction and operation of any additional dugout port capacity and alterations, this research proposes consulting stakeholders along with subsequent eco port guidelines based on best practises

Planning/Zoning concerns can often serve as another problem identified by previous port case studies especially where insufficiently coordinated consultation has occurred with key stakeholders. Port developments not only create zoning issues (including property revaluation) but may lead to displacing the local community from the negative pollution and other externalities concerned. Ports have to consider maximizing benefits while minimizing the costs to all affected parties. A further recurring port dilemma comes from planning issues linked to integrating port efficiency, productivity and layout improvements for both existing and future projected capacity to municipal infrastructure and the local/national economy. Tourism consequences include potential denying of beach and site access, watersports, yachting, fishing and other existing recreational opportunities. Stakeholder also expressed concerns about the probable port effects on existing heritage, desiring to preserve the residential character of their suburbs, along with preserving places of religious, cultural, historic and environmental heritage. Stakeholder concerns also include potential social, economic and environmental consequences of introducing port expansions where none previously existed, along with improving current port equipment, layout and service to increase port activity – especially the number of vessels calling and cargo throughput, include the additional effects of noise to key port

users. Those affected by more established commercial ports often point to concerns over an increase in crime proliferating in areas adjacent to the port, from increased value-related economic activity and additional levels of demand for drugs, alcohol and prostitution in areas frequented by sailors and other port callers, although perhaps less of an issue for smaller ports. One principle advantage of therefore concentrating upon smaller harbours and marinas is that many of these common concerns do either not exist as problems or at a far more insubstantial and lessor degree, than commercial ports. They are therefore more manageable in the planning and operation of various activities for the blue economy.

2.3 Policies, Legislation and Other Potential Guidelines or Technical Standards for Marinas and Small Ports.

Locally and Internationally, stakeholders have yet to formally agree on a definition legally of what constitutes small harbours and how these differentiate from larger ports. Many global nations specifically lack the equivalent of a Small Harbours Act specifically across South America, Africa, most of Europe, Turkey, Russia, the Middle East, Southeast Asia and the Pacific. Comparatively few provide engineering, environmental, socioeconomic, heritage and other policies and guidelines specifically applying to marinas and small harbours. A summary of existing guidelines identified in this research is summarised in Table 2.2. Certain characteristics as to how these can be defined for smaller harbours as opposed to larger ports are summarised below.

Characteristics of Small Harbours and Marinas.

- Size/magnitude of port.
- Availability of facilities -i.e. not generally offering pilots and tugs
- Location -history/heritage.
- Vessel size
- Less autonomy -being centralised in administration -rather than separate port authorities or a parastatal -often falls directly under a municipality, county or national government department i.e. Canada and South Africa.
- Generally, not present in port traffic, performance and other statistics
- Not often commercial cargo -dominated by recreational, subsistence and artisanal fisheries, nautical and marine/coastal tourism activities.
- More competitive -

Although comparatively few sources formally classify small harbours, this scholarship will focus South Africa's Operation Phakisa Working Group defines a Small Harbour as "*An access point to the ocean and inland waterways that allows for a wide range of value adding through economic, recreational,*

cultural and educational activities to the benefit of the community it serves and contribution to the greater blue economy of the country."

This research perceives a review to be necessary to ensure that any potential stakeholder is sufficiently conscious of the legal risks and implications of their decisions and to provide further certainty. No formal convention directly applies in international law as of 6 April 2020 Common Era binding all parties to work towards a global pollution free or minimised environment, sustainable circular and to prioritise the transition towards a circular economy, prompting compulsory producer, consumer and supply chain stakeholder responsibility for the consequences of their actions related to small harbours and marinas. Nor are they considered an essentially worthy component of contributing towards a sustainable blue economy future by existing policymakers, investors, businesses, individuals and the public outside the communities and visitors they experience, irrespective of their geographical location for many. As subsequent sections will analyse, small harbours as a viable business and general solution is expected to influence questions over access and control to maritime resources, exploitation and use of marine ecosystems, ocean governance, preserving heritage, fishing and tourism communities, enforcing the polluter pays principle, safety, security and the transition towards the blue economy, yet remain underregulated, possibly providing greater flexibility for more daring, adventurous and entrepreneurial supporters of a sustainable blue economy and lifestyle.

Table 2.2: Existing Small Harbour and Marina Laws, Guidelines and Policies

1999 US Virginia Marine Site Selection Criteria	1998 and 2019 PIANC Fishing Port Guidelines
1991 UK Marina Site Guidelines	2004 FAO Guidelines for Fishing Harbours
2018 UK Responsible Fishing Ports Scheme	2001 Australia Marina Design Guidelines
2002 New South Wales Guidelines for Operating Marinas	United States Environmental Protection Agency 1993 Guidelines for Operating Marinas
Canada Fishing and Recreational Harbours Act.	Canada Small Craft Harbour Environment Manual

Source: This Study

The US state of Virginia provides still valid marina site selection criteria (Virginia Marine Resources Commission 1999). It recognises the challenges caused by conflicting of interests including those waterfront speculators who purchase sites to deprive shellfish aquaculture, fisherfolk and other community stakeholders of their rights to access facilities. It proposes separated zones and ensuring that any marina/fishing port development does not radically, irrevocably cause ecological damage downstream to other activities dependent upon it. It proposes 0-50 slips have 1.8 of a mile; 51-100 slips extend to ¼ mile and over 100 slips extend to ½ a mile to a mile. Marinas really broadly defined

as *"Any installation operating under public or private ownership which provides dockage or moorage for boats (exclusive of paddle or row boats), and provides, through sale, rental or fee basis, any equipment, supply or service (fuel, electricity or water) for the convenience of the public or its lessee, renters of users of its facilities."* Yet this loose definition could extend to regular ports. It proposes controls and guidelines related to technical design of facilities, ecosystem protection, soil waste disposal, sanitation, stormwater management, removal of maintenance waste, water depth, salinity, water quality, current and dredging. Other factors include vegetation, erosion control, existing site uses, navigation, safety, threatened or endangered species, biodiversity from adjacent wetlands and other services.

One major port stakeholder representative association established voluntary recent guidelines for fishing ports; although these have yet to consider the extent of true risks and opportunities present (PIANC 2019). The 1998 original guidelines have been amended only slightly in relation to port expansions or construction activities. It notes how these have become increasingly challenged too resolve core risks such as threats to marine resources via poaching and the need to enforce fishing quota, hygiene and aquaculture quality standards, even among smaller ports. Ports also need to connect more to smart ports, Internet, the development of apps and the Internet of Things, magnifying resilience to disasters and other hazards. Infrastructure and facilities need to be renovated or upgraded for many members to remain valid. Updated information is critical. The guidelines specify how fishing ports can especially link to UN Sustainable Development Goals 9 and 14, focusing on various system, operational, service, facility and management functions. It distinguishes between divergent forms of port management and ownership such as state, private, landlord, tool, autonomous and semi-autonomous structures. It reaffirms both the necessity of these guidelines to assist preparation and minimising possible costs along with the lack of clear regulation leadership as best practises conspicuously from existing sources. This chapter recognises the comparative lack of guidance from the International Maritime Organisations; the International Association of Ports and Harbours, International Association of Maritime Economists and various port associations such as the European Seaports Organisation, Association of Pacific Ports; and their Australian, Caribbean, African and other regional counterparts.

PIANC guidelines consider fishing ports need processes, assets, equipment, infrastructure, utilities, staff and investment sufficient to shelter vessels, conduct repairs and maintenance and support other supply chain/value chain processing activities to the extent of stakeholder demand (PIANC 2019). Examples include a quality control laboratory, storage, smoking, canneries and market facilities. Globalisation has increased pressure on minor ports to often comply with international regulations, even when excessive or superfluous -i.e. port security requirements under the ISPS Code imposed after the isolated incident of the September 11th 2001 attacks on the Twin Towers in New York.

The European Union lacked specific minimal regulatory standards for small harbours and marinas and need for guidelines on the environment, safety, security, employment mobility, access - permits/authorisation to entry and other regulations along with infrastructure technical standards (Ecorys 2013). Although no centralised source of best practise guidelines, technical standards and implementations exists globally for small harbours and marinas specifically, this research identifies numerous sources focusing from a primarily engineering perspective aiming at minimising potential externality costs. One example for UK marina sites focused on impacts from various activities such as ports, fisheries, recreation and water quality (ABP Research 1991). These ports therefore consider the need for ongoing maintenance but also the need for well-designed structures to minimise resources dedicated on a more permanent basis such as dredging and waste management to avoid ecological damage, siltation, turbidity and other risks. Increased vessels may adversely affect fisheries, ecosystems and their reproduction/fertility and present risks of increased collisions, noise and seabed churning via greater marine pollution, nose, abrasion, visual disturbance, water depletion, emissions; hazardous waste if not with port garbage reception facilities. It needs to minimise the risks and disadvantages in Chapter 3 including that from maintenance waste, anti-fouling paints, ballast water, sewerage, dredging and various activities from all movements of assets, cargo, people and vessels. European Ports consider the environment under the Habitats Directive, which seeks to minimise impacts for existing ecosystems, especially avian breeding grounds. For example, noise chronically affects dolphin and whale communications among others.

In response to the absence of specific guidelines for small harbours and marinas, the United Kingdom have launched the voluntary Sea Fish Project or Responsible Fishing Ports accreditation scheme (Archer and Jacklin 2018). Users fund independent audits to consider the extent to which different tiers

of ports are complying with recommended best practises. These areas include Food Safety and Structural Integrity, Ports and the Working Environment, Care for the Environment, Care of the Catch and Traceability with specific criteria summarised in Table 2.3. It aims for ISO Standard 17065 international recognition. It distinguishes between smaller ports with facilities only for landing catches (Category 1) and storing catches (Category 2); and larger ports which have capacity to sell and process catches directly (Category 3) and indirectly such as via auctions (Category 4). The aim is to focus on hygiene, environment, waste disposal, responsibility, accountability, safety, security and adequate maintenance, productivity and labour welfare sufficient to enhance reputational risks. In Year 1 the scheme charged 400 pounds plus 800 per day for the site visit, moving to 825 and 850 per day but no application fee in Years 2 and 3.

Table 2.3: UK Responsible Fishing Ports Scheme Criteria Guidelines

Modules/Standard	Aim	Criteria
Food Safety and Structural Integrity	Promote food safety and mitigate contamination risks	• Hygiene Levels • Structural condition • Temperature Insulation/Control • Food protection -site security, protection from malicious damage and extraneous factors
Port and the Working Environment	Provide a safe working environment through enhanced operating and welfare practises and provisions	• Due Diligence and Compliance with Legislation • Improve Knowledge and Skills, • Training Provision • Health, Safety and Welfare
Care of Environment	Promote and encourage a positive approach to environment protection	• Waste management • Recycling • Environmental controls
Care of the Catch; Fish is Food	Promote and maintain food protection	• Grading • Quality maintenance, • Temperature control/Insulation
Traceability	Provide provenance for all seafood handled	• Traceability Systems in place • Food authenticity

Source: Archer and Jacklin 2018.

To consider various risks ports therefore need to consider an Environmental Management Plan, a Climate Change Adaptation Strategy as well as Safety, Security and other Risk Management Plans, Policies and Guidelines, even if smaller ports experience comparatively fewer resources. These also need to receive higher stakeholder awareness, involvement and participation to reduce the possible impact. All port generated waste for smaller ports needs to connect to the circular, green and waste

minimising economies as much as practically possible. It includes eco-friendly materials, provision of low emission based fuel, renewable energy sources, recycling facilities and water recirculating systems/rain tanks to become more sustainable. Port cleaning materials such as biocides, bleaches and detergents can be biologically hostile and need to be replaced with more organic friendlier alternatives. Even concrete and road tarmac can utilise recycled plastic. For areas such as the South Pacific, coral reefs would really benefit in no longer being used as a core construction material, wherever possible. These marinas and ports also need to consider both traditional purposes and new users, finance, operations, management and maintenance, given constrained resources, including community concerns, heritage and stakeholder priorities.

Many guidelines remain decidedly outdated including those for Australia and the 1993 UK ones and even engineering standards have yet to be adapted to ascending risks such as climate change, climateproofing against possible hazards (Australia Standards 2001). The 2001 Australia marina design guidelines focus on vessels up to 50 metres in length along with the need for necessary marina facilities including parking, wharfs, dry and refrigerated storage, berths, boatlifts, access ramps, toilets, breakwaters, channel depths, walkways, mooring points and other infrastructure, fixed and floating structures or essential services. Examples include firefighting, telecommunications, IT, lightning, waste management, electricity, stormwater control and water supplies. It focuses on the need for climate, environment, water and geotechnical surveys. It proposes commercial opportunities such as supply chandlers, a restaurant, shops, sailmakers, bunkerage, laundry, sailing school, yacht sales and charters, liquor store, showers and toilets, commercial offices, vessel and motor repair and valet services.

New South Wales Australia focuses specifically on environmental impact and technical standards as guidelines for operating marinas (New South Wales Department of Urban Affairs and Planning 2002). It proposes the need to consider noise, visual, traffic and water impacts along with echoing others in direct and indirect marine infrastructure and services whilst promoting business, safety and security. Examples include ramps, holding piles, berths; pontoons, jetties, access ramps, docks and berths. It also advises a climate/weather assessment; topography, existing and potential essential utilities along with implications of pollution, local flora and fauna biodiversity, soil, geology and local community when selecting a site. It seeks to avoid the accelerating of existing issues where manageable and to remain

compatible with other levels. Examples include employment, heath, safety and accessibility. This extends to existing heritage, events, recreation, access and land use/economic activities and risks. It specifies guidelines for noise, air quality and waste disposal from fixed, construction and operational activities. It proposes needing action to promote indigenous and deter alien exotic species. It includes considering the need for public transport such as ferries, parking, cycling and pedestrian facilities and preserving heritage.

Another outdated source of guidelines for marinas and recreational boating including degree of effectiveness, purpose and associated costs for the USA focuses on prescribing recommended environmental, waste and water quality standards (United States Environmental Protection Agency 1993). In the definitions, marinas are defined formally as containing a minimum of 10 slips. It specifies detailed environmental consequences applicable of all stages of a marina or small harbour's existence including sediment and habitat disruption, shoaling and shoreline erosion and stormwater management. Unlike more recent studies it provides cost estimates for various environmental studies possibly needed and monitoring programmes. Examples include physical, botanical, water, air, soil and biodiversity quality, effluent, waste, littoral drift and biological survey studies. It provides 30-40 year old estimates of various environmental related possible solutions including a greased swale, vegetated filter slip, infiltration basin/trench, porous pavement, constructed wetlands, a wet pond or sand filter. More contemporary studies are necessary too provide more detailed information specifically related to climate change, green, blue, grey and other natural capital or ecological rehabilitation based approaches. Other solutions included oil grit separators, a catch basin with sand filter or swirl concentrator.

Marina Del Rey in Los Angeles California extends over 403 acres of land, 401 of water and 4700 moorings in Los Angeles. The marina includes parks, boat storage, residential, commercial marine and tourism zones as well as a bike trail, boat storage, police station and parking, whilst preserving wetlands. (Los Angeles Department of Beaches and Harbour, 2016). It also provided guest docks, specialised slips, a local library, a dinghy dock, Visitor's Centre and Beach facilities. The design guidelines proclaim a Marina del Rey Vision Statement to aspire to as a "*vibrant, sustainable, pedestrian, visitor, resident and boater friendly destination that supports water orientated activities, provides low cost access to the water, contains a variety of shopping and dining experiences, and is*

a premier location where people want to play, relax and live." The detailed planning design guidelines provide several examples of recommended best practise that would benefit those seeking to prioritise small harbours and marinas as essential catalysts towards the blue economy. It contextualises a marina as linking visitors and other uses between the urban and natural environments to the aquatic domain, showcasing this element rather than submerging it. This includes providing a promenade, suitable facilities for all general needs, signage and local information about the place on displays and via exhibits or art sculptures. Sport activities need to be possible. It means considering pedestrians and aesthetics; minimising aspects that deter from the visual, sound and other senses. Designs need to be sustainable and buildings follow green standards where capable. Aside from public art this entails cycle lanes, pavements, raised walkways, benches, tables, garbage and recycling bins, lighting, ferries and scenic cruises along with landscaping with suitable trees for shade, shelter and climate suitable vegetation. It recommends facilities for boaters, pedestrians, tourists, retailers, residents, government, cyclists and the disabled along with courtyards and plazas considering daylight and parking. It advises minimising water consumption and creating water features.

Canada's Small Craft Harbours focus upon the vision of: "*provision of an essential, national network of safe and accessible harbours, in good operating condition, that meets the principal and evolving needs of the commercial fishing industry, while supporting the broader interests of coastal communities and Canada's national interests" (*Fisheries and Oceans Canada 2014). Fisheries and Oceans Canada has a total of 1039 harbours with 743 core and 296 non-core fishing and recreational harbours under 3 divisions Client Services, Engineering and Integrated Program Planning and Analysis. However, although it divested itself of harbours, Canada stipulated the need to retain existing community and public access for the first 5 years. It advises lifecycle management focussing on planning and design, construction, operation and planning; reuse or removal focusing on sustainably, ease of access, durability, avoiding congestion, and others. With few resources it evaluates priorities. 694/793 smaller ports have more independent harbour authorities and management. Canada therefore prioritises port investments on criteria of safety/risk management and functional needs, degree of harbour isolation and market access, management, activity and the economy.

Unlike many nations whose small harbours and marinas were constructed or renovated mostly decades ago, Canada's annexation of Nunavut gives it more contemporary experience then many in modernising this sector (Fisheries and Oceans Canada 2006). The area is characterised by more traditional, indigenous and artisanal fisheries dependent communities. The source recommends evaluating existing status of fisheries ecosystems, infrastructure and transport linkages to improve operations, interlinkages and prosperity. It proposes fixed/floating wharfs and installing community freezers to store more harvested produce. Other characteristics it is considering include tide access (cheaper for high tide than low tide too), an entry channel, marshalling yard, breakwater, dredged basin and launch ramp. It advocates investing $41.2 million for 5-8 years. To implement small harbours in a new territory it is considering core issues of ownership, project funding, site selection, operation, maintenance, risks and management. This would support 26 communities and around 500 vessels with minimal current tourism or other ocean economy activities with parallels to South Africa and various other developing nation harbours. It projects a total $14.380 million to GDP to harbour and $8,510 million to labour income during construction and an additional $520 million and 440 million respectively each year. It aims to reduce regional unemployment from 23 to 17% via 198 direct and an unquantified indirect job creation effect. Other benefits include emergency search and rescue provisions being improved and improved artisanal handicraft raw materials and social improvements from reductions in poverty. The source recognises high costs from the extreme remoteness and frigidity of the near Arctic regional operating conditions and relative transport inaccessibility, lack of skilled labour, equipment, technology and capital. Charts need updating and the source advises a 15% contingency reserve fund. It proposed a partnership with the community who offer voluntary labour, whilst they provide more of the expertise.

Canada's foresight in preparing new ports has extended to creating a Small Craft Harbour Environmental Manual, tasking Harbour Authorities with either using these as guidelines or drafting their own (Fisheries and Oceans Canada 2012). This has provision for dealing with contaminated waste sites, recycling and conventional waste banning dumping, the need for a full dredging and environmental impact assessment including risks and pollution sources during construction phases. It includes enforcement and mandatory data collection and storage requirements to monitor various changing conditions in water, environment and climate. Emissions, sound, air quality, smog and litter should each be targeted under due diligence processes and regular cleaning. It recommends

nominating a specialist representative to attend to it and more eco-friendly guidelines for maintenance, solid, fish and hazardous waste, pollution and oil spills along with other incidents. Biodegradable cleaning products are advised for vessels.

The Food and Agricultural Organisation published 2004 recommended methods to establish artisanal fishing harbours and village landings (Sciortino, Barcali and Carlesi, 2004). It distinguishes between small ports and artisanal landings. The latter are defined as for smaller and brief fishing trips up to 24 hours, inshore often without slipways for artisanal fisheries, refuelling up to 10,000 litres and without breakwater/other protection and minimal facilities such as a wharf. This aims to minimise pollution; address safety, hygiene and quality control for seafood and consider using renewable energy along with sound infrastructure standards, port management and enough amenities for user needs. It argues the need for a suitable harbourmaster authority to address management, maintenance, funding, law enforcement, hygiene, environment and other standards; statistics, safety and security. Depending on the port, those dealing with ferries, fisheries, various tourism and commercial activities may require staff. It advises environmental and hydrographic surveys. It is also essential to consider international legislation based on prospective liability and marketing/reputational risks, even if not directly affected or relevant.

Ideal international guidelines for marinas and small harbours to comply with legislation for core global risks and problems include the 2015 Paris Agreement on Climate Change, the 2019 UN High Seas Treaty, the 1982 UNCLOS, the Montreal Protocol for the Ozone layer, MARPOL and London Conventions on marine pollution, 1974 SOLAS, the ISPS code and UNFCCC. Ideally the source proposes the need for ports to eliminate marine pollution, avoid erosion and ensure dredging, sanitation and public health. It specifies standards for hygiene, hazardous, regular, recycled and oil waste, pest control, water and air quality. The aim is to mitigate aesthetic, pollution emission and climate-ocean-environmental condition changes. The guidelines specifically mandate social and environmental impact assessments with stakeholder engagements. As part of the advised methodology it proposes a hazard analysis and critical control point programme to monitor and address individual waste and effluent types.

As detailed later in Section 3.5 comparatively few sources have provided guidelines for addressing climate change for small marinas and harbours (Dyer 2018; Samples, Riseng and Diana 2014). One source advised the need for stakeholder engagement via various events, interviews and surveys (Samples, Riseng and Diana 2014) to consider various climate risks, potential impacts and experiences to assist in forming best practise and risk management plans. A rather low sample of 27 responded, advising the need for simplified, user friendly information and reducing uncertainty. The source focuses on various US tools and approaches along with mentioning the need for effective risk evaluation assessments and cost-benefit analysis of potential impacts and adaptation. It cautions the need for greater awareness and communication. An alternate source emphasises the need for climate change resilience at small harbours and marinas via assessing various potential risks and impacts such as changes in water level and availability (Great Lakes Clean Marina 2014). This means subsequently modifying infrastructure technical standards to consider future long and short term risks. It considered average physical adaptation costs of $53-83,000 per marina direct engineering costs. It recognises that operators could benefit from considering various climate related technology, information, financing and other preparation toolkits and approaches. The World Ocean Council as of 2019/2020, as of personal experience by this particular professional maritime economist are also engaged in seeking to mobilise private sector interest and investment in climateproofing future port investments via grey, green and blue infrastructure/assets to specifically mobilise this. Although formal laws do not formally exist internationally and domestically; section 3.5 provides best practise recommended approaches towards climate change risks, impact costs and adaptation strategies.

In South Africa the more recent example of expanding Simonstown Marina by Cape Town and the False Bay Yacht Club (Botha and Badenhorst 2016) set up a special Marina Development Company in 2004. It proposes to improve vessel sheltered anchorage via a Sealflex structure with myriad cited environmental and other advantages including a new breakwater; 30 year lifespan habitat for species; reduced seabed disturbance and sediment along with additional profit or rent from newly protected docking bays. The second alternative merely focused on engineering a new breakwater, without securing funding, with a more vulnerable rubber pipe as anchorage. It conducted an environmental impact assessment which recommended investigating issues such as geology, biodiversity, land use; socioeconomic conditions, historic and cultural aspects, surface, groundwater and soil. Another example in Croatia includes Marina Tucepi in Croatia, adding to the 71 existing marinas (Bozidar and

Favro 2017). It favours eco-tourism via more sustainable eco-marinas with guidelines others could follow including green building design and construction standards; waste recycling and water recirculation plants, solar power generators and eco-friendly paint/maintenance practises.

2.3.1: Proposed Characteristics of a Small Harbours Act

South Africa echoes many other African and global nations in not possessing a unique regulatory framework for its 50 existing and 12 functioning small harbours (Ntuli 2018). The 12 harbours are Stilbaai, Lambert's Bay, St Helena Bay, Saldanha Bay, Gansbaai, Arniston, Kleinmond, Hermanus, Struisbaai, Gordon's Bay, Kalk Bay and Hout Bay. In helping to determine the extent of existing demand from local vessels, it can assist not only to consider historic community usage and experiences but existing stakeholder demand; related blue economy projects but also predetermined fishing rights, fisheries management protocols and quotas as an indication of the number of vessels permitted (South African Department of Agriculture, Forestries and Fisheries, 2013). The characteristics of permitted vessels and extraction methods can also aid planning, maintenance and operational practises. Examining ship registries under cabotage incentives and safety requirements can further confirm this to avoid providing too many or too few facilities such as berths, quays, storage etc. For example, in 2013 South Africa allocated only 455 vessels and 3450 crew fishery rights.

Therefore, the absence of this framework creates significant policy uncertainty for those wishing to become involved but also opportunities from a less stringent regulatory environment, enabling greater opportunities. For example, many small island developing states, South America, the Pacific or Africa offer significant prospects for entrepreneurs wishing to enter this blue economy sector from a legal perspective as of 2019, few of its own industry stakeholders or global markets are exploiting this. Few governments currently have specific reference to marine biotechnology, often exempted from related policies and strategies. It is however recommended that various government stakeholders and the African Union consider specific policies for the various small harbours and marinas. It is concerning how few policies are truly long term in their approach without recognising the need to avoid species extinction, preserve marine biodiversity, protect and punish against marine pollution and other ecological threats and ensure resilience against climate change. Public health remains critical given the COVID 19 pandemic. Based on international best practise and policies; a comprehensive blue or

marine biotechnology and framework would decisively include the following core elements with a specific overview of processes and maximum rather than minimum time period articulated clearly for each involved. Many of these elements are missing from even the most developed of policies, laws and strategies reviewed in this research and in other sources. Proposed characteristics of a Small Harbours Act or operating framework should consider the following

- Designated powers and responsibilities, capacity to make, amend or repeal regulations
- Site selection criteria
- Management, operation and maintenance
- Risk management and links to other legislation including safety, security, environment, water, Admiralty Jurisdiction, cargo, fisheries, tourism, etc.
- Freedom of financing, lease security and concession, ability to set port/marina user fees; fines for infringement and incentives
- Freedom over selling/procuring assets and properties/pay supply chain on time without the rigorous onus of centralised government procurement policies inhibiting development.
- Links to fisheries, aquaculture and other blue economy areas
- Ocean sovereignty and governance; creation of marine protected areas and private reserves.
- Marine spatial planning and functional zoning/integrated coastal zone management
- Links to blue carbon expansion and preserving
- Preserving of marine biodiversity and ecosystems; Regulated introduction and exploitation of rare and exotic species sustainably.
- Need to establish marine reserves and protected areas.
- Education, research and training.
- Specific ring-fenced budgetary resources provided for long and short term maintenance, potential expansions/construction and 15-20% for contingencies.
- Environmental, water/ocean impact assessments for certain activities with a maximum specified time period.
- Research, information; marketing, commercialisation and all value chain issues.
- Trade regulation, exports and provision of financial, investment, research and other incentives.
- Resolving market barriers to entry -competition; infrastructure and standards;
- Issues over marine resources,
- A suitable enforcement, regulatory and independent oversight/appeals authority
- The extent of public participation and consultation in the process
- Avoiding of marine threats -issues of Polluter Pays Principle, carbon footprint offsetting, and company liability. Risk management. Need to ensure recycling, reduction of bycatch and related waste and the principle of ensuring the circular economy wherever possible.
- Issues over resources as climate change develops
- Links to other policies and supporting legislation
- Specific prescribed legal and other penalties for violations
- The resolution of disputes and appeals process

In designing future marinas and small harbours, as Chapter 3 highlights, sustainability is becoming an increasingly integrated concern that is advised to be factored in (McKinley and Robins 2012). This extends to the entire related marina cluster and extended supply chain/ocean dependent economy focusing on the environment and community not just the economy. A significant constraint remains overcoming popular and influential policy makers' perceptions of marinas beyond as merely a mechanism to benefit the selective affluent elite privileged enough to own a boat or directly work there. The source argues certain guidelines for a good marina. These include the following as examples of best practise. It also recommends community engagements and partnerships to identify how marinas and small harbours can be of direct value to those around it for mutual benefit. It advises education people on the need for more sustainable practises such as recycling. Knowledge and experience exchange with other operators can assist in pooling technical, legal, marketing and other expertise from finite scarce resources, reduce risks and issues of failure and connect opportunities not just competitors. It proposes a Marine Passport so that users have incentives to visit multiple small harbours to mutual benefit. It advises encouraging local businesses to become involved and sharing updates on key potential legislation, financial and other policy incentives where possible with other authorities, harbourmasters and operators. The source concedes mutual risks exist for market entrants including fluctuating fuel prices, development costs; high European and Caribbean competitive pressure, risks over corporate social responsibility, circular economy and marine conservation pressures. It proposes marketing events such as "Introduction to Sailing Days," Marina Open Days, Farmer Markets and regattas.

It considers a good marina will:

- *Be both economically and environmentally sustainable, with a significant role within the local community in terms of leisure activities, economic growth, jobs provision and skills and training*
- *Have strong links with tourism organisations, promoting the local area and attractions to visitors to create a more complete destination for both permanent and visiting berth holders.*
- *Will be well established as a community asset, viewed as a vital component of Channel communities, with support from local authorities*
- *Operate at close to full capacity on both sides of the Channel and will promote cruising between sites to ensure widespread benefits of visiting vessels.*
- *Have a thorough understanding of the environment and planning legislation impacting the sector, through improved relationships with policy makers and increased involvement with the marine planning process and future policy development*

- *Have strong environmental strategies in place, engage widely with associations such as the Green Blue to improve awareness among staff and customers, and ensure the sector is as ecologically sustainable as possible.*
- *Will have collaborative and mutually supportive business relationships with local and regional businesses.*
- *Will feel effectively represented at all policy levels by their trade association and have a "voice."*
- *Will be actively engaged in sustainable operation practises, ensuring they are providing the highest possible quality of service to their customers. Action points will include provision of WIFI at berths, promoting green behaviours via provision of recycling facilities, effective grey water dispersal facilities, providing information on sensitive local marine ecosystems and ensuring there are effective management practises.*

Best Practises for small harbours and marinas should consider the following:

2.3.2: Small Harbour and Marina Design/Operational Plans and Technical Standards Guidelines

- Construction Plan/Site Specific Selection Criteria as in Section 2.1
- Engineering/Technical Design Standards
- Business/Operational, Financing, Marketing and HR Policies/Plans -education and training
- Environmental Management Plan, Climate Change Risk, Impact and Adaptation Approach;
- -Sound, Light, Air and Water Quality, Pollution etc.
- Safety, Security, Oil Spill, Pollution and Other Risk Management Approaches
- Circular Economy -Recycling-Waste Management, Water Security and Renewable Energy Plans
- Maintenance Policy
- Ocean Governance and Marine Conservation -Enforcement
- Community Engagement/Social Responsibility
- Specific Fisheries, Marine/Leisure/Cruise Tourism and other blue economy requirements
- Cybersecurity, Data Gathering/Statistics and Management Protocol.

For a well-functioning small harbour or marina to operate, this maritime economist recommends the following at a minimum.

- Sufficient funding/reserves to ensure a 15-20% contingency reserve along with operations
- Minimal, well trained, experienced and qualified staff professionals
- An effective, cyber-secure IT and Port Community System and external site backup
- Sufficient and well-maintained assets, infrastructure and equipment to address stakeholder needs
- A suitably climateproofed and sheltered physical office
- Provision of Internet services (paid for)
- Provision of bunkerage -including cleaner fuels, renewable energy, water minimising facilities
- Marketing budget
- Hosting events etc to stimulate sufficient community interests such as regatta etc,
- Proper legal contracts offering security of lease/tenure for local businesses, yacht clubs, recreational users etc subject to certain conditions such as environment/heath etc.

- Considering a competitor analysis on what competitor counterparts are undertaking and responding accordingly.

2.3.3: Investor Guidelines/Criteria

These are not extensive but include:

- Site specific characteristics and marketing -i.e. location; availability of attractions/services
- Commercial indicators (See section 3.4) such as profit, Rate of return on investment
- Fiscal Incentives, fines and penalties
- Extent of regulations -are they practical or excessively bureaucratic and onerous as a detriment
- Security of leisure/property rights and tenure
- Local development of marina/fisheries and surrounding economy -does it provide growth potential
- Competitors -considering an opportunity cost on the rate of return on potential investment?
- Social, environment, heritage and other factors.
- Extent of management, maintenance and receptiveness to client/stakeholder requirements- i.e. reputation and experience.
- Environment/Climate Change Hazards
- Possibilities of considering well marketed marinas -i.e. positioned to offer adventure/experience-based tourism
- Possibility of smaller harbours and marinas in attracting visitors seeking a reprieve from more congested ports of larger cruise vessels and more tourists.
- Possibilities of reducing commercial congestion from larger ports.
- Integration into Smart Ports/4th IR and efficiency
- Greater eco-chances and sustainability-tourism -smaller ports have less contaminated beaches and marine environments than commercial ports -for creating blue carbon finance, marine reserves, blue economy activities and other opportunities as in Section 3.6.
- Marine real estate on land and at sea is far cheaper/can be more characterful, yet often still accessible for more historic and established ports in smaller harbours and marinas.
- Growth of smaller harbour/marine leisure based tourism may prosper given escape from climate change emerging risks, high congestion from land over population and contemporary public health risks such as the COVID-19 Epidemic -as more may seek to physically escape -far safer and less exposed out at sea/visiting smaller ports for those who can afford it.

2.4: Evaluating Case Study Methods, Lessons and Approaches: Successes/Progress

Small Harbours offer a peripheral focus for many in this Age of many pressing priorities, except for those who directly often value and benefit from them and have served as an underappreciated, under-researched and yet valuable sector as part of the emergent blue economy. Understanding past, current and future efforts to resolve the challenges currently experienced by small harbours and the subsequent myriad roles they conduct; can subsequently channel our time, attention and other scarce resources towards actually accelerating progress on this issue. This is far more productive rather than

this report being yet another one in a snowballing series of published reports and scholarship. This section provides a literature review summary of historical and contemporary marine pollution reduction case studies that succeeded with certain factors that contributed to their potential success. It proposes that if any region, nation or any value chain and related stakeholder were to consider implementing lessons contained here, it could reduce potential externality, maladaptation and opportunity costs in learning from other case studies that triumphed. Not only does this provide the enabling conditions for subsequent blue economy sustainability and prosperity, it also becomes a series of aureal opportunities. As Chapters 3 and 4 will testify, few updated marina, fishing port and adjacent marina/land waterfront real estate exist across Africa, small island developing states, the Southern Hemisphere and globally for myriad prospects exist for the alert investor or any circular/blue/green economy supply chain participant.

The sample of existing surveyed case studies analysed in this source is summarised in Table 2.4 below. The majority of research present appears to target Europe and the Caribbean, followed by the odd source for Australia/Oceania and the Middle East or South/North Africa. Smaller ports and marinas have seldom appeared to be investigated for Mexico, Central and South Africa and Sub Saharan Africa, most of Asia, Small Island Developing States, Russia and many South Pacific islands. One case study of a yachting marina partial success, the Marina di Stabia in Castellanmare di Stabia, Italy (Bizzarri and La Foresta 2011). It cites advantages of increased cashflow and profits for locals but concern over additional congestion, pollution and threats to historic cultural heritage. The nautical tourism industry supports over 92,000 employed directly in Italy. Other concerns include just how many marinas are really necessary in Italy when a port exists on average every 14 kilometres and around 20.5 berths exist on average per kilometre of coastline. It therefore makes sense to prioritise renovating existing marinas and small ports first, rather than automatically constructing new ones. Conflicts are often present between seasonal visitors or occasional callers/tourists versus locals.

Table 2.4: Examples of Existing Case Study Successes and Lessons

Marina di Stabia, Italy	Ireland Bullock and Sandy Cove Harbours Draft Master Plan
A study on Latvian Ports -Engure municipality	Irish Sea Fisheries Board 2013' study on small harbours
Cork Harbour, Ireland	2018 Isle of Man Strategy for 5 small harbours
Anguilla Mega Yacht Facility Feasibility Study	Association of Marina Industries 2018 US study on marinas
Los Angeles Marina Del Rey	Alexandria Virginia Marina Feasibility study
Shute Harbour, Queensland, Australia	7 Nunavut Harbours Canada,
Canadian Atlantic Ports	Laaiplek Harbour, South Africa

Other South African Small Harbours	

Source: This Study

The Ireland Bullock and Sandy Cove Harbours Draft Master Plan emphasises the need to retain cultural heritage aspects as integrated parts of planning and operation not just from a tourism or fisheries perspective but from a more ethereal and intangible community heritage perspective (Comhairie County Council, 2019). It cites advantages of social atmosphere, heritage, a good community ethos, tourism, health, economic activity and accessibility as locational advantages against constraints of a lack of investment; few toilet facilities, anti-social behaviour such as vandalism and littering, poor resilience due to weathered wood and climate change risks and risk perceptions underestimating its value and threats. Other concerns include possible environmental and recreational impacts and the need to retain the character of the area including adding a promenade or managing tourism/traffic. The ports also include sea scouts, sea rescues, aquatic sports such as kayaking and anglers along with boat hire. Potential solutions from the Master Plan will also include improved bus and rail link access. Bullock Harbour will gain from a cycling hub; micro-enterprises from shipping containers such as for vendors, more benches and greater footpaths for pedestrians. Sandycove Harbour can gain similarly from repaving the boardwalk, a new café and streetlighting.

The European Union has also considered marinas and small harbours to indirectly contribute to recreation and coastal tourism, provided the challenges of sustainability, the absence of a regulatory framework, funding and policy certainty are resolved (Ecorys 2013) .It advises the need to consider how tourism may be seasonal in effect, yet livelihoods require sustaining throughout the year and the challenges of remaining competitive given a high supply of various facilities present across Europe. The sector remains uncoordinated, potentially needing more funding, devoted skills, training and career interests. Yet it has multiple economic benefits as visitors stimulate transport, food, textiles, gifts, fuel, accommodation, finance, insurance, travel and other economy areas, especially for less popular coastal settlements. In 2013 European yachting and marinas alone was estimated to employ over 253,000 direct and 372,000 indirect. It mentioned advantages for smaller ports for which cruise tourism could not directly access and potential demand from BRICS nations. However, it did indicate the need to consider more responsible impacts of tourism, resolving marine waste and other pollution sources; to evaluate the extent to which activities are “green” or sustainable along with reducing ecological pressures and damage. Latvian ports also provide an example of a successfully integrated

community model promoting entrepreneurs and artisan skills, planned with local cities, employment, ecosystems, tourism and fisheries (Straubergs and Lukstina 2019). In Engure municipality for example 260 people were involved in fish processing but it also hosted an ocean catamaran factory, fishing port, marina, sailing academy, a boatyard, charter and tour services. It specifically seeks investment to link it towards the blue economy.

In contrast Ireland are focusing more on preserving the fishing aspects of harbours across 40 lessor ports and 80 minor piers (Irish Sea Fisheries Board 2013). It advises evaluating the socioeconomic demographics of the area and indicators such as the physical number of vessels and people employment in related industries such as aquaculture, processing, fishing and wholesale aspects. Demographics indicate that boating is perceived as less of a younger generation's pursuit and those more affluent and elderly interest with greater interest, experience and leisure time (Kinsella 2014). More favour used than new boat sales, often due to the price differential. In the US second hand comprised 91% of total sales in 2012. Fisheries are becoming fewer but larger in vessel sizes due to changes in vocational interests, improved efficiency of processes, technology and reduced fisheries yields. In planning marinas and small harbours, sufficient attention has to be considered as to whether sufficient demand therefore exists to generate a viable rate of return on investment (Kinsella 2014). The source proposes the need for biological, upland, geotechnical, coastal or river analysis, preserving ecosystem functions, construction and operational footprints wherever possible. Aquatic species still need access. Sufficient signage was found to be beneficial.

In Ireland Cork Harbour's marine leisure industry received a standard economic impact analysis methodology to determine market opportunities, existing direct visitor and resident expenditure and output along with direct and indirect employment (Medina 2017). In 2016 10.94 million euros was directly added to the local economy along with 29 direct and 290 indirect jobs from 555 berths and 1035 moorings. The source specifically excluded fishing and other commercial industrial activities along with 69 cruise vessels, all of which provide demand to local businesses such as tours, ferries, chandlers for supplies, bunkerage, vessel repair and marine engineering, shops, restaurants and 6 yacht clubs. The proximity of the world's oldest continuous yacht club -the Royal Cork Yacht Club of 1720 attracts other visitors and the Cork Sailing Week event. Cork Harbour has considerable demand and popularity with an average berth occupancy rate of 79% and mooring rate of 97% due to significant

marketing, quality of facilities, services and reputation. On average around 400 sailors per day were estimated to be present. The 29 direct marina staff jobs include the Harbour Master, marine engineers and boat repairers, marina maintenance and dredging, staff and administration.

The Isle of Man's approach to invest in 80.37 million pounds for 5 small harbours is to consider the constraints and opportunities of each (Isle of Man Government 2018). It aims to "look to the future" and "value for money" to remain economical when preparing. A proposed layout is identified in Figure 2.3. Small vessel berths yielded around 1,160 pounds per vessel on average. It proposes investment in dry stacking for boat storage and 24/7 permanent vessel access for greater flexibility. Current identified harbour constraints echo others globally in ranging from geophysical and technical, to reduced land and water space based on existing usage with few ferries, cruise tourists and fuel bunkerage services. Others include remoter access for certain island harbours, dredging and mobile crane limits and tidal access. It proposes pier renovation and berth redundancy, a wind farm extension for renewable energy, pontoons, breakwaters, an expanded search and rescue station along with supporting services such as marine engineering, fabrication and related supply chain businesses. Marine insurance, waterfront property, events such as a regatta and a club could provide additional revenue generating activities. Existing ports are seldom redesigned to optimise efficiency and performance. As part of its investments it looked at a 350 metre long, 25 metre wide floating breakwater and prospects for cruise tourism, although mindful this may place considerable pressure and congestion on local communities from an influx of 2500-5000 passengers at any one time. It does not control pilots (similar to South Africa's tugs falling under Transnet at commercial ports not small harbours and the Department of Public Works) and 3 million pounds spent on 2 tugs, yet many smaller vessels do not require these. Cruising would also yield the need for additional security, supplies and passenger handling facilities as a major expense for seasonal and uncertain fluctuating trade. However, against that is the fact that the Isle of Man received over 62000 passengers in 2017. Poor weather prevented over 3,000 others from voyaging.

Figure 2.3: Proposed Port Douglas Small Harbour Layout Investment

Source: Isle of Man Government 2008.

The Caribbean has an extensive history of experience for marinas and small ports from a tourism perspective along with publicity and research studies meant to validate their potential market and investment necessity. One example of an Anguilla Mega Yacht Facility Feasibility Study considers the market, the coastal environment, existing wildlife and marine protected areas along with climate related risks such as the need for greater resilience from sea level rise (Government of Anguilla, 2018). It identifies the absence of existing marinas for 5 possible sites. It considered various aspects such as physical facilities and direct ocean access, market proximity, competitors, quality, climate and environment. Others include location and proximity; environmental impacts; land use; safety; coastal geomorphology such as currents, waves, wind and storm surge. It contends that a mega-yacht status (i.e. over 46 metres or 150 feet) requires additional tourism attractions, decent Internet connectivity, an international airport; good bunkerage, repair and provision prices, swift customs and excellent medical facilities and a depth of at least 5 metres with smaller yacht of 3-4 metres. It estimated macroeconomic benefits of up to $2 million, 11 direct and 41 indirect jobs. Yacht charters can reach

up to $1000,000. Another European source identifies how marinas can complement other forms of local economic development such as nautical tourism, charters and cruising (Kizielewicz and Lukovic 2013).

The Caribbean are starting to recognise the need to reduce dependency on cruise tourism via economic diversification given the significant pollution, congestion and minimal expenditure associated with passengers, firms and companies (Phillips 2014). One demand model estimated tourism contributed 1,976,000 jobs in 2011 alone and $47.1 billion to regional GDP. In 2014 the Caribbean hosted 140 marinas and 7340 berths across 16 territories with 13 marinas in St Martin, 11 each in the US Virgin Islands, Grenada and Anguila. Essential marina services include provision of sheltered anchorage; essential supplies, repairs and equipment; attractions; chartering services and refuge against natural disasters and events such as storms, gales and hurricanes. It extends to laundry, medical, banking and entertainment services. However, all these benefits require considerable investment costs with the source estimating average costs of developing a berth between $50-$60,000 in 2012, 8 years ago. To justify the need for investment the model considers several socioeconomic and climate variables including incomes in source markets; number of yachting arrivals, the price of jet fuel, frequency of hurricanes, charter services price; consumer tastes and preferences or presence of amenities

Another industry and publicity biased source on the economic impact of US marinas (Association of Marina Industries 2018). 11,500 US marinas contribute over 105,000 direct jobs and $5 billion in economic impact but more than $18 billion to the total economy dominated by Florida, California, Texas, New York and Massachusetts. Its modelling methodology distinguishes between direct, indirect and induced economic effects but underestimates the socio-environmental-community and other impacts of a marina's presence, as do other industry dependent sources. It contributes over $927,000,000 in Federal taxes. In 2017 Los Angeles' Marina Del Rey conducted a subsequent visitor's survey which this chapter recommends as an example of best practise to secure the need for continuous feedback receptive to clients and other users along with continuously adapting provision of services and management. 961 survey respondents participated with 51.7% motivated by aesthetics, heritage and environment; 47.6% ambience and atmosphere; 47.5% climate; 37.5% dining and 31.7% recreation and activities. 70.4% favoured the beach, 36.1% shopped, 31.8% the walks and

pedestrian facilities, 30.1% festivals and events and 20.1% parks (Los Angeles Department of Beaches and Harbours 2017). This influx of visitors was estimated to produce considerable macroeconomic benefits including $418,510,000 to the local economy including $12.6 million in taxes and $321,930,417 in direct visitor expenditure. This excludes indirect community benefits from various events such as fireworks, lights, food trucks and a summer concert along with other events.

The USA focus on myriad components beyond the simple provision of facilities that need to be included for small harbours and marinas as a highly specialised area of research and design (Moffat and Nichol 2017). For example, one case study of Alexandria's marina in Virginia worked out projected revenues, costs and pricing, staffing, operational and regulatory conditions along with a market demand and supply analysis based on industry trends, demographics and customer demand. These assisted in the formation of facilities necessary. It means capitalising on existing waterfront assets as much as possible. Site selection criteria included geology, environment, climate, access to existing tourism, retail and other facilities and space available for City Marina, Robinson Terminal North/South and Point Lumley options. One site needed wave and debris deflectors. It proposes the site needs dock lighting, fire equipment, fibreglass or polyethylene dock boxes for vessel maintenance and equipment storage, a solid and recycling waste collection service and sanitary pump out systems at any site selected. It also raises the need for security guards and systems, parking and drop off zones. Minimal advised staff requirements include a marina manager, supervisor, bookkeeper, administrator, security, engineer and maintenance. It proposes a 25 foot slip offers only around $3000 in yearly revenue compared to $5,940 for a 45 foot dock and $12,960 for a 90 foot dock against projected staffing costs of $240-260,000 per year and insurance costs of $115,000. However, it ignores the potential to obtain revenue from other sources such as commercial enterprises. A competitor analysis revealed that whilst 100% of neighbouring marinas possess water and sanitation and 92.3% electricity, only 6.7% offer Internet; 7.7% shopping, water sports and diesel and 13.3% phone facilities.

Another marina design study in the USA emphasises excellent water access as among the most influential criteria in the decision of strategic marina users (Keogh 2008). It emphasises the core need to establish successful marketing, core maritime industry clusters and networking to capitalise upon prospective clients and experience for a new market. It proposes determining price and a competitor analysis. Prices do not have to be uniform but can be based upon discrimination and bundling. It

proposes investigating insurance and other unavoidable expenses to be as economical as possible based on the user pays principle. Staff need to be minimised but compensated well, trained diversely and motivated to optimise performance and cost recovery. It identified fewer than 300 marina managers are certified globally by the International Marina Institute and advises following it as a reputational selling point and example of industry best practises.

A socioeconomic impact assessment of Shute Harbour Marina in Queensland Australia (Shute Harbour Development Ltd, 2008). It was constructed from 2008-2011 projected to contribute $253.4 million in direct expenditure and 78-192 workers employed during construction or 142 full time employed during operations. Up to 75% will be employed from the local community as a priority. Marina facilities included power, water, garbage, telecommunications, Internet and other basic facilities along with a marina office, parking, charter boat waiting lounge, dining and retail options, a 5 storey tourist resort and other accommodation. The source recognises the need for community consultation to preserve its lifestyle and culture as much as capable. Public transport, pedestrian, parking and cycling access remain critical. It proposed a regional economic growth by $322.9 million and Queensland growth by a minimum of $452.5 million. Household incomes were forecast to improve by at least $13.4 million. It also conducted a systematic cost-benefit analysis with a minimum projected total net benefit of $299.2 million, against a value of $984.5 million and costs of $685.3 million. Marinas are viewed as primarily benevolent to facilitate local economy opportunities, sourcing labour, business, production and materials locally as much as possible.

Existing socioeconomic factors and demographics will assist in determining the extent to which Shute Harbour and others can remain sustainable beyond seasonal traffic from non-local vessel, tourist, fisheries and other callers. Potential also exists for skills development and increased career awareness/related opportunities. Stakeholder consultation expressed concerns such as about the resort's height as possibly impairing views, implications of dredging on local ecosystems, electricity restrictions currently existing, too narrow a channel for superyachts and how it would be financed. The project consultants proposed a variety of standard environmental economics assessment tools to assist in quantifying intangible ecological, social, community, tourism and other benefits. Examples include contingent and equivalent valuation, choice modelling, hedonic pricing, the travel cost; factor of production, producer and consumer surplus along with defensive expenditure techniques.

Canada's approach to Small Craft Harbours recognises the need for community involvement in management and the invaluable role provided in subsisting livelihoods and societies (Canadian Parliament, 2009). It proposes the expectation to generate sufficient revenue, address climate safety and security risks under the Fishing and Recreational Harbours Act. From 2009-2014 it allocated $82 million for essential infrastructure along with $46 million for 7 Nunavut harbours. However, it is radically seeking to divest of all non-core harbours given funding constraints to concentrate on the rest. As part of its core strategy it identified the status of existing infrastructure, determined repair, maintenance and long-term upgrade/preservation costs; a continuous risk assessment, the need for safety, continuously adequate funding, labour and other support and constructed additional facilities when requirement in alignment with market demand and community expectations. Climate change, storm protection and other hazards were perceived as essentially viable. It also considers fund raising, forming business plans, partnerships and marketing to be critical. Research on 163 independent Atlantic Canadian marine ports (Pinfold 2018) supports their economic potential in 39% of regional cargo, over 3750 full time people employed, gaining $219 million in salaries, $50 million in taxes and $368 million to regional expenditure. Cruise tourism contributes another $60 million in taxes, 574,0000 passengers and over $105 million in direct expenditure. However, ports still have operational constraints in securing sufficient revenue, lack independent authority to establish user tariffs, maintenance fees and other forms of funding to remain viable.

The more successful marinas consider their relationship and proximity to area based maritime clusters of complementary businesses including size, location and ownership (Robins 2011). Few look at regenerating existing sites. Other services that may provide benefits include entertainment, chandlery, emergency services and coastguard/sea rescue services, bunkerage, chandler, boat sales, boatbuilding, insurance, marine industry, engineers, a café, shops, accommodation and reserves/marine conservation. Few consider research and development or education and skills providers. Yet other stakeholders merely value the proximity to a marina, waterfront and ocean views/beach access.

Certain harbours also have their own site-specific maintenance plans which are recommended as best practise standards if resources permit. For example, South Africa's Laaiplek Harbour, Lambert and St

Helena Bay renovation in the Western Cape advises a cultural-heritage assessment extending to shipwrecks and heritage buildings along with a dredging and local marine ecosystem impact assessment (Aurecon 2017). This assessment investigates for organics, pesticide, biological organisms and water quality implications along with trace and more accumulated metal concentrations. Dredging found open ocean dispersal and beach nourishment was adequate given only minor traces of each. The South African fishing community have not only expressed environmental concerns but also implications of areas such as marine diamond and phosphate mining along with offshore oil and gas to influence small harbour, fisheries and marina operations (Brick and Hasson 2016). Seabed diamond mining has however provided the sole reason for the existence of the privately operated and De Beers concession, Alexander Bay minor port. Existing fisheries and aquaculture follow global ports in being underappreciated and invested in for smaller/artisanal users; despite significant implications for global food security. Certain ports do not even receive attention despite their contributions such as Cape St Francis for squid.

In 2013 South African fisheries contributed over R76.7 billion to deep sea trawl, R12 billion in hake inshore trawl and R2.2. billion for small scale pelagic fisheries sectors, employing over 27,000 people directly and 81-100,000 indirectly. It added over R4.2 billion to country export value. Comparatively few species and ports dominate exports and fishing activity for most seafood produce, which simplifies reallocating scarce resources when investing in minor fishing ports, infrastructure and services. For South Africa hake occupies 45-50% on average. For other global nations it is dominated by tuna, catfish, sardines, prawns, mussels, oysters. They receive comparatively limited attention in most local and international commercial ports, with containerised, reefer, bulk cargo and cruise vessels gaining priority in port layout, customs and vessel clearance or requirements. Significant past research focusing on industrial/artisanal fisheries and their socio-economic contributions to nations and regions exists, which can provide even further motivation to invest in fishing ports. Yet small harbours and artisanal/subsistence fisherfolk, communities and value chains are especially interdependent on each other. For example, South Africa in 2013 hosted at least147 fishing communities and 29,000 people (Brick and Hassan 2016). Given space, environmental and other limitations at commercial ports, aquaculture too also becomes increasingly significant. Recreational tourism has played a selective but increasingly valuable part although not formally targeted by the state specifically for small harbours or local municipalities. For example, Hermanus generates high revenue from whale watching tourism.

2.5: Evaluating Case Study Methods, Lessons and Approaches: Failures/Issues.

Failures, problems and challenges can provide valuable experiences that prevent a recurrence of certain solutions towards the blue economy and the contributions of marinas and small harbours within this area. Examples of related case studies examined inn this section are outlined inn Table 2.5. Whilst many case studies exist professing the advantages and successes of marinas; this source also recognises the lessons of ensuring stakeholder requirements; funding; information and marketing; sufficient balance, sustainability, market demand, accessibility and competitor rival strategies as among the foremost lessons to various case studies of failures or less effective approaches or solutions which generated their own issues. Stakeholders are also investigating nautical tourism specifically for yachting in Morocco (Boukerouk 2018). Saidia and Bou-Regreg Marinas are providing prototypes on the basis that whilst Europe incurs significant competition from over 4500 marinas, over 6,300,000 yachts and 1,750,000 berths far fewer exist as rivals across North Africa. Comparatively minimal market demand appears to exist at present. Tangier and Casablanca are also looking to capitalise on the shortage of European vessels. In 2017 the source reported the industry contributed over 17 billion euros and 180,000 jobs per year. Saidia aims for 802 berths and Bou-Regreg 250 berths. A potential client satisfaction survey (which failed to indicate the number of respondents), identified urban accessibility and mobility as most essential, followed by security and marina equipment, the master and staff as the most significant, with activities, nightlife and information as least essential in determining a port. Concerns were raised over hygiene from existing experiences, excessive bureaucracy, coastal fragility and insufficiently updated information.

Table 2.5: Small Harbour and Marina Case Studies of Failures, Stakeholder Issues and Concerns

Gansbaai South Africa	Herzliya Marina Israel
Baltic Sea Fishing Harbours	Caribbean ports
Karwar and other India minor ports	Canadian ports
South Africa small harbours	UK fishing ports and seafarers

Source: This Study

Few of the existing studies concerning experiences of specifically constructing fishing harbours and historical lessons appear to be both publicly available and managed the transition online to be swiftly

accessed as a core limitation of this research providing insights into adversity, fear and failure or delays. One example in South Africa exists for Gansbaai whose harsh environment, poor climate and geology imposed significant and time-consuming expensive interruptions in construction from a civil engineering and operational perspective (Van Dijk, Vonk and de Retief 2010). It emphasised the worthy investment of undertaking a wave, climate, hydrographic and environment based series of surveys along with the stock of fisheries resources to ensure the harbour remains actually technically feasible and commercially or ecologically viable. The first attempts collapsed. Initial breakwaters were constructed during 1939-1942 with sporadic efforts in engineering breakwaters/dredging and other infrastructure from the 1950's to the 1980's. Engineering designs faced issues in ensuring current vessel access would remain throughout the process with high generated wave energy pressures from occasional 5-6 metre high waves and expenses. Other issues included the stability of the caisson wall. The subsequent dissolvement of the Fisheries Development Corporation in 1986, declining fisheries yields/fleet registration, support and lack of priority/attention by the South African government caused a collapse in market demand and infrastructure maintenance, only slowly being reprioritised since 2014 under Operation Phakisa's Small Craft Harbour initiative. It conceded the need for thorough modelling and testing simulating as many conditions and factors as possible prior to construction.

Many sources remain focused on publicity with only superficial examination of the true ecological impact of marinas, aiming to get authorisation. Israel's Herzliya Marina utilised breakwaters to partially resolve issues of coastal erosion of neighbouring beach sand, deterring tourists from using them (Klein and Zviely 2000). The solution merely diverted erosion away from the immediate area and adjacent vicinity. The design required a physical modelling approach to assess latent implications but this proved to be insufficiently accurate as an investment in underestimating changes in waves, wind and geomorphology. Formed between 1990-1992, this and 12 other planned Israeli marinas will more recently face reduced demand in the COVID19 epidemic era in which the government prohibited international travel indefinitely since March 2019 in strict quarantine, which will deter foreign callers.

Although many nations such as South Africa, Australia, the South Pacific and Caribbean have invested in considering climate change implications for fisheries and ecosystems this seldom extends to the construction, design and operation of ports, especially smaller harbours and marinas (Department of Agriculture, Forestries and Fisheries 2016; Dyer 2018). As yields decline and species migrate this will

subsequently affect the extent of demand for specific ports and species; whilst other infrastructure may become more or less resilient, depending on the extent of trade diversion and investment in blue, green and grey infrastructure or assets. For example, South Africa forecasts a reduced Sardine Run, a pelagic fisheries migration east and scattered prawns off the KwaZulu-Natal coast. Aquaculture, marine biotechnology and reserves are perceived as more climate resilient and sustainable than direct fisheries. It is therefore essential to consider climate change projections. Fishery vessels will need to acclimatise and adapt, possibly requiring larger vessels to become more viable or alternatively smaller, as fishery restrictions become even more urgent. Alternative species may require more value-added processing or alterations in storage. Few studies have specifically concentrated on fishery and recreation port or vessel emission contributions to climate change or a subsequent need to pursue greener ports as part of the blue economy such as fuel bunkerage, improved technology, transport links and processing.

Smaller ports and marinas can also provide alternatives for intermodal logistics and to avert the challenges of congestion at more commercial ports as recognised in Tanzania outside Dar es Salaam conditional on sufficient resources, education, training and finance (Tanzania Government 2012). However, port costs or incentives, accessibility, hinterland connections, cargo storage and operational facilities, services, customer requirements and services present, remain critical. A Port Community System to provide information, coordination and single point of entry for data exchange can assist. The United Kingdom equally recognise this in their “Maritime Vision 2050” for the future of small ports as part of an overall attempt to entice people into supporting, preserving and contributing towards their coastal and maritime related heritage (United Kingdom Department of Transport 2019). It also means repositioning small harbours and marinas to complement changing economic requirements; embrace smart ports and assist in marine litter reduction or global contributions towards zero emissions in shipping. It consoles the need for greater commitment to research, technology and innovation development including entrepreneurship along with greater interlinkages to various blue economy related activities. Ports can also provide LNG, hydrogen and other fuel bunkerage facilities along with solar/wind and other forms of renewable energy and energy efficiency. Yet it does not specifically connect to small harbours and marinas specifically as per this scholarship’s conceptual contribution in Chapters 3 and 4.

A Baltic Sea Fishing Harbour Survey on sustainable waste practises including abandoned and entangled ghost fishing gear needing responsible disposal along with recycling and hazardous waste management (Press 2017) beyond more containers. Out of 50 surveyed harbours in Germany, Latvia, Sweden and Estonia, nearly 50% experienced challenges. Stakeholders experienced poor marine environmental awareness of the impacts and how to manage their contributions. Limited monitoring, compliance and enforcement was observed. It consoles recommended best practises such as the MARPOL Convention on marine pollution and the European Union PRF Directive, specifying port waste facilities need to be available, adequate and address all user requirements for all vessel sizes, waste volumes and types to adequate protect marine environments. The 2017 EU Waste Directive and Action Plan for the Circular Economy seeks to move towards measures that will convert marine and other garbage towards circular economy reuse principles via suitable financial incentives and penalties. It specified criteria on a score of 1-4, with 1 ranking lowest with poorly present, maintained or non-existent waste treatment and reception services. Score 2 requires minimal litter present with regular contracts for normal garbage and hazardous waste removal. Score 3 charges vessels fees for produced garbage and offers recycling/hazardous waste and separate fishing gear options with information to port users. Score 4 has a specific local and state waste management plan and cooperation with various stakeholders such as recycling fishing gear and the zero waste economy. Communities and local users actively cooperate and participate in marine litter awareness and reduction initiatives.

The survey determined only 33% of Estonian and 42% of Swedish Harbours scored 3 or 4 compared to 63.5% of Polish and 73.5% of German harbours. Finances and fewer users were cited as constraints. Harbour sizes clearly skewered the results, as the smaller harbours and marinas were more likely to not have sufficient labour, management, information and funding/investment to ensure higher ranking. Findings indicated an increasing concern for ecological sustainability and marine litter reduction practises. 68% of port participants separated recycling; 84% created a vessel waste fee and 90% dealt separately with hazardous waste. 70% of harbours had implemented or were investigating ghost fishing gear. However, 32% need more facilities to address waste including 25/50 ports for vessel bilge and sewerage treatment. Over 33% desired greater stakeholder engagement and information. Others expressed opportunities to use modern technology for information and tracking waste with sufficiently advanced notice. Stakeholders still perceive fishing ports to receive far less

attention than both larger commercial ports and those focusing more on cruising and nautical/leisure tourism. The source recognises the need to consult older fishermen for their experiences in mending fishing nets and in designing/improving harbours. The source advocates responsible recycling via life cycle approaches, mass educational outreach and awareness; fines, penalties, user fees and cost recovery processes such as deposits; reporting on lost and discarded gear or litter along with infrastructure.

A 2013 case study for Port Hope Marina in the United States identified motivation for seasonal demand as a basis for a subsequent commercial investment (Shoreplan Engineering Ltd 2013). Demand was forecast to rise from 231,450 in 2013 to 345,980 vessels in 2028. Clients considered a water, wastewater supply, fire protection, solid and oil waste, maintenance, insurance, boat repair, laundry, a marina office and security as paramount. Other concerns included safety, access, a shuttle service, bicycles, a pet exercise area, electricity, supplies and attractions It also created an operational management model as a guideline working out projected revenues, expenses, costs and fees. However, it failed to consider how it could remain more competitive than its 32 marina counterparts within a 50 kilometre radius. A standard cost-benefit analysis provides projected revenue will increase from $402,720 revenue to 2021 to $626,900 in 2027 against $389, 260 to $564,520 in costs. This ignored subsequent adjustments to economic activities such as socio-economic-political-environmental factors and the COVID-19 pandemic and a subsequent loss after that time period. However, this can partially be offset against a projected direct expenditure benefit of $1,1999,250 in 2021 to the local economy but only 10 new direct jobs It assesses facilities offered by competitors such as 84.4% offer water, 81.3% picnic tables and 80% a barbeque whilst only 31.3% offer vessel charters and rentals, 34.4% Internet and 40.6% a pool or beach. Budged expenses include a 10% capital reserve towards maintenance and future asset replacement costs; along with other costs such as dredging, security, crane rental, marketing and promotion, uniforms and clothing and basic repairs/maintenance

Caribbean ports assimilate fisheries, cruise tourism and marinas more seamlessly lacking large scale commercial ports for most nations (Sanchez and Wilmsmeir 2014). Yet the sector has experienced maintenance problems, congestion and ecological impacts of cruise vessels, low tariffs and vulnerability to risk events such as cyclones. It proposes the need for minor harbours to process more

automation, smart ports, information technology and even the single transmission of data under the Electronic Data Interchange system. Training, finance and knowledge remain core concerns including issues with education, weak law monitoring and enforcement compliance.

Although India lacks a tradition of fishing and recreational tourism for its 200 smaller ports; one article is proposing to retransform them to reduce congestion and alleviate the congestion and land constraints of the nations' 13 commercial ports (Kuntoji and Rao 2015). 200 minor ports produced 545.83 MT in throughput against 555.50 MT for the 13 major ports (each of which is operating already at 75-100%+ capacity). Yet India seeks to expand this to over 3,130 MT by 2020. The Karwar port case study argues however, that smaller ports experience numerous problems from illegal dumping in rivers, poor finance, maintenance, staff and planning; lack of access to technology; insufficient channel depths being dredged, poor productivity and labour motivation. Minor ports remain less popular from reduced customer service and higher user fees relative to the facilities provided. This has to be offset against the higher opportunity, inaction and impact costs however of idle and delayed cargo throughput. Therefore, Karwar are investing in improved road, rail and physical port dredging access, a jetty along with equipment, storage and other measures to increase cargo volumes up to 5 MT per year as an example of how with sufficient planning, small harbours can complement larger ones.

Canada echoes others in that it has experienced constraints of minimal staff; finance and recruitment challenges to remain relevant to many lives; evolving and altering port roles such as towards the blue economy rather than fishing. Health and the environment also need increasing attention. Falling revenue is increasingly stimulating more enterprising means of income from other activities (Canada Parliament 2009). Examples include parking a museum, laundry, equipment, boat charters, vessel repair, electricity, shops, water, garbage and recycling, Internet, telecommunications, post, storage, gift shop, bunkerage, toilets and showers. South Africa and other nations could also learn from its specific commitment pledging to ensure timely procurement and payment of all goods and services, to aid suppliers in cashflow and enhance efficiency. It also is advised to consider how to address the problems of ghost fishing equipment and abandoned vessels, expensive to salvage, recycle and repair via legislation, confiscation and scrapping to assist the circular economy. Whilst it may recommend local municipalities are among the more effective custodians and operators, for many African and other developing states, these cities are not always effectively operated, with high cashflow/liquidity

constraints. The aim is to preserve a harbour's functioning existence as much as possible for as long as possible including its heritage.

South Africa has started to consider small harbours and their socioeconomic contributions in existing sources but has experienced a significant number of implementation challenges most notably the lack of employing dedicated skills such as a professional working group composed of experts including a qualified marine economist to exploit this sector. Others included obsolete assets, equipment and infrastructure, poor tourism demand, high bureaucracy and crime rate issues along with electricity disruptions. It has formulated a number of policies and ideas that whilst sound in principle, have yet to be implemented for a variety of reasons (Mosegomi 2015). It proposes concentrating on small harbours to gain additional jobs, revenue, skills development, small and medium enterprises, investment and economic development without providing significant examples as to how these would be produced. It advised hosting specific Investor Conferences to facilitate funding. The source envisions radical macroeconomic contributions rather ambitiously of R6.1 billion and 12,100 jobs in the first five years from 2014-2019 but without evidence of progress and monitoring indicators. It suggests investment opportunities in the retail sector, office parks, ice makers, tourism including Skeleton Wreck museums, water theme parks, and caravan parks, leisure, maintenance, repairs and aquaculture facilities.

A South African fishing harbour community consultation emphasised issues of existing poor maintenance, crime, grime and other lingering residual concerns (Thobakgale 2018). However, it conceded the need for a fully resourced and financed Small Harbours Development Authority to coordinate, support and otherwise stimulate priority small harbours via localisation and maritime industry/employment generation. A standardised lease system now applies to all proclaimed areas and a 12 year maintenance system was undertaken in phases from 2000 to 2012. It created 102 jobs and 11 small/medium enterprises in removing 29 sunken vessels (worth R3.5 million); conducted dredging in 8 of 12 harbours and slipway/shore crane repairs. 9 divers received training. The source mentioned the wasted opportunities in not collecting revenue from any vessel users; in high contrast to international marina counterparts and neglecting opportunities for additional lease or auctioned off property. It cited the need for more security precautions.

Others include desalination, renewable energy and diamond mining tours. It proposes to invest a minimum of R4.1 billion in operational infrastructure to improve safety, security, ocean governance and economic development as a basis for supporting a local shipping, boatbuilding, repair and supply industry. It advises the need for a series of professional skills audit, career, business and environmental development plans. However, it only initially envisions focusing on 3 harbours, ignoring the 12 proclaimed Western Cape fishing harbours and those of other provinces such as Shelly beach, Kosi Bay, Port Alfred, Port St Francis, Hibberdene, Port Grosvenor and Hondeklip Bay. It considers a basic harbour need to procure landing and launching, storage, repair, bunkerage, chandlery, icemaking, processing, security, market and logistics facilities at a minimum. Ambitiously it considers small harbours are able to benefit youth, military veterans and the disadvantaged not limited to businesses and communities. Small Harbourmasters need to be professionally trained along with other specialised education. Shipwrecks may necessitate removal. The need for security at South African harbours remains another fundamental constraint given high endemic poverty, poaching, corruption, smuggling and unemployment (South African Police Service 2018). 8 Western Cape Harbours received targeted visits in 2017 and 2018 but long-term provisions to improve security have not been sufficiently maintained permanently. Unlike the 8 commercial ports, small harbours lack specific security provisions, resources and protocols, whether private or the police. Police do not have aerial or water based resources capacity.

Another way to ensure the most optimal future of small harbours and marinas is by directly interviewing and surveying existing fishing fleets, marina users, seafarers, cruise companies, passengers and others. One UK survey of needs identified fishing directly employed over 22,000 people and contributed 1.14 billion to the national economy for 41 ports (Seafarers UK 2014). Existing fisherfolk and seafarers seldom benefit from updated training and other benefits such as marketing, aquaculture and entrepreneurship. Yet the population is rapidly aging with younger people far less interested in the excitement but rigorous vocation. Stakeholders have proposed migrants as a solution but in light of the significant number of people signing on for unemployment benefit and the high public health risks of importing people in a COVD-19 pandemic epoch; this appears highly foolish. Consultation provides a number of fair recommendations including stimulating future career plans in the sector, capitalising/upgrading equipment and facilities along with increasing value adding/beneficiation. Uncertainty over sustainability and allocation of fishing quotas and high bureaucracy for

aquaculture/fisheries permits deters many existing participants and latent market entrants. 32% experienced local housing shortages/high prices for current supply.

2.6: Conclusion

In conclusion, this literature review can assist stakeholders in identifying the elements considered necessary for operating the most successful harbours to capitalise on their advantages at a lessor transaction cost, whilst seeking to limit their exposure to the elements of more failed/weaker small ports and marinas as summarised below. Other constraints that have resulted in the bankruptcy or highly condensed ambitions of various projects include; the lack of updated best practises and standards, attention, finance and a newly Crafted Future Vision for Small Harbours and Marinas. Data limits, asymmetrical information and moral hazard can create problems for stakeholders. Few examples can be found to investigate the extent to which specific small harbour and marina strategies have failed and to provide explanatory factors or to empirically verify successes. Challenges remain in securing the support needed to rectify existing research gaps. Subsequent sections will specifically focus on the advantages, disadvantages, risks and opportunities of reprioritising small harbours to secure a viable blue economy future. This includes investigating how a viable sector can specifically be created and viable, to aid investors and other stakeholders, even considering climate change, COVID 19, digital and shipping disruption, ecological, overpopulation, declining fisheries and other emergent risks.

2.6.1: Elements of a Successful Harbour

- Following the above successful site selection criteria and Investment Funding Guidelines.
- Following Stakeholder Requirements including Engagement and Community Involvement.
- Conducting a Successful Market Demand/Supply/Requirements Study and Cost-Benefit Analysis
- Well executed guidelines and policies following the proposed Small Harbours Act in 2.3.1-2.3.3.
- Sufficient Financial, Labour, IT, Information and other Reserves against the unknown risks
- Continuous monitoring, evaluation and improvement of infrastructure, services, performance and seizing economic opportunities whilst managing risks.
- Need to evaluate existing and projected fisheries/aquaculture conditions under climate change.
- Actively contemplating a Competitor Analysis.
- Learning the other lessons of the above case studies, focusing on economic diversification, marketing and awareness to remain increasingly and contemporarily relevant.

2.6.2: Elements of a More Failed/Less Viable Harbour

- Aside from ignoring the above, refusing to learn from the case study and other recommendations/lessons within this research.
- In planning, the need for detailed physical, hydrographic, technical, environmental and socioeconomic surveys.
- A lack of sufficient funding.
- Crime, Poaching, Grime and hygiene/sanitation. Need for security
- Marine litter and pollution including ghost fishing gear removal and hazardous waste.
- The need for recycling and a circular economy is conspicuous.
- Environment and climate change issues including fragility and erosion.
- Changing demographics; closed businesses and economies.
- Static or falling demand for slips, berths and other facilities.
- Fewer businesses, derelict infrastructure and services -poor maintenance.
- Obsolete or too few assets and equipment.
- Skeleton or no staff.
- No autonomous funding, regulation or lease granting powers.
- Centralised, overbureaucratic process for minor repairs and asset replacement.
- Too stringent and onerous regulations.
- Failure to consult stakeholders.
- Lack of IT, technology and other forms of modernisation.
- Insufficiently updated information.
- Need for marketing, education, awareness and training including upskilling existing fisherfolk such as in entrepreneurship along with recruiting new youth effectively. Utilise skills and experience.

Chapter 3: Transitioning Towards a Blue Economy and Circular Economy Age: Reimagining the Purpose and Destiny of Small Harbours and Marinas.

3.0: Introduction

Chapter 3's objective is to provide this research's conceptual contribution towards addressing the need, contribution and issues of small harbours and marinas, to further determine the extent to which they can contribute towards a viable, aureal blue economy future. Tracing the extent of the current market and contemporary trends for small harbours and marinas; the benefits, disadvantages, risks and opportunities it provides will not only aim to overcome existing research gaps identified in Chapter 2; but aim to further persuade more stakeholders to participate in the Blue, Green and Circular Economy Age globally. It will aim to overcome those reluctant to prioritise this sector, given other pressurising priorities as excuses for failing to act.

3.1: The Current Market Status of Small Harbours and Marinas, Recent Trends and Developments.

This section specifically evaluates the present status of marine small harbour and marina markets, globally, in Africa and locally, for investors and other existing/potential supply chain stakeholders to capitalise on subsequent opportunities. This aids in identifying market gaps, supporting existing players and maritime communities or economies, whilst determining suitable strategic interventions. Table 3.1 and Figure 3.1 identifies a partial summary of the existing number of global marinas and fishing harbours with at least 4902 fishing harbours and 2043 marinas with a total of 6945. This is dominate by Europe (2602) and North America (2153) with the fewest in the Middle East (470) and the Pacific (2320) then Africa (2450). Table 3.2 and Figure 3.2 identifies estimated global marina and small harbour employment. Table 3.3 estimates potential socio-economic employment. If each marina employs an average of 10 people, the at a minimum, direct marina and small harbour global employment would be 69,450 excluding those dependent upon it Although few global standards exist to determine marinas and small harbours that prioritise the environment, the international Blue Flag movement based on environmental, safety, public awareness and other best practise standards and criteria. As highlighted in Table 3.4, in 2019 it awarded a total of 670 marinas from 30 countries.

Table 3.1: An Estimate of Global and Local Small Harbours and Marinas

Country/Territory	Total No of Fishing Harbours	Small Marinas	Total
Canada	882	184	1066
Mexico	36	36	72
USA	554	460	1014
Australia	42	42	84
New Zealand	25	19	44
Papua New Guinea	15	1	16
Fiji	5	5	10
Solomon Islands	14	1	15
Vanuatu	2	1	3
New Caledonia	7	1	8
French Polynesia	7	7	14
Samoa	1	1	2
Tonga	3	1	4
American Samoa	1	1	2
Cook Islands	1	1	2
Wallis and Futuna Islands	1	0	1
Tuvalu	1	1	2
Niue	1	0	1
Tokelau	1	0	1
Federated States of Micronesia	2	1	3

Guam	1	1	2
Kiribati	1	1	2
Northern Mariana Islands	5	5	10
Marshall Islands	1	1	2
Palau	1	1	2
Nauru	1	1	2
Nigeria	12	1	13
Ghana	4	0	4
Côte d'Ivoire	4	0	4
Senegal	2	1	3
Guinea	1	0	1
Benin	1	0	1
Togo	1	0	1
Sierra Leone	1	0	1
Liberia	4	0	4
Mauritania	1	0	1
Gambia	1	0	1
Guinea-Bissau	1	0	1
Cabo Verde	7	0	7
Saint Helena	1	0	1
Tanzania	3	3	6
Kenya	4	1	5
Mozambique	5	0	5
Madagascar	2	2	4
Somalia	2	0	2
Eritrea	2	0	2
Mauritius	5	5	10
Djibouti	1	0	1
Réunion	1	1	2
Comoros	3	0	3
Mayotte	1	1	2
Seychelles	2	2	4
Egypt	28	6	34
South Sudan	1	0	1
Algeria	18	0	18
Morocco	11	11	22
Tunisia	5	5	10
Libya	15	0	15
Western Sahara	2	0	2
South Africa	12	26	38
Namibia	3	2	5
Democratic Republic of the Congo	1	0	1
Angola	2	0	2
Cameroon	2	0	2
Congo	1	0	1
Gabon	1	0	1
Equatorial Guinea	2	0	2
Sao Tome and Principe	2	0	2
India	200	3	203
Pakistan	4	0	4
Bangladesh	3	0	3
Sri Lanka	2	1	3
Maldives	2	2	4
China	172	20	192

Japan	292	5	297
South Korea	17	0	17
North Korea	1	0	1
Taiwan	6	2	8
Hong Kong	2	1	3
Macao	1	0	1
Indonesia	154	8	162
Philippines	2	2	4
Vietnam	15	2	17
Thailand	15	15	30
Myanmar	5	1	6
Malaysia	15	15	30
Cambodia	2	1	3
Singapore	6	6	12
Timor-Leste	1	0	1
Brunei Darussalam	1	0	1
Turkey	39	39	78
Yemen	1	0	1
Syria	2	0	2
Azerbaijan	1	0	1
United Arab Emirates	3	21	24
Israel	3	3	6
Jordan	1	1	2
Lebanon	1	1	2
Oman	1	0	1
Kuwait	1	0	1
Georgia	1	0	1
Armenia	0	0	0
Qatar	4	4	8
Bahrain	1	1	2
Germany	192	192	384
France	73	73	146
Netherlands	24	5	29
Belgium	8	8	16
Monaco	1	1	2
Russia	105	2	107
Poland	12	1	13
Romania	18	1	19
Bulgaria	2	1	3
United Kingdom	351	51	402
Sweden	82	4	86
Denmark	159	3	162
Finland	5	5	10
Norway	83	5	88
Ireland	2	2	4
Lithuania	1	1	2
Latvia	3	3	6
Estonia	3	1	4
Iceland	67	3	70
Channel Islands	1	1	2
Isle of Man	5	5	10
Faeroe Islands	2	0	2
Italy	243	243	486
Spain	107	107	214

Greece	31	31	62
Portugal	62	13	75
Serbia	3	3	6
Croatia	68	71	139
Bosnia and Herzegovina	1	0	1
Albania	5	5	10
Slovenia	1	1	2
Montenegro	1	1	2
Malta	18	18	36
Gibraltar	1	1	2
Brazil	12	12	24
Colombia	15	3	18
Argentina	55	2	57
Peru	33	1	34
Venezuela	41	3	44
Chile	46	1	47
Ecuador	9	1	10
Uruguay	3	3	6
Guyana	1	0	1
Suriname	0	0	0
French Guiana	1	0	1
Falkland Islands	1	0	1
Guatemala	1	0	1
Honduras	1	0	1
Nicaragua	1	0	1
El Salvador	1	1	2
Costa Rica	7	7	14
Panama	8	8	16
Belize	1	0	1
Cuba	37	6	43
Haiti	1	0	1
Dominican Republic	10	10	20
Puerto Rico	9	9	18
Jamaica	5	5	10
Trinidad and Tobago	4	4	8
Guadeloupe	1	0	1
Martinique	5	5	10
Bahamas	34	34	68
Barbados	4	4	8
Saint Lucia	7	7	14
Saint Vincent - Grenadines	3	3	6
Grenada	3	3	6
United States Virgin Islands	4	4	8
Antigua and Barbuda	7	7	14
Dominica	2	2	4
Cayman Islands	3	3	6
Saint Kitts and Nevis	3	3	6
Sint Maarten	6	15	21
Turks and Caicos Islands	3	6	9
British Virgin Islands	2	2	4
ABC Islands	3	10	13
Anguilla	1	1	2
Montserrat	1	1	2
Saint-Barthelemy	1	1	2

Total	4902	2043	6945

This Study

Table 3.2 Estimated Global Marina and Small Harbour Employment.

Nations	Fishing Harbours 5-10 per port low estimate 10-Average 20-25 high estimate	Marinas 5-10 per port low estimate 20-25 high estimate	Total
North America	14720	6800	21540
Pacific/Oceania	1390	930	2320
Africa	1780	670	2450
Asia	9610	1230	10840
Middle East	160	310	470
Europe	17400	8620	26020
South/Central America	2370	420	2790
Caribbean	1590	1450	3040
Total	49020	20430	69450

Source: This Study (Number refers only to those directly involved in marinas/fishing ports not supply chains, seafarers/fisherfolk and others.

Figure 3.1: An Estimate of Global and Local Small Harbours and Marinas

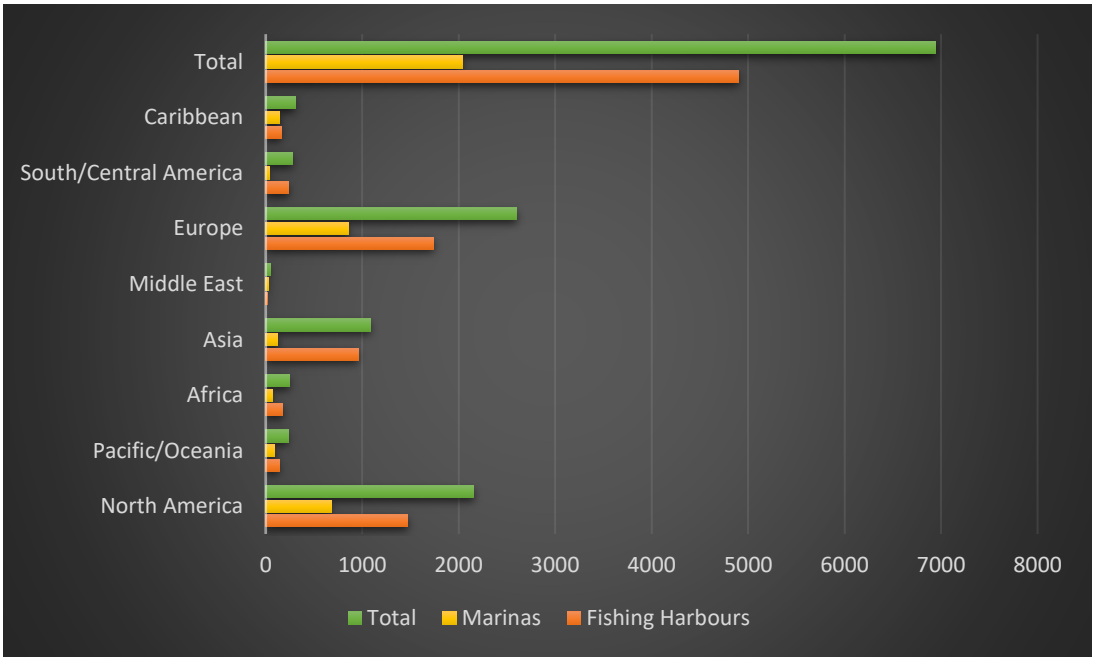


Figure 3.2: Average Estimated Direct Global Marina and Small Harbour Employment.

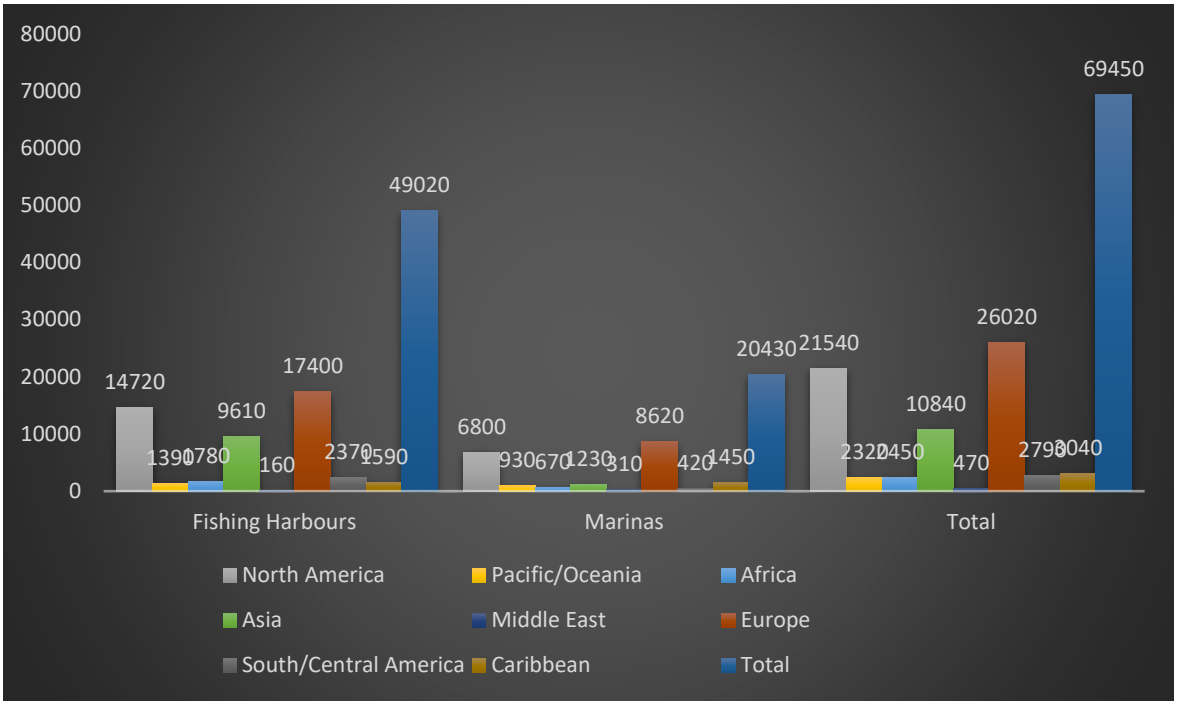


Table 3.3 Existing Socio-Economic Contribution of Marinas.

Nations	Contribution to GDP $	Estimated Direct Employment
USA	18,000,000,000	105,000
Australia	1,400,000,000	28,000
South Africa	75,000,000	15,000
Asia	Unknown	Unknown
Middle East	2,940,000,000	12, 500
Europe	70,000,000,000	180,000
South/Central America	Unknown	Unknown
Caribbean	1,600,000,000	65,0000
Total	94,015,000,000	405,500

This Study, based on European Boating Association, Association of US Marina Industries, SABBEX, Marina Industries Australia, etc.

Table 3.4 International Marinas and Blue Flag Best Status

Country/Territory	Total No of Blue Flag Marinas
Spain	98
France	106
Greece	14
Turkey	21
Italy	72
Portugal	17

Denmark	20
Netherlands	122
Germany	87
Croatia	27
Ireland	8
England	0
Wales	3
Latvia	2
Poland	10
Iceland	2
Belgium	8
Sweden	11
Montenegro	1
Norway	3
Bulgaria	1
Slovenia	3
Northern Ireland	4
Morocco	1
Jordan	1
Israel	2
Canada	12
Mexico	3
Brazil	6
US Virgin Islands	1
New Zealand	4
Total	670

Source: Blue Flag International Jury 2019

Recent market trends and developments specifically related to small harbours and marinas need to consider a variety of blue economy sectors as subsequently detailed in Section 3.6 opportunities. Superyacht orders were 375 in 2015 and 442 in 2018. The global yacht and marina leisure industry has been estimated by experts to reach a 4.4% average growth by 2018 to 2025, reaching US $83.2 billion. This excludes the fishing, cruise, marine tourism, cargo, waterfront real estate, biotechnology, marine conservation, education, boatbuilding and other markets. Top yacht manufacturing competitors include Azimut/Benetti; Ferretti Group; Sanlorenzo; Sunseeker, Feadship, Lürssen, Princess Yachts, Amels / Damen, Heesen Yachts, Horizon, Westport, Oceanco, Trinity Yachts, Fipa Group, Overmarine, Perini Navi, Palmer Johnson and Cerri – Baglietto Christensen among others. The top 3 are from Italy however, which may be adversely affected by this pandemic. Although currently slowed by the COVID-19 pandemic and recessionary consequences; this market will remain considerable from growing affluent among the rise of NASDAQ related companies, Middle East affluent and hosting of events such as the 2020 Dubai Expo and 2022 FIFA Football World Cup in Qatar and those seeking

new experiences in the US-European markets; with far reduced prospects from Africa. Cyclone Dorian in the Bahamas and other related climate events destroying various vessels and marinas will have a lagged demand effect across the Caribbean and Oceania. More eco-sustainable methods of tourism and adventure experiences may stimulate further market demand. Racing and sporting yachts are receiving growing global interest from additional racing events. Market sources estimate $5.9 billion worth of yachting demand in Japan and $3.7 billion in China by 2022. Yet the USA has received less demand over time with a 67% recorded decrease from 2010 to 2020 for superyachts.

This source recommends also considering local marina associations wherever possible.

Table 3.5: Various Marine and Marina Industry Associations

Association of US Marina Industries	ACOBAR -Brazil
Argentina National Association of Nautical Companies	Association of Bahamas Marinas
Australia Marine Export Association, Boating Industry Association, Boating Industries Alliance Australia, Marina Industries Association, Superyacht Australia	NMMA -Canada, Canadian Safe Boating Council
Belgian/Flemish Industry Association	Barbados Sailing Association
European Boating Association	Yacht Service Association of Trinidad and Tobago
China Cruise and Yacht Industry Association	ASONAUTICA
European Sailing Federation	Association of Leisure Boat Harbours Denmark Danish Sailing Union, Danish Boat Owner's Association
Finnish Marine Industries Association	French Nautical Industries Association, French Motor Boat Association
German Federal Association of Watersport Industries German Boat and Shipbuilding Association	Italian Marine Industry Association, Italian Recreational Craft Association
International Association of Marina Industries	Yachting Association of India
Association of Marine Industries of Malaysia Malaysia Sailing Association	Mexico National Marine Manufacturers Association Mexican Tourist Marinas Association
Netherlands -HIWA	Norwegian Leisure Boats Association Norwegian Boat Owner's Union
Polish Chamber of Marine Industry and Watersports Polish Power Boat/Yachting Association	Portugal -ACAP Nautica
Spain -National Association of Nautical Companies	Swedish Leisure Boat Association, Swedish Sailing Federation, Swedish Yachting Federation
Taiwan Yacht Industry Association	Turkish Yacht Exporter Association
UK Marine Industries Alliance	SABBEX/Marine Industry Association of South Africa

Source: This Study

3.1.2: South Africa

Aside from the 12 existing functioning fishing harbours of the Western Cape and 3 new small harbours of Operation Phakisa, South Africa currently hosts the following marinas and yacht clubs in Table 3.5. The sector has benefitted from a DTI incentive seeking to promote a local boatbuilding value chain

and associated procurement drive of at least 60% domestically sourced materials. Despite a lack of significant support for the sector, South Africa has become the world's second largest exporter of recreational catamarans after France. In 2015 it exported over R1,504 billion

Table 3.5: South African Marinas and Yacht Clubs

Algoa Bay Yacht Club, Port Elizabeth	Hout Bay Yacht Club Hout Bay
Bayshore Marina, Vaal Dam	Knysna Waterfront, Knysna
Bluff Yacht Club, East London	Point Yacht Club
Buffalo River Yacht Club, East London	Port Owen Marina, Port Owen
Club Mykonos, Langebaan	Royal Alfred Marina, Port Alfred
Durban Marina, Durban	Royal Cape Yacht Club, Cape Town
False Bay Yacht Club, Simonstown	Royal Natal Yacht Club
The Water Club Granger Bay	Simonstown Marina
Knysna Yacht Club, Knysna	Thesen Island Marina, Knysna
Manten Marina Vaal Dam	V&A Waterfront Marina, Cape Town
Port St Francis, St Francis Bay	Yacht Port, Saldanha
Mossel Bay Yacht and Boat Club, Mossel Bay	Zululand Yacht Club, Richards Bay
Harbour Island Gordons Bay	

3.1.3: Existing Personal Global Small Harbour Visual Experiences and Observations

Figure 3.3: Cape Town V and A Waterfront

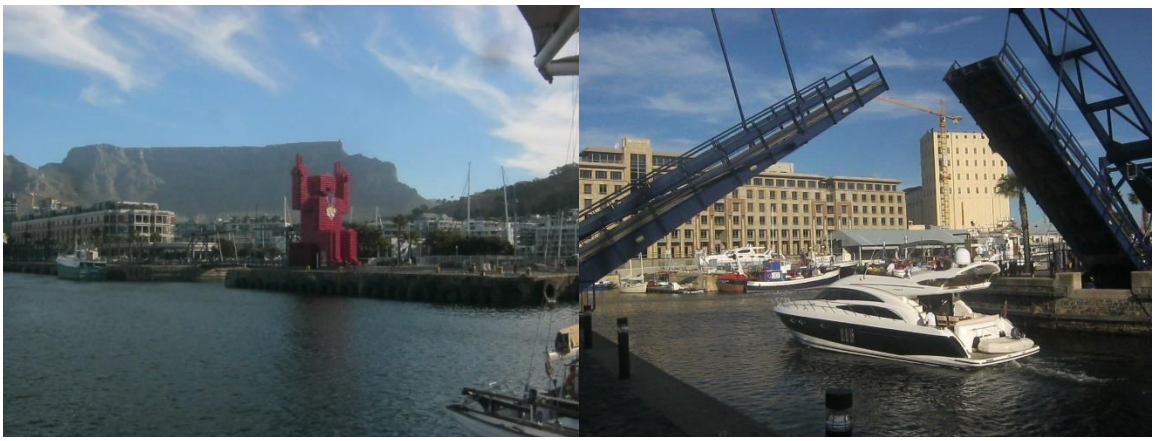


Figure 3.5: Accommodation, Catamarans, Luxury Real Estate and Pirate/Heritage Cruises

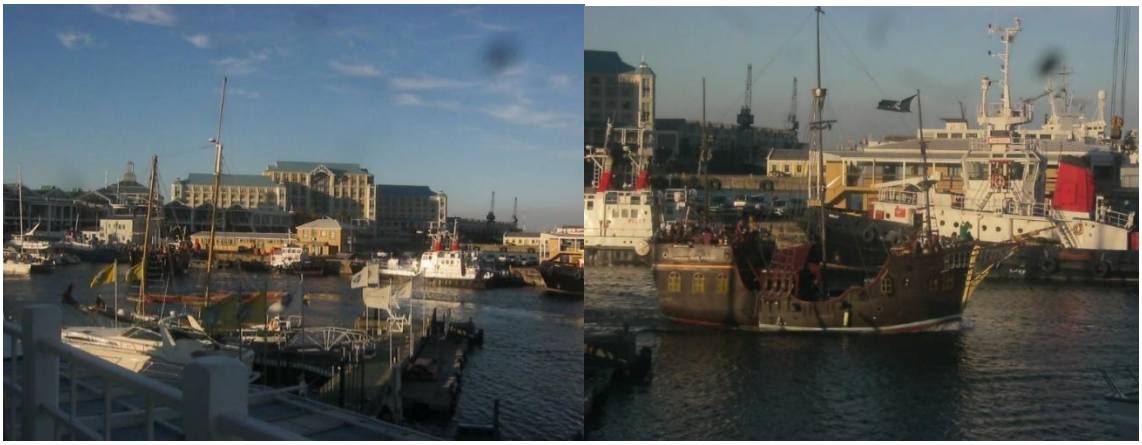


Figure 3.6: Durban Cruise Vessel Callers, Maritime Museum and Royal/Point Natal Yacht Clubs from the Roma Revolving Restaurant Tower -John Ross House

Figure 3.7: Swakopmund and Walvis Bay

Figure 3.8: Wildlife and Vessel Cruises Namibia

Figure 3.9: Servicing Oil Rigs, Commercial Fisheries and Aquaculture

Figure 3.10: Reducing Congestion and Facilitating Commercial Port Traffic/Throughput.

Figure 3.11: St Helena Island, Without a Marina Or Small Harbour

Figure 3.12: Mozambique Recreational and Game Fishing Charters

Figure 3.13: Seychelles Scuba Diving, Luxury Catamaran Cruise, Port Victoria Yacht Cruising

Figure 3.14: Ferry Crossings Absent Small Harbours, Bruny Island Tasmania Versus Caprivi Strip Botswana-Zambia

Figure 3.15: Malindi Kenya Traditional Fishing Vessels, Port and Beach Camel Rides

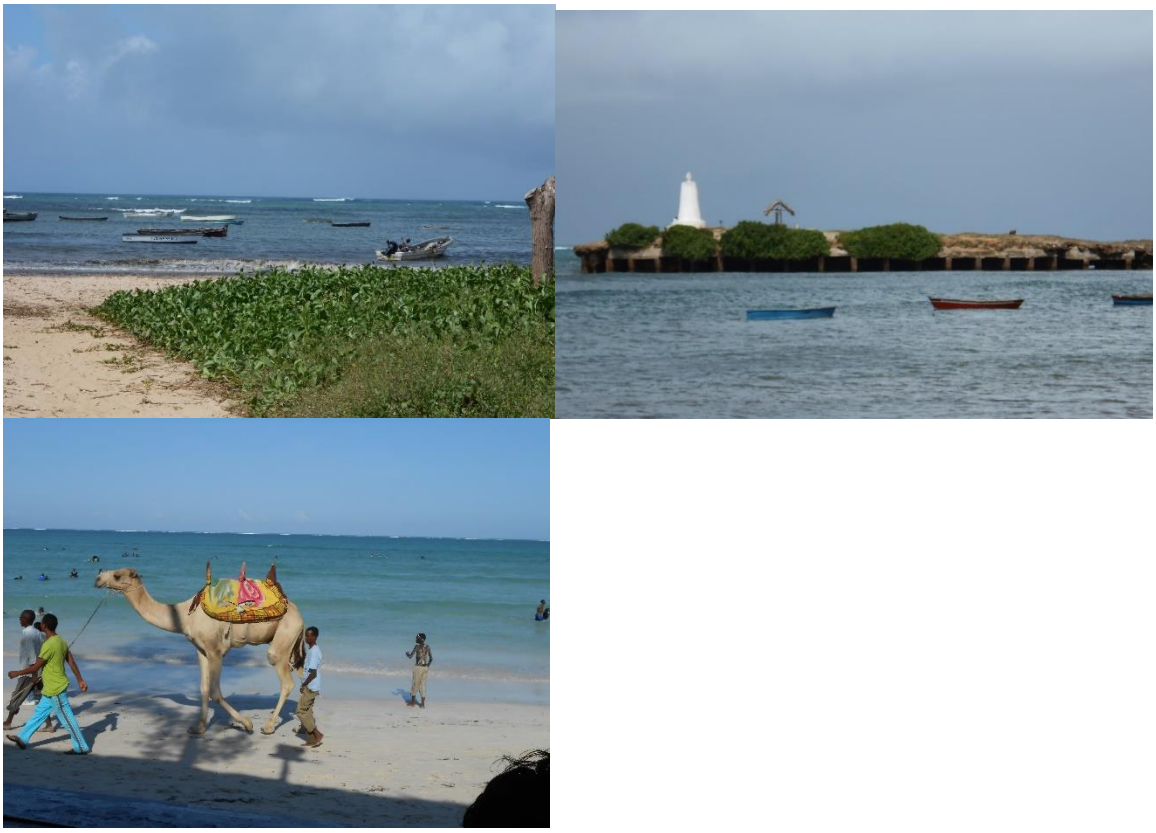


Figure 3.15: Mombasa, Kenya, Traditional Dhow Dinner Cruise

Figure 3.16: Egypt Nile Fishing, Ferries and Felucca Cruise, Luxor-Aswan

Figure 3.18: China Industrial Fishing Fleet and Need for Surveillance/Inspection Vessels

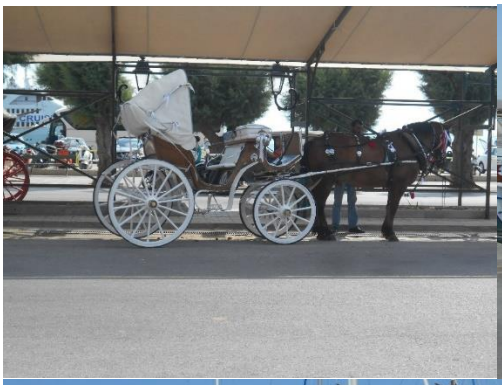
Figure 3.19: UK, Europe Traditional Piers and Entertainment Tourism

Figure 3.20: Ireland Small Harbours

Figure 3.21: Cardiff Wales Tourist Marina/Waterfront

Figure 3.22: Sightseeing Cruise off St David's, west Wales.

Figure 3.23: Greece Marinas and Small Harbours, Carriage Rides, Donkeys, Ferries









KYRIAKI CRUISES


SEAJETS

Figure 3.24: Rio de Janeiro, Brazil.

Figure 3.25: Paraty, Brazil

Figure 3.26: Launceston Seaport/Marina, Tasmania, Australia

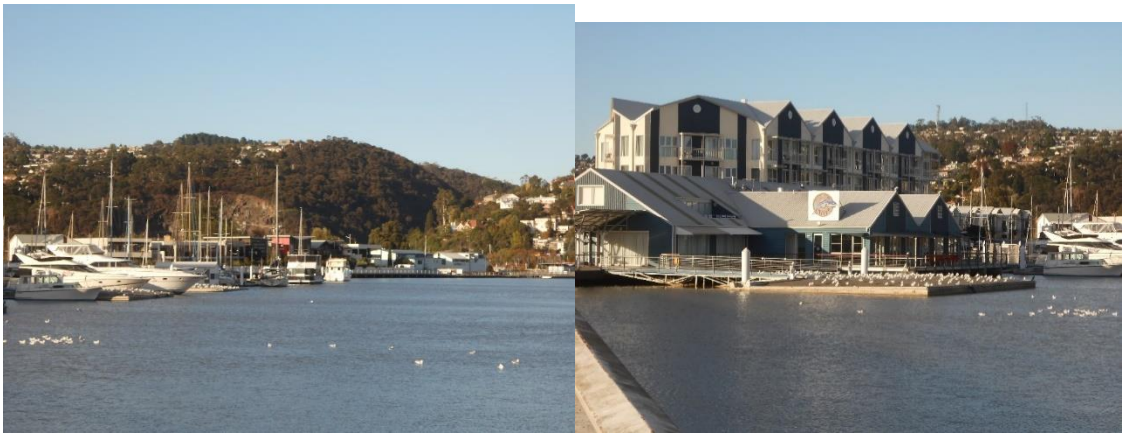


Figure 3.27: Wollongong

Figure 3.28: Fremantle Maritime Museum/Ferry to Rottnest Island, Sydney, Adelaide and Other Australia/Tasmania Ports


BUFFALO


SEA LIFE

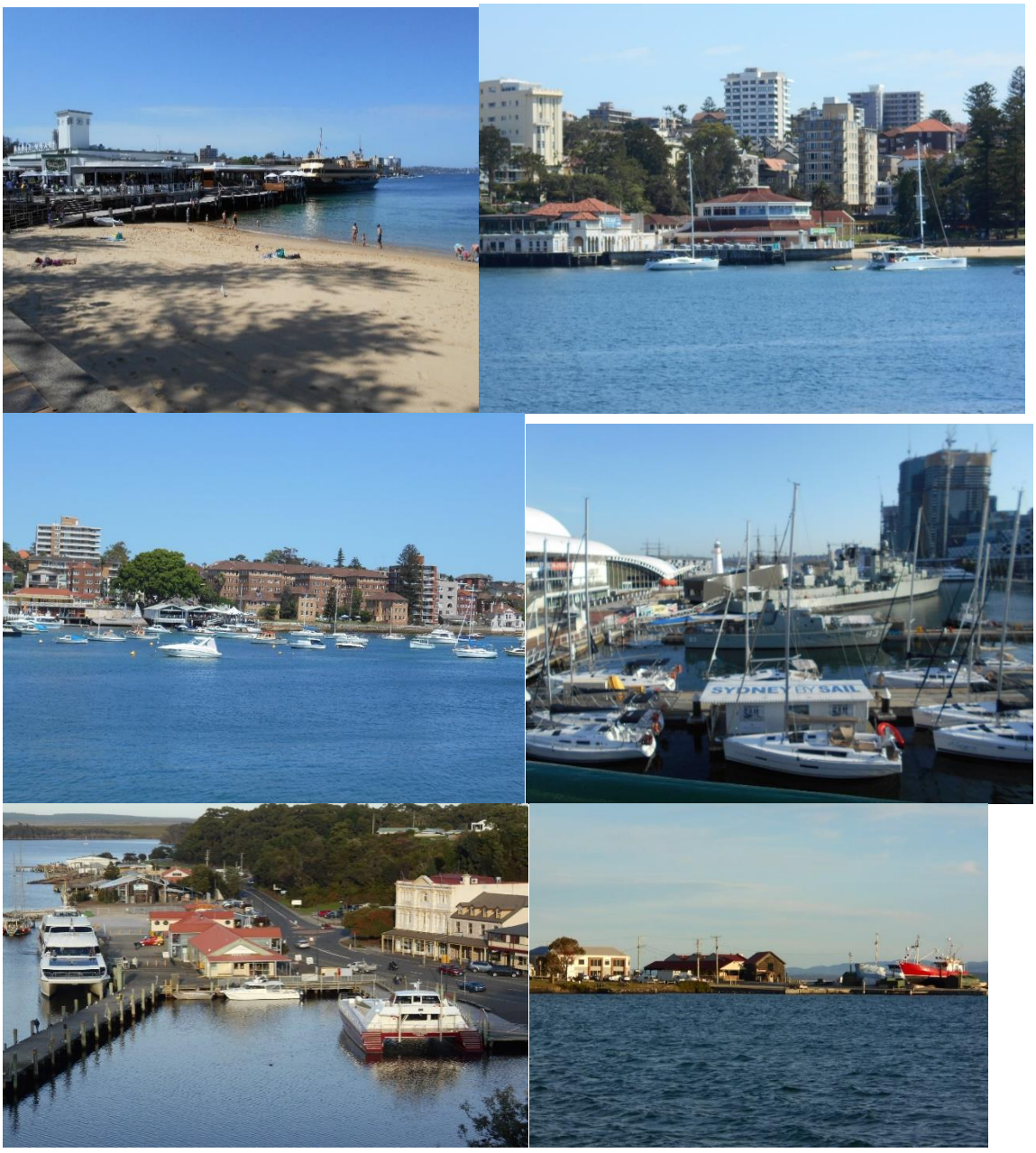
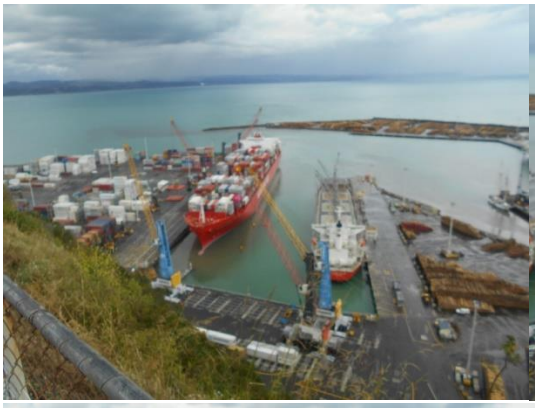


Figure 3.29: Maria Island and Triabunna

Figure 3.30: Auckland Harbour -Largest Marina in the World Over 4000 Vessels

Figure 3.31: New Zealand Small Ports



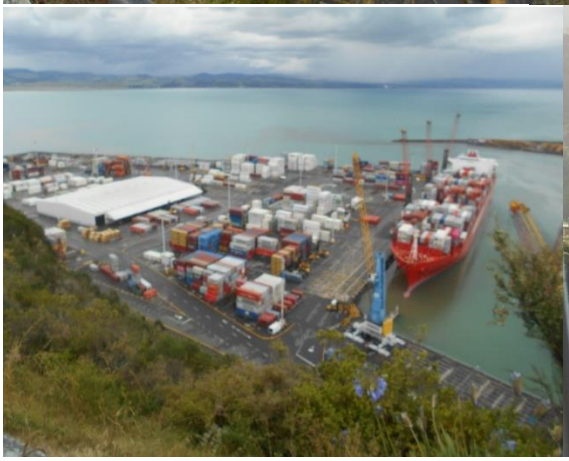




Figure 3.32: Wellington Harbour

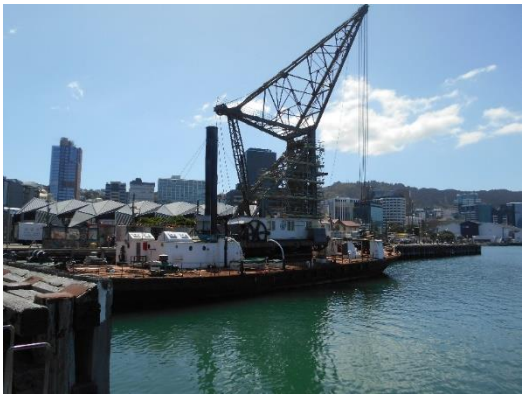


Figure 3.33: Suva Port, Fiji

Figure 3.34: Port Denaru Marina, Nadi, Fiji

Figure 3.35: Apia Harbour, Samoa

Figure 3.36: Samoa Ferry to Upolu, No Small Harbour.

Figure 3.37: Samoa Ferry to Apollima, No Small Harbour

Figure 3.38: Rarotonga, Cook Islands Harbour

Figure 3.39 Aitutaki Harbour.





3.2: Advantages

In crafting a future vision for small harbours and marinas amid the Blue Economy Age, multiple potential benefits exist towards investing in existing and potential developments, over other investment opportunity costs. First and foremost, remains that they are far more cost effective, provide more space or land; flexibility; cheaper prices and nascent opportunities for investments and economic developments; than many of their congested, ecologically, tourism and socially challenged commercial counterpart ports. Although marinas are heavily competitive in certain regions, this does not extend to

other opportunities across Latin America, Africa, the Middle East and many Asian countries. Small fishing harbours have mostly remained stagnant, confined to existing business leases or essential maintenance, without recognising the subsequent blue economy or traditional ocean economy opportunities as detailed in Section 3.6. Comparatively few stakeholders appear to really be committed to this opportunity but the Chinese government has been significantly investing in not only larger commercial ports across Africa, Sri Lanka and the Pacific but also partnering with the South African government to consider existing and new fishing harbours, apart from within China itself. Small harbours and marinas therefore can extend various contributions that tourism, fisheries and primary resource extraction and processing provide towards local economies. This section especially highlights the various economic, environmental, social, legal, research, technical, health, physical and other strategic advantages that could develop from an effective, coordinated and targeted series of interventions to support this sector. There are numerous macro and microeconomic benefits towards reigniting an existing ocean economy sector for the African continent or extending current global efforts. Unlike conventional ports this section actually benefits from being restricted in the attention of previous commercial, government policy and academia as it provides the chance to avoid their errors, mitigate risks and narrowness of scope/vision. With few competitors, it enables greater prospects and fortune to reward those more audacious to invest, as this researcher will highlight in this research's sections for opportunities and in devising an implementation strategy.

Small harbours can produce income, employment, consumption, production, additional exports, imports, trade facilitation, tax and customs revenue and improve the balance of payments. Various employment contributions that small harbours and marinas can provide are highlighted in Table 3.6. This extends to the extended Figure 2.1 supply chain, economic hinterland and coastal community. Globally, the Food and Agricultural Organisation estimates at least 59.7 million people are employed directly by fisheries and aquaculture, many needing smaller port facilities. Over 3 billion consumers depend on ocean products for food security, nutrition or preference. Oceans sacrificed 170.9 million tonnes of sea life from wild fisheries (90.9 million) and aquaculture (80 million) in 2016 alone. Global cruise tourism estimates reached over 30.1 million tourists, many of them favouring smaller ports of the Mediterranean, Caribbean and Australia-Pacific. Yachting and marina tourism employ around 100,000 people just for the marinas directly, excluding value chains.

Table 3.6: Small Harbour and Marinas Employment Opportunities

Port expansion and upgrading construction and repairs	Logistics -high priority cargo
Pilots, cargo equipment operators	Seafarer crew/support staff
Ship Repair -floating/dry docks, bunkerage	Banking/Finance and Insurance,
Port Security, Drones, Legal, terminal operators.	Administration, HR, Marketing, IT, Finance,
Education and Training	Salvaging, Diving and Surveys
Chandlery, Catering, Entertainment, Transport for crew	Utilities, Circular Economy Waste/Marine Pollution
Communication, Information, Electronics	Marine/Port Engineer/Naval Architect, Consultant
Freight forwarding agents	Technicians
Fisheries, Aquaculture, Biotechnology	Marine, yachting/recreational and cruise tourism
Ferries, Marine Renewable Energy, Desalination	Coastguard, Seabed mining, offshore oil and gas

Source: This Study:

Each sector creates its own prospects and opportunities for local social and economic development. For example, the waste generated by vessels and surrounding area can be recycled as part of the circular economy from marine pollution reduction. As larger ports become more expensive and congested to vessels; smaller harbours can benefit more from cruise, marine and leisure tourism. In particular, cruise tourism has experienced significant growth, although this may decrease due to public health fear concerns amid the COVID 19 era. *A*n increasing number of coastal countries globally are endorsing the cruise industry as a perceived existing and future, sustainable catalyst of tourism, economic activity and development. This derives not only from the swelling rise in publicity and experience generated popularity and demand; along with an increased availability of supply of vessels, destinations, market sectors, facilities, prices and itineraries; but from its perceived imperviousness to fluctuating business cycles and economic recessions. It serves as one of the comparatively few global industries to grow permanently in excess of global GDP averages of 1-2% and global seabourne trade of 4-6%; aside from telecommunications over the past three decades.

One's previous research for cruising, aquaculture and other areas is directly available via the https://www.blueeconomyfuture website platform online. Cruise tourism can aid small ports via passenger, crew and company expenditure including activities and attractions, fuel and bunkerage, catering, entertainment, shore excursions, transport, utilities, financial and telecommunication services. This extends to temporary, permanent and casual employment. Passengers benefit host economies through generating income, investment and tax revenue for food and drinks in shops and dining venues, gifts as reminders, clothing and textiles, perfume and cosmetics, jewellery and watches, cosmetics, toys, postcards and stationery, books, admission fees/tours, travel agents and shore

excursions; entertainment, accommodation; taxis and public transport, communications, pharmacies plus passenger taxes from the cruise line. Crew benefit host economies similarly through these industries but spend more on communications, medicine, medical and dental services along with banking and personal services. Cruise lines contribute to host economies through purchasing supplies from value chain stakeholders both wholesale and retail, especially food, drink, shore excursions, gifts, linen and cleaning materials, basic repairs, maintenance, furnishing, equipment and materials including wood, rope, paint and metals. They also pay site occupation charges, passenger levies and other user fees/taxes including customs, utilities, fuel/bunkerage charges, port fees, lighterage and navigation, pilotage, tugs and towing, baggage/cargo stevedoring and cruise terminal operator costs. It also provides revenue from insurance and banking services. However, many smaller ports may lose on these benefits if all facilities were provided in advanced in response to only occasional or seasonal traffic.

Smaller ports may gain from exports of local products and events that passengers are interested in including game products and seafood; wine, spirits and beer; tobacco, fruit, wood carvings and art; handicrafts and textiles sold on boards –i.e. T Shirts, books and local tour operators reducing imports, slightly improving the balance of payments and trade competitiveness. Others include supporting community and eco-tourism benefits. Indirect social benefits may include poverty and crime reduction along with education and skills development to support not just cruising but yachting/other recreational and leisure tourism facilities along with indirect community benefits from any subsequent investment in facilities and area attractions, which might otherwise be denied to them. It can aid in responsible tourism measures. Responsible tourism consists of minimising waste and other externalities, conserving local resources, managing risks and consulting stakeholders to ensure amiable stakeholder relations. More locals can therefore understand and benefit from inclusion, whilst local heritage receives more material incentives to be preserved as long as possible rather than being lost. More eco-friendly cruise vessels including solar and wind energy powered options are being developed to minimise on externality costs.

Small harbours often contain cleaner environments or those easier to purify from marine pollution and other risks. This can subsequently aid not just commercial, recreational and artisanal or subsistence fisheries but emerging areas in marine biotechnology and aquaculture. Globally, the World Food and

Agricultural Organisation “Fish to 2030” projected an annual average, world fish consumption growth from 12 to 15,000,000 tons of fish between 1970-1990 (1% per year), to an estimated 185,000,000 by 2030. Global population is expected to add to this consumer demand from just over 7 billion in 2020 to over 9.5 billion by 2050. Similar macroeconomic benefits exist to developing these sectors, as for small harbours. Higher value products can raise income for producers, whilst greater supply could lower prices from consumers. Greater local production and consumption can also have environmental advantages in supporting activities reducing externality costs compared to wild fisheries, if managed sustainably within the principles of the green, blue and circular economies. Greater import substitution can reduce vessel and other logistics supply chain emission and ecological footprints.

Small harbours can also contribute to increased food security, especially with international supply chains facing accelerated global disruption via reduced flights and shipping during public health pandemics such as the COVID-19 pandemic. Small harbours make it easier to ensure quality control for aquaculture and marine biotechnology including augmented health and nutrition where quality, quantity, safety, variety and production process can be regulated and efficaciously monitored/conserved. Increasingly finite and scarce resources, physical climate change and arid land serve as future constraints to supporting billions of human beings, at historic Western consumption levels. Significant market potential is present in establishing a reliable supply of aquaculture related seafood, cosmetics, seaweed, pharmaceuticals, fish oil and fishmeal to deal with a projected 8.6 billion people by 2033. This chapter considers small harbours could potentially aid supply chain stakeholders with greater consistency, quality; reasonable size and comparative price/product supply stability from economies of scale/ greater enforcement protection in contrast to overfished wild sectors. However, currently a limited demand exists beyond the direct community so consumers would need an awareness campaign to initially favour existing small harbours and marinas where market, community and ecologically viable or sustainable.

Smaller harbours and marinas are easier to monitor strikes, corruption, crime and other risks, provided sustainable resources are provided than larger, commercial ports. Small harbours can aid socioeconomic development of more economically peripheral communities. It also could enhance consumer sovereignty via greater market choice, lower prices both wholesale and retail, competitiveness, exports, tax revenue, foreign exchange and improve the balance of payments via

import substitution with many small ports offering land for facilities that larger ones cannot as a competitive advantage. The most significant and meaningful environmental benefits may exist if it can prove sufficiently attractive enough to investors, government, individuals, businesses and other stakeholders. Their support could generate sufficient motivation to create more marine protected areas, private eco-capital reserves, research facilities and areas, thus saving more species to ensure their protection against biodiversity, climate change, human overpopulation, overfishing and other threats, including the ultimate risk of extinction. The economic functions of marine ecosystems for maritime supply chain stakeholders (as in Table 1.3) provide powerful psychological and other incentives to indirectly preserve connected ecological functions. Communities also benefit indirectly from greater health benefits from greater seafood consumption and a more diversified income source.

Small harbours via the need for education, skills development and entrepreneurship and as a base for various blue economy activities supports scholarship in marine biology, law, technology, health, oceanography, chemistry, economics, ecology, nutrition, fisheries, aquaculture, climate change, genetics, entrepreneurship and myriad other areas such as marine ecological literacy, empathy and awareness. It aids with understanding marine biodiversity. Specific skills and training that aquaculture could potentially provide include asset fixing, repair, maintenance, construction, nutrition, aquatic/human and environmental health, promote rural soil, water, afforestation, conservation, water/resource/ecological conservation, plus general management, marketing and business skills. This can provide a source of recurrent employment for unskilled labour with little mechanisation or formal education required for many projects and production/processing stages. Another potential advantage towards world and African marine biotechnology, fisheries and renewable energy research labs, factories, farm hatcheries and reserves include tourism for tours of projects/cafes including minibuses to convey people from urban centres, combined with other rural visits as a tourism tour opportunity. Commercial aquaculture products for sale could be sold retail as gifts such as pearls and jewellery from oysters, chutneys/spreads e.g. fishpaste, textiles, cosmetics, medicine and other products.

Small harbours and marinas provide virtually the only economic chance to readdress poverty, equity and economic prosperity for coastal communities and artisanal fisheries, especially those involved in

high risk, low profit margin and often hazardous livelihoods as their vocations. To therefore not invest in them, is to reassign them to remaining peripheral and lacking in significance, in a rapidly technology bound, overpopulated and climate change riskier world. The FAO definition of small scale or artisanal fisheries as "*traditional fisheries involving fishing households using relatively small amounts of capital and energy, making short fishing trips, close to shore mainly for local consumption*". It estimated over 35,470,800 artisanal fisherfolk globally in 2012 alone. One study shows how catches can fluctuate and are predicted to decline even more under climate change, pollution and overfishing, lack of access to training, technology, capital and invested harbours (Tietze 2016). More harbours therefore require economic diversification. The source cites myriad successful case studies undertaken by nongovernmental organisations, international agencies, national governments, and other entities such as small-scale fisheries across Sabah Malaysia, Brazil, Lebanon, Tonga, Madagascar and Nile perch in Kenya. Others include Kenya sea cucumber fisheries and Philippines seaweed farming.

It proposes the need for greater education, training, access to credit, marketing, transport, electricity, ice, integrated ecosystem reserve and coastal zone management along with improved small harbour facilities. Boatbuilding, storage and repair amenities can assist this sector along with hygienic practises. With support at least 94% of surveyed participants were able to survive on a viable livelihood, despite the recurrent challenges including ensuring the preservation of catches long enough to sell them. The need for an effective monitoring and law enforcement mechanism remains essential; especially to enforce fishing quotas, pollution reduction and minimise erosion/other environmental pressures. Many small harbours and their users experience constraints not only in securing credit and finance from investors but also insurance. To capitalise further on the advantages of small harbours and marinas, this section identifies the success of China which has provided insurance for marinas, small fishing ports and fisherfolk with over 50,000 members since 1994. Unsustainable means of fisheries extraction and spoilage/waste along the supply chain is advised to be highly discouraged whilst beneficiation opportunities can be endorsed and stimulated.

3.2: Disadvantages of Small Harbours and Marinas

Certain disadvantages exist in proposing either new small harbours and marinas. One of the most significant economic opportunity costs with these areas as with any opportunities, is the cost of failure

and investing due to sunk costs and market barriers to entry prior to commercialisation. If the project does not succeed, there are high costs associated with abandoned projects including ecological rehabilitation and to remove infrastructure, reducing alternative possibilities. These initially employ comparatively few people directly on average (5-10 at a minimum during operation excluding construction). Most marinas employ a maximum of 20-25 directly. A potential economic disadvantage to small harbours is that, although it may increase economic activity, this potentially has to be offset against potential losses of employment/economic activity in conventional fishing that might occur from lower prices/increased competitiveness. Each potential investment creates a subsequent opportunity cost due to potentially desirable production, consumption and rates of return on investment that do not occur. Many small harbours and marinas may require extensive investment in infrastructure maintenance and marketing to be viable or lack sufficient market demand to be commercially viable for investments.

Small harbours and marinas also may create more pressures given scarce resources in ensuring security against crime, poaching and ocean governance/statistics information requirements. They potentially present social pressure risks due to conflicts or uncertainty over land ownership and security of tenure. Insufficient training, education and skills development for qualified local harbourmasters, marine and coastal engineers, boat builders, technicians and maintenance staff could present challenges. Additional influxes of non-locals could raise community tensions from additional infrastructure and services constraints if insufficiently integrated into local communities, municipalities and areas, their plans and requirements. Examples include more traffic congestion and higher real estate prices, although others may benefit sufficiently to counteract this.

Increased ocean/blue economy activities may create greater ecological pressures for local ecosystems. More visitors may enhance marine pollution and surface litter. As identified in this researcher's previous study on marine pollution reduction, from 1986-2010, Ocean Conservancy's International Coastal Clean Up only managed to remove an impressive 152,077,087 pieces of marine litter. Cigarettes and filters included 52,907,956, food wrappers and containers contributed 14,766,533, caps and lids 13,686,423, plastic bottles 9,549,156 and glass bottles 7,062,199. An alternative source (Eriksen et al. 2014) estimated over 268,000 tons are floating in the oceans, with over 5.25 trillion pieces of plastic based on 24 expeditions from 2007-2013. Of the total of 5.25 trillion

pieces (1,990 billion is traced to the North Pacific, 1,300 billion to the Indian Ocean, 930 billion for the North Atlantic, 491 billion for the South Pacific, 297 billion for the South Atlantic and 247 billion for the Mediterranean. Nets were used to collect samples for analysis. Estimates ranged from 1000 to 890,000 pieces per square kilometre of surveyed ocean. These present as yet unquantified economic, ecosystem and public health risks from asthma to obesity, HDHD, thyroid disorders, cancers, choking, poisoning, infertility and other issues. Synthetic polyester textile fibres also contribute to marine waste. Further additional potential environmental disadvantages of small harbours and marinas are highlighted in Table 3.6. These can potentially adversely affect the ecological and economic functions of marine ecosystems including loss of biodiversity and acceleration of species extinction if not following best practises and standards; including the need to ensure a circular economy and climate change/environmental impact assessment prior to construction with continuous monitoring and evaluation throughout a small harbour or marina's existence.

Table 3.6: Potential Environmental Disadvantages of Small Harbours and Marinas

Maritime Emissions/Air pollution	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFC's), hydrofluorocarbons (HFC's), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3)
Shore public transport and taxi emissions	Road, rail, air
Value chain/industry smog/pollution	logistics, materials, distribution
Solid waste	Metals, equipment
Hazardous waste	Chemical dumping
Potential recyclable waste	paper, plastic, glass, packaging, organic
Hydrocarbon pollution	Energy/petroleum use/ oil spill
Black water	Sewerage
Grey water	Cleaning/Drinking waste water from plumbing, detergents kill life
Bilge water	Alien species, foreign bacteria and viruses
Ballast water	Alien species, foreign bacteria and viruses
Eutrophication	Alien species, foreign bacteria and viruses
Ocean acidification	coral bleaching, ecosystem loss
Species/Biodiversity loss/pressure	Endangered species, contaminated seafood
Geological/ Vegetation loss	loss of heritage, erosion, subsistence, ecological resilience seagrasses, mangroves, coral reefs
Coastal erosion, soil and sedimentation	Nutrients, sand loss
Drain on fresh water	Irrigation, food security
Future Sustainability	Coastal over development pressure
Sound, light…	
Climate Change	

Table 3.7: Ecosystem Functions for Blue/Marine/Ocean Economy Stakeholders

Ecological	**Economic**
Biomass/Biodiversity Life Formation and Habitat	Life, Food, Material
Conservation	Supply of Natural Resources, Reduced Imports

Biological/Physical/Chemical	Redundancy against Uncertainty
Growth, Reproduction,	Trade, Production, Consumption, Income/Profit
Respiration/Oxygen/Photosynthesis	Greenhouse gas mitigation funding/source sink
Water supply/purification. Food security/Nutrition	
Protection	Protection –Vulnerability and Resilience
Ocean Chemistry, currents, salinity	Risk Identification, Monitoring, Prioritisation, Adaptation
Coral atolls –geographical physical formation, continued growth and survival	Risk Enhancement if Ignored –Legal, Reputational, Insurance, Security, Operational, Impact Costs
Sand formation, nourishment and sediment	Opportunity
Evaporation, Condensation and Absorption	Insurance against Maladaptation,
Climate Regulation –calcification, stratification	Future Sustainability and Survival
Counter eutrophication	Knowledge –Existing and Potential/Spiritual
Detoxification	Stability/Security/ Increased Adaptive Capacity
Population equilibrium	Aesthetic/Cultural/Social
	Tourism

Other disadvantages that may emerge is that small harbours and marinas create additional pressures on current river, aquifers, lakes and other freshwater sources or land present; given challenges for marine spatial planning, integrated coastal management and ocean governance. Depending on usage and the small harbour/marina or other blue economy activities involved, many sources have alternative uses -i.e. for drinking, fisheries, agriculture, tourism and recreation, hydropower and sewerage, transport, ecosystems etc, which must not be impaired or catastrophically averted. Investing in this blue economy sector and related activities needs to carefully be conscious of potential social, economic and other stakeholder needs, requirements and opportunity costs. It can be challenging to establish market viable circular economy enterprises and receive local community engagement or participation to ensure they adhere to reducing marine waste. Otherwise this could act as a dramatic deterrence. It remains essential not to subscribe to development pressures and preserve social-cultural heritage rather than reducing heritage or natural coastal aesthetics. Depending on the location of proposed facilities, it might also affect recreational and other forms of fishing and watersports. Major challenges to marine spatial planning such as the valuation of coastal real estate, commercial ports, tourism and recreation/yachting taking current precedence need to be minimised.

Certain economic activities such as cruise tourism may present unique challenges for small harbours and marinas if not astutely forewarned and forearmed. Although cruise tourism does generate significant localised economic activity for local value chain stakeholders; there is no certainty that employment, expenditure, wages, fees, trade and tax revenue will occur; that they will be temporary or sustainable and that these will be sufficient to offset the significant resources, capital and other costs that small ports/authorities might incur in promoting cruise tourism, modernising and providing

staff/upgraded terminals and processes. Many studies emphasise only marginal expenditure by passengers, companies and crews, with high lobbying powers and pressures by cruise vessels. There is also the cost if vessels are delayed, itineraries are changed or cancelled, generally not reimbursed by the line, yet terminals/etc possess fixed not just variable operating costs. Existing research indicates that being foreign owned, cruise corporations are interested in maximising their own revenue –cruise vessels serve as floating resorts, whose casinos, entertainment, dining venues, shops and official shore excursions, minimise localised activity from passengers, crew and the line. Few small and medium enterprises directly benefit and increased visitors can add selective congestion.

These companies become more economically dependent on cruise tourism as lines become more established over time. Localised revenue is often reduced further by procurement policies which allow stocking of most supplies disproportionately in the hub/home port or wherever globally, purchases needed are most cost-effective. Tax revenue and various fees can be undermined by the extent to which cruise companies can exploit their monopoly bargaining powers, fostering economic dependency against high global competition for their presence unless the government/destination stakeholders coordinate and are sufficiently specialised/popular to offer the firms equality. It can be challenging to ensure cost-recovery under the user pays principle. A significant opportunity cost of infrastructure, capital and equipment investments with high maintenance and capital investment/security/ technology costs. Many businesses, attracted by the presence of passengers do not consider long term time horizons for cruise tourism, establishing short term businesses without future sustainability and cost recovery, yet very limited time exists per port call. Cruising has a significant potential ecological cost. In one's 2014 study on cruise tourism (also on the www.blueeconomyfuture.org.za), one presents the example of a single 3000 passenger cruise vessel estimated at producing high environmental externality costs with 56781.77 -113562.35 litres of blackwater, 340,687.06 -965,280.005 litres of graywater and 8 metric tons of bilge water per day whilst producing 24% of global solid wastes including incinerator ash, batteries, cleaners, oils, solvents, cleaning material, paint etc. Ocean Conservancy rated virtually all major cruise lines F on the basis of an extreme lack of environmental sensitivity, information and transparency, many ignoring existing regulations. Comparatively few small harbours and marinas or nations outside the Caribbean, Pacific and Mediterranean have yet to conduct a full environmental impact assessment report in hosting MSC and previous cruise vessels. Nor has research to be conducted for any African/ few Southern

hemisphere examples to consider the extent to which cruising has affected local climates, land, air and ocean ecosystems. Without enforcement capacity, smaller harbours may face even greater prosecution or investigation/monitoring challenges which extends to fishing fleets not just cruising.

3.4: Risks involved in the Future of Small Harbours and Marinas

As identified in this section, several risks create uncertainty towards whether small harbours and marinas can be revived as part of the blue economy. First and foremost, remains global climate change. Uncertainty over changes in human demographics and preferences influences the extent to which people will live, invest and support minor ports and communities. Aside from uncertainty over fluctuating economic cycle, socio-political and technological uncertainty from digital disruption. A legal/policy risk of uncertainty also remains in the various policies, laws, regulation, financial and other incentives or disincentives exist as obstacles or enablers of implementation. Stakeholder reactions and expectations are also partially determined by their rivals, competitors, allies or superiors. For example, it may be governed by other tiers of government or businesses and supply chain connections. Ecologically it depends on the extent to which existing ecosystems can survive sustainably or are replenished and the overwhelming implications of excessive human overpopulation, plastic and other marine pollution volumes and rates of biodiversity loss, species extinction and coastal degradation.

3.4.1: Climate Change, Global Climate Change Projections and Stakeholder Implications

Global climate change has been unequivocally consented to as real by surveyed peer reviewed sources and experts. Earth and all blue economy activities including small harbours and marinas will be radically altered by the following gradual, climate change risk events and impact consequences as projections at a minimum, unless we act immediately

- An increase in global average land surface, atmosphere and sea temperature levels, of 1.5-2ºC for the B1 scenario. This occurs even if emissions were to cease, based on historic inventory levels.
- 2.5-4ºC increase for the IPCC (2015) A1B scenario, if emissions are stabilised at the current, medium growth rate by 2100.
- 4-7ºC increases for the IPCC (2015) A2 scenario if emissions are not reduced.

- A 0.5 metre global, average SLR is projected for a low risk, current growth, scenario where emissions are highly reduced, 0.8m rise. This presents a medium risk if emissions are stabilised. Up to 1.1m high is expected for a high risk, continued emissions increase scenario by 2100, in pursuing current, global GDP growth rates of 3-5% annually.
- Other global, Pacific regional and individual increases in sea level, temperature, humidity, precipitation and wind speed are anticipated. Potential variations in wind direction, current, ocean swell, wave energy and sedimentation, are expected as long-term risks.
- Greenhouse CO_2 emissions would have to stabilise around 450 parts per million (ppm) (430–480) at present; no higher than 550ppm (530–580) by 2100, to ensure survival.
- A projected increase in the frequency, duration and intensity of climate- related, natural disaster risks.

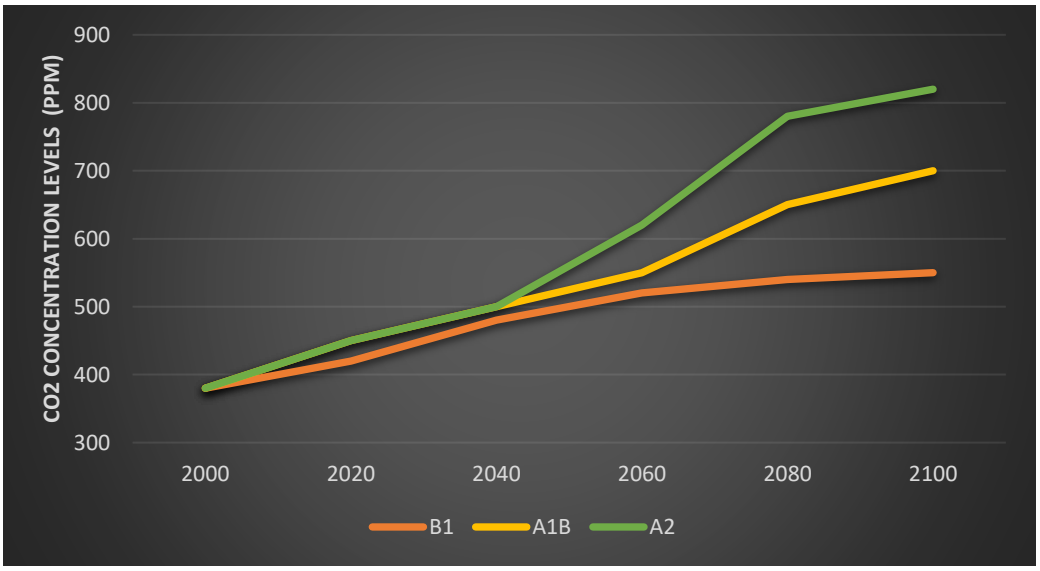
The 2019 Intergovernmental Panel on Climate Change (IPCC), Australia General Bureau of Meteorology and other Pacific/global meteorology services conventionally utilise baseline historic data. This provides a mechanism to help determine future, climate change scenarios. This section outlines three scenarios (B1, A1B and A2) that will be utilised to identify potential future risks for blue economies on a global scale, over 3 time horizons. B1 is used by the IPCC (2015) and international, climate change policy makers to refer to a low emission, growth scenario. This occurs if humanity were to become substantially more environmentally sustainable; to convert from an industrial to a services-based economy which is less resource and emissions intensive and restrict population growth to reduce emissions. A1B refers to a medium, emissions growth scenario or "business as usual" if population and economic activity were to continue at current growth levels. A2 refers to a projected, high emissions growth scenario. This occurs if developing countries do not stabilise population, dramatically reduce emissions and pursue the globalisation or industrialisation, economic activity levels of developed nations. The three projected time horizons (2030, 2055 and 2090) are defined as short, medium and long-term periods for blue economy stakeholders such as small harbours and marinas to adapt.

3.4.2. Projected CO_2 Emissions Growth

Global projected, CO_2 emissions are projected to increase from an actual baseline of 380 parts per million (ppm) in 2000 to 550 ppm under a B1, 700 ppm for an A1B and over 800 ppm for an A2 high emissions scenario. This is based on IPCC (2015) data estimates and illustrated in Figure 3.40. The implications of increased emissions possess significant, disruption risks and direct and indirect impacts with adaptation costs for blue economy activities. Increased ocean acidification and changes in

salinity/pH balance from emissions; project further disruption costs to natural resources and coastal protection roles of coral reefs and other tropical ecosystems. These projections illustrate how vital it is for MSC stakeholders globally from producer to governments, ports and intermodal transport to consumers; to prioritise not just mitigation but adaptation.

Figure 3.40: Global Projected CO_2 Emissions Scenario Growth



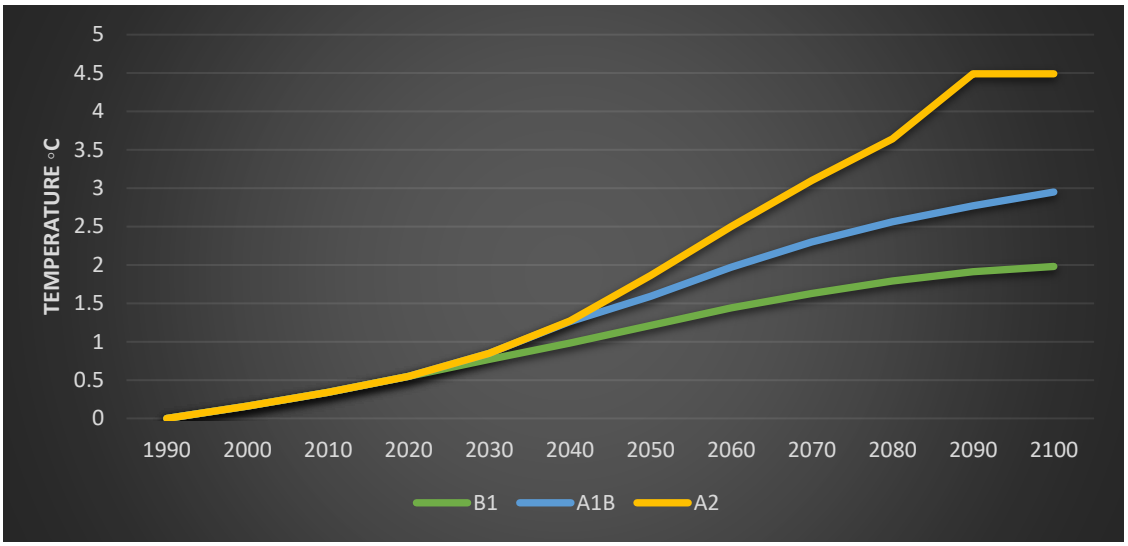
Source: Author

3.4.3. Historic and Projected, Global Mean Temperature Rise

Based on IPCC (2015) data estimates and Figure 3.41, global, mean surface temperature rises are projected to increase from an actual baseline of 0ºC in 2000 to 0.85ºC by 2030 under all 3 scenarios. By 2055, emissions are projected to diverge, around 1.2ºC under a B1, 1.59^{0}C for an A1B and 1.86ºC for an A2 scenario. This increases to an average of 2, 3 and 4.5ºC respectively by a 2100, long term projection. Figure 4.4 (Encyclopaedia Britannica 2008) provides an alternative visual representation of how specific world regions will be affected and vulnerable under an A2 scenario. Increased global mean temperature implications for blue economies are indicated throughout this thesis possessing significant disruption risks, direct and indirect impact and adaptation costs. These projections illustrate how vital it is for these stakeholders globally to adapt, enhancing vessel and infrastructure resilience to higher temperatures and increased salinity. Higher temperatures contribute towards an increased frequency of droughts, greater temperature extremes; reduced water; higher evaporation and evapotranspiration rates. This affects future climates, natural resources and productivity. According to

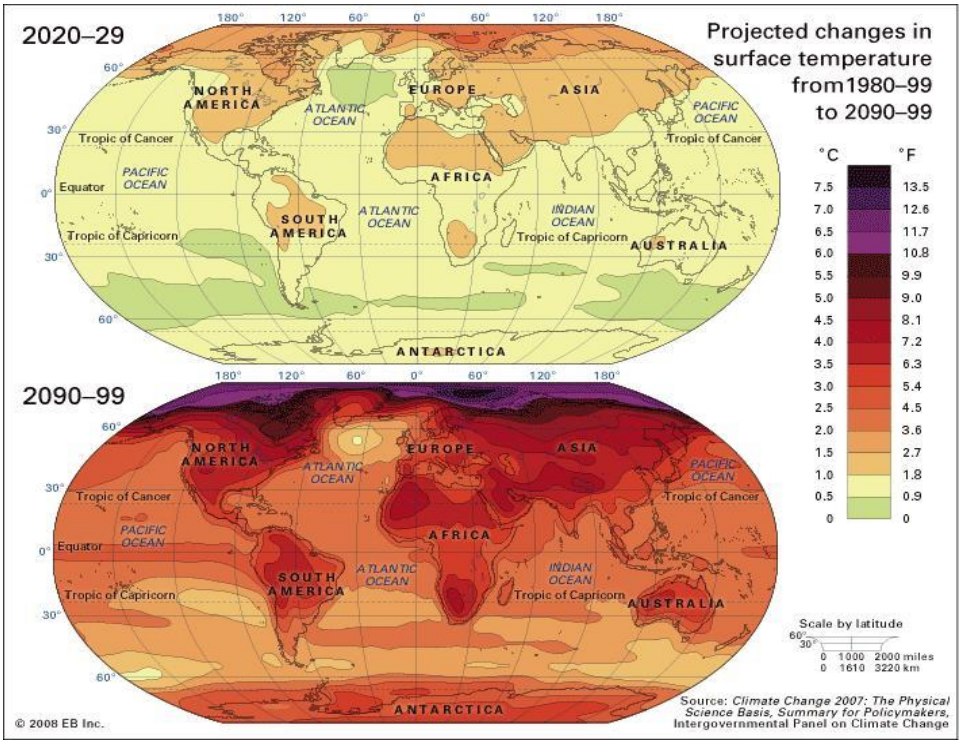
these sources climate change projections may include slower ocean currents/thermohaline circulation, complicating navigation.

Figure 3.41: Global Mean Surface Temperature Change



Source: Author.

Figure 3.42: Projected Climate Change, Surface Temperature Changes 1999-2090

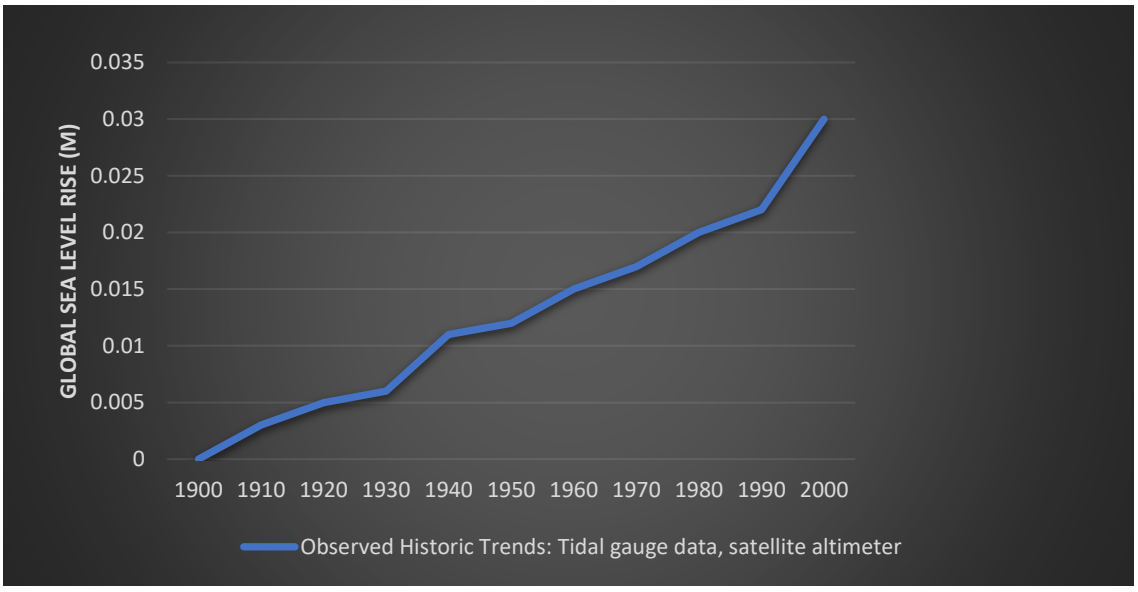


Source: Encyclopaedia Britannica 2008, page 72.

3.4.4. Historic and Projected Sea Level Rise

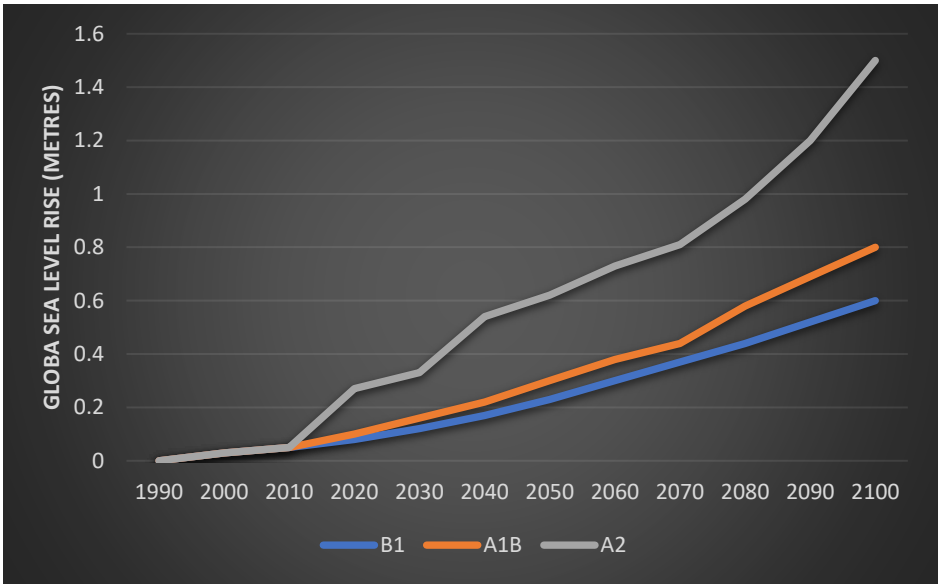
IPCC (2015) data from tidal gauge data and satellite altimeters; illustrated in Figure 3.43, estimate global average, SLR rose historically from a 0m baseline in 1900 to 0.03m by 2000. The rate of increase has substantially accelerated from several, global, climate change related factors. These include accelerated polar melting of sheets, glaciers and ice caps, land-based water discharges and thermal ocean expansion from increased mean temperatures. These have expanded from an average of 1-1.5 mm (1900-1980) to 3-3.5 mm per year (1980-2014) (AGBM 2015). It's projected to reach 8-10 mm per year by 2100, if global climate change trends are not stabilised. From IPCC (2015) data and Figure 3.44, global, mean SLR is projected to increase from a 0 baseline in 2000 under all 3 scenarios. However, by 2030, scenarios are projected to diverge around 0.12 metres under a B1, 0.16 m for an A1B and 0.33 m for an A2 scenario. This increases to an average of 0.23, 0.3 and 0.62 m respectively for a 2055, medium time horizon. By 2100, on average global small harbours and marina stakeholders are anticipated to experience a mean, SLR of 0.6 (B1), 0.8 (A1B) and 1.5 metres.

Figure 3.43: Historic Average Global SLR 1900-2000.



Source: Author

Figure 3.44: Global SLR, Climate Change Risk Projections



Source: Author.

3.4.5. Implications of Global Climate Change for MSC Stakeholders

The implications of increased global SLR, temperatures and other long-term risks for marina and small harbour stakeholders are indicated throughout this section. Specific nations and their physical, economic and environmental survival prospects; are threatened under all three projected scenarios. Stakeholders may have to adapt to a world where low altitude countries, ports, populations, infrastructure, resources and coastlines experience substantial disruption risks. From one's PHD on climate change and Pacific maritime supply chains (Dyer 2018), sufficient consensus exists about the actual effects and process of climate change. This justifies stakeholders adapting from the Precautionary Principle; even where various climate change models provide a range of confidence intervals, risks, impact costs and solutions, not the actual occurrence. This section echoes the lessons provided in one's thesis includes projections to identify risks, possible impact costs and assist adaptation strategies and in response to stakeholder concerns; expressed as existing literature weaknesses or possible directions for future research. Most global circulation models are flawed in failing to consider projected local and sub-regional, climate change impacts. A considers a lack of projection studies exists globally, which concentrate on localised coastal areas, ports and supply chains. Few consider localised, interdependent environment-ocean-land-atmosphere as climate change factors, to ascertain an inventory of exposed coastal assets/supply chain vulnerabilities. This

review suggests stakeholders would benefit from more representative studies utilising projections for specific regions, islands and MSC case studies. This identifies and minimises potential risks, impact costs and adaptation solutions more accurately.

An emergent supply chain and business stakeholder requirement for more practical and specific/localised projections. This has yet to physically manifest inn providing financial and other support to those such as I. Yet, if sufficiently prioritised by nations, the private sector, financial institutions, aid agencies and individuals, this assists to identify specific risks, impact costs and opportunities for individual stages including businesses. A lack of studies specifically focussing on private sector climate change adaptation, rather than for governments and local communities, is further criticised. Accurate projections might incentivise private sector funding for enhanced supply chain resilience and other adaptation solutions. Externally financed, situational awareness and accurate information especially aids those nations with limited government funding. This source points moral hazard as a reluctance to invest in supply chain adaptation without more certain information. Accurate detailed projections can further aid impact damage cost estimates and various ecosystem replacement values (Previous natural disasters and gradual risks can demonstrate current vulnerabilities and disruption risks to minimise opportunity, delay, externality and maladaptation costs for anticipated events.

It is an emerging legal requirement for key infrastructure and systems of more countries, such as ports and supply chains, to consider projected climate change and to disclose emissions and risks. It also aims to aid companies especially those listed on the Australian, US, UK and other stock exchanges, (whose supply chains may stretch as far as the Pacific.) These must identify and disclose physical risks/impact of climate change for individual businesses. Awareness may reduce legal, reputational, litigation and other noncompliance risks, including stakeholder pressures. This pioneering research on small harbours aims to minimise legal, compliance costs for its selected Pacific MSC example. It provides specific global, regional and local projections to determine relationships between key risk variables and supply chain stages or blue economy activities, especially for marinas and small harbours. However, a significant constraint to implementing adaptation solutions, is most supply chain, business planning horizons are short term: 1, 5 or even 10 years, yet current reviews envision 100 years for projected climate change.

Therefore, dependent stakeholders require a tool such as Pacific Climate Change Futures, or literature proposed models. Stakeholders need projections considering a range of scenarios and time horizons to aid effective decision making when planning to adapt businesses. This tool approach is flexible enough to aid adaptation solutions. Examples include revising technical design standards, climateproofing existing infrastructure, equipment, transport and processes to determine the degree of resilience. It includes the stress and asset lifespan to determine adaptation and post-event, recovery and replacement cost; disaster reduction and risk management. This is necessary as risk may be significantly underestimated by stakeholders relying on conventional small harbour and marina guidelines. For example, Australia's National Ports strategy considers standards of 50-100 years in design but significantly underestimates risk using a probability of 1:100 years of significant storms. Other ports generally prepare 20-30 years in advance. Therefore, this scholarship contribution considers accurate projections contain advantages for MSC stakeholders to assess how risks originate and subsequently develop. It determines how impacts can differ across various economic sectors, stages, stakeholders, countries and even between short, medium and long-term time horizons.

This section and its projections aim to contribute towards stakeholder awareness of risks. This must mainstream climate change information including data availability, the cost effectiveness of proposed responses and the urgency of risks for all dependents and participants through projections, updating existing Pacific studies. Scenarios can further aid risk identification, assessment severity and prioritisation. They ascertain direct and indirect impact costs, timing and type of adaptation response Comparatively accurate climate projections and short-term, meteorological data are essential to ensure business continuity, future profits and rates of return on investment for stakeholders. Identifying possible global, regional and local climate change impacts upon small harbours, maritime supply chains and communities or ecosystem resources further emphasises the need to incorporate scenarios and assumptions into any subsequent methodology. This computes more accurate integrated risk-vulnerability and impact cost analyses These projections further indicate the urgency of stakeholders to react to climate change, to minimise these threats as the ultimate risk threatening the future economic, environmental and physical survival of Pacific MSCs.

Research needs to embrace digitisation and the 3rd/4th Industrial Revolutions with new tools for diagnosing the probability of climate change to aid effective risk management. High resolution impact data has already aided Caribbean, coastal supply chains that are similarly climate risk exposed. For example, stakeholders could use Google maps and satellite imagery to identify impacts of SLR, temperature and other risks. Accurate, localised, updated projections enable stakeholders to evaluate each adaptation strategy's costs and benefits and individual solutions) to minimise impact costs. Another significant constraint is the limited availability of shared information and cooperation across different stakeholders; even when mutually advantageous in lowering costs. Accurate information also assists in identifying an event's timing, threats and opportunities presented. These further indicate the need for a joint risk, cooperation approach in information, communication and adaptation across entire small harbour value chains, integrating stakeholders. This aims to minimise disruption costs to international trade and economic activity, throughout an event. Specific risks include hazardous coasts and futureproofing against the uncertainties of projected climate change, with enhanced climate resilient infrastructure and services. Energy security could be provided by offshore and onshore renewable energy; water security via desalination and cleansed streams/additional dams and tanks. Greater access to fisheries from enhanced ocean governance, marine ecosystem protection and aquaculture, would enhance food security.

3.4.6: Specific Climate Change Risks for Small Harbours and Marinas

Climate change possesses significant physical survival and uncertainty risks to geographically vulnerable small ports, marinas, shipping and other maritime supply chain stages for all blue economy activities. These include short and long-term risks. Gradual risks include sea level, land, sea and atmosphere temperature, current and wind velocity rise, changes in sedimentation and wave energy. These often require less immediate priorities, constraints and mitigation or adaptation strategy responses over a longer time period of years, decades or longer. A second category identified focuses on unpredictable risks associated with short term, sudden impacts, e.g. related natural disaster events such as storms, tsunamis, typhoons, cyclones, droughts, heatwaves and landslides. These offer greater, more direct risks and impacts necessitating short-term adaptation, resilience and mitigation strategy responses, and present a direct threat over a year or less (The risk of changes in species

migration and biodiversity loss poses seldom considered costs for affected stakeholders. To address central disruption risks it is necessary to include both short/sudden and long-term risks.

Climate change generally presents these risks to global and Pacific ports, shipping and overall supply chains through influencing exports, imports and transhipment values, qualities, volumes, related revenue and fixed/operational costs (Dyer 2018). These projected impact costs will therefore influence the continued physical survival, commercial profitability and other requirements for global and local stakeholders, across all supply chain stages in Figure 2.1 beyond immediate small harbours and marinas. In failing to define and recognise both risk event types and associated impacts in existing studies, current stakeholders are often climate change averse. Many fail to adapt to risk uncertainty Concentrating on a single risk type underestimates impacts identified. This increases eventual disruption and adaptation costs involved, if response actions are not perceived as necessary by stakeholders. To completely adapt to climate change, this both disruption risk and impact types need to be prioritised and evaluated across supply chains and blue economies including small harbours and marinas

3.4.6.1: Long Term Impacts of Climate Change on MSCs

These first concentrate and identify only specific risks for ports, before assessing direct consequences for disrupting various stages and stakeholders. Projected long term, risk events threatening ports, shipping and other supply chain stages, include SLR, temperature, humidity, precipitation, changes in current, wave energy and sedimentation according to IPCC (2015). These events and associated long-term impacts/consequences are summarised in Table 3.8 and analysed further in this section. Long-term risk events and associated impacts for ports include sea level rise which creates a progressively smaller, total port surface area, pavement and foundation damage from flooding. Flooding impacts can create reduced port, surrounding road, rail, shipping, air transport, utilities, and supply chain land area and access. Changes in sea spray, wind velocity, waves, humidity and temperature from storms, tsunamis, heatwaves and others may further decrease potential port activity from corrosion and other damage to local and cargo transport vehicles and equipment. Physical damage to port infrastructure, vessels, equipment, cargo and related utilities (water/electricity/sewerage) for all risks from increased sea spray and erosion, may create idle infrastructure/equipment capacity, delaying port/supply chain

performance. These may cause significant damage to port and associated supply chain infrastructure, services and performance, the quantity of cargo throughput through the port, the composition/quality of these commodities and physical damage posed to cargo.

Other long-term risks and associated impacts include increases in temperature, humidity, wind velocity, currents and precipitation frequency, duration and intensity. These risks can significantly delay port operations over an extended time period, creating a high economic impact cost on the surrounding economic hinterland. These risks may create further physical damage and delay, impact costs to port processes directly and MSCs indirectly. Infrastructure and other assets progressively lower climate resilience from repeated physical exposure over time. Increased sea levels, precipitation and wind velocity can impair crane and other equipment, operational capacity and mobility, and twist road and rail infrastructure. It may displace containerised cargo and hinder ro-ro and other cargo loading/unloading, storage and distribution functions. Potential small harbour and marina risks, with associated long-term impact costs identified by literature, are summarised in Table 3.9. Various physical, economic, financial, legal-policy, technological, psychological, health and safety, education, training and environmental impact costs may influence stakeholder adaptation solutions. A projected increase in storms, precipitation and surface run-off may damage cargo and passenger terminals, equipment, vessels, cargo, wharfs, piers, bridges, roads, rail, and port security cameras. This further provides economic, profit, environmental, physical survival and direct security risks to affected users (Dyer 2018) predicts increased wave oscillation and turbulence plus decreased circulation from prolonged wind velocity. This may further complicate vessel navigation, especially through narrow/congested port channels, increasing associated berth occupancy, port, cargo, transport, equipment and idle capacity costs. Wind velocity increases may further delay or damage terminals, port and customs authorities, directly affecting profits. Increases in information uncertainty and planning/emergency responses may exist through significant damage or interference to communications, information and hazard warning systems. This further affects intermodal connections and global supply chains through decreased profits, increased congestion and costs, as detailed in further sections. Higher wind velocity, humidity and temperature may increase port dust and related cleaning/storage protection costs.

Maritime disruption risks and related long-term impacts may initiate changes in ocean currents, wave energy actions, coastal erosion and channel sediment, higher temperatures, humidity and moisture from precipitation. Increased salinity from ocean acidification, humidity, temperatures and precipitation may further increase port infrastructure, transport, equipment and cargo erosion/corrosion rate costs. This source anticipates particular weakening of metal based over more resilient concrete/timber-based structures from sea spray increases, with further associated repair, replacement, maintenance and adaptation costs. This may further gradually impair port functions and environmental resilience or absorption capacity of the related ecosystem. Climateproofing development increases repair, maintenance, replacement and adaptation costs (Dyer 2018). Direct long-term risks and associated impacts include delayed or damaged cargo throughput. Therefore, supply chain efficiency and performance are reduced, significantly increasing congestion directly. This reduces profits and increasing other opportunity costs for dependent stakeholders, and indirectly throughout the affected supply chain These long-term impacts gradually challenge each stage's capacity to satisfy requirements of accessibility, reliability, certainty, speed and frequency. This ultimately reduces port productivity, efficiency, equity, user cost and inter-port competitiveness.

Table 3.8. Climate Change Long Term Impacts for Small Harbours, Marinas, Shipping and Blue Economies

Gradual Physical Climate Risk Events (Increases in frequency and intensity)	Impacts on Small Harbour/Marina	Impacts on Shipping	Impacts for Blue Economies
SLR	-Increases in coastal erosion/ -Reduced port and surrounding economic hinterland/supply chain physical land area and access. -Physical damage and weakened climate resilience from potential flooding for port infrastructure, equipment and services. -This creates increased repair, maintenance and replacement costs	-Increased water depth/reduced bridge clearance creating changes in vessel navigation route and minor increases in fuel/bunkerage costs	-Physical damage, delay, congestion, financial and opportunity costs to individuals, cargo, property, equipment and port functions to all supply chain stakeholders for all risk events **Changes in** -Inputs/Resources, -Labour -Processes -Production Outputs -Outsourcing -Distribution/Sales -Access to Financial Capital -Profits and Costs -Customs processes -Legislation
Precipitation	-Increased duration may create flooding and increased surface runoff creating temporary/permanent physical damage, delay and other port disruption costs. -Increased damage to exposed physical commodities and port equipment This creates increased port and related supply chain performance delay and impact costs	-Increased precipitation may discourage strategic vessel callers. -Increased physical vessel fatigue, commodity damage and reduced navigation –increased vessel delay/slow steaming, insurance, costs	
Temperature/Humidity increase	-Weaker structural infrastructure resilience and possible physical damage oxidation and corrosion increasing over time. -Potential health/safety risk to port labour, equipment, management and technology decreasing port performance	-Potential physical commodity damage and increase in energy consumption of reefer/containerised cargo throughput	
Wind velocity	-Risk to cargo handling labour, container stacking crane gantries, equipment	-Risk to physical vessel docking, pilotage, tugs turning basin movement	
Change in currents, wave energy, ocean acidification and sedimentation	-This disturbs port ecosystems and physical risk exposure; maritime resources and habitats affecting related commodity yields.	-Alters water flow, complicates vessel navigation, higher tug mooring and pilotage costs. Increased hull cleaning, maintenance and repair costs.	

Source: Author.

Whilst the majority of established literature sources have analysed projected climate change impacts for ecosystems, economies, ports and supply chains, very few such have considered focusing specifically on the shipping sector (Dyer 2018). This study conceptualises including these links in the global MSC, delivering goods and services from producer to consumer, as opposed which restrict their focus to ports. It evaluates projected risk events and associated impact costs for shipping as a key blue economy distribution stage. Long-term maritime risks and related costs are summarised in Table 3.9, which identifies long-term impact costs to vessels and shipping companies as similar to ports and other maritime stakeholders. Costs also include gradual changes in physical damage and port access, market demand and supply, operating schedules and adaptation measures. Examples of long-term impacts include potential physical vessel damage from increased frequency and intensity of gradual risks, including increases in wave energy, temperature, wind velocity, sea levels and acidification. Risks enhance vessel thermal expansion and associated structural fatigue. Additional impact costs include restrictions in port access/availability from risk exposure over time, if adaptation is not prioritised. SLR is also expected to affect navigability through reduced bridge clearance, e.g. ports such as Sydney, Brisbane and Auckland, limiting vessel height. This may necessitate expanding the frequency of bridge openings plus increased clearance for new bridges It may affect port water depth for approaches/channels influencing vessel magnitudes capable of utilising a port. Vessel navigation may also be impaired through submersion of navigational aids. This affects shipping operations and related MSCs as cargo loading/unloading, storage, customs processes; transport and distribution functions are delayed or averted.

Long term, specific impacts identified for shipping include reduced navigational safety and altered trade routes. Increasing hazardous coastlines and reduced visibility exist from projected increases in precipitation, wave, wind and current energy. These risks may increase the need for additional berth depth at harbours. It also requires physical vessel configuration and technology to enhance resilience, as vessels become more exposed to the stresses of increased precipitation intensity and frequency. This presents higher associated swell and waves, humidity and temperatures, wind and current direction/velocity. Projected coastal ecosystem erosion and sedimentation increases may necessitate more frequent dredging, to avert further navigation costs. Alternatively, increasing water temperatures may accelerate hull organism and sedimentation growth rates, increasing hull cleaning costs. However, previously unmentioned changes include species migration and biodiversity variations may cause habitats to change to existing shipping, routes, coastal areas and ports, as climate change significantly disrupts ecosystems. For example, in Hobart

2016 Antarctic whales disrupted shipping owners with threats to navigational safety and delay demiurge costs of $5000 per vessel per day, as community members and state laws necessitated safe species relocation.

Long-term risks and associated impacts for other MSC stakeholders and stages are categorised by this thesis in Table 3.8, as impacts to inputs, processes, production outputs and distribution/sales. These are divided as cost consequences for producers, retailers and consumers in Table 3.9. Affected inputs include reduced physical access to natural resources over time, from direct ecosystem and biodiversity loss risks. Potential risks and connected, economic impact costs are enhanced by global corporations, which outsource production, labour and resource inputs. Risk event changes will change agriculture and aquaculture economic yields, associated cargo throughput and production, especially for reinvented roles of small harbours to service fishing, aquaculture, marine biotechnology and trade. As Table 3.9 summarises, increased risk exposure may influence supply chain, production processes through reduced labour and operation productivity. It increases damage, delay and congestion impacts to infrastructure, equipment and technology. These may create higher associated maintenance, repair and adaptation impact costs. Production output capacity, performance, speed, composition, quality and quantity may also be affected through disruption risks to cargo throughput. For interlinked beneficiation supply chain stages, these create higher associated transport, storage, insurance and opportunity impact cost and lost profit consequences.

Table 3.9: Climate Change Impact Costs on a Commodity Supply Chain

Producers	**Retail/Wholesalers/Intermodal Transport**	**Consumers/Customers**
Physical damage, delay, congestion, financial and opportunity costs to individuals, cargo, property, equipment and port functions to all supply chain stakeholders		
Inputs/Resources, Labour	Transport, storage and other costs	Demand/Supply
Processes	Insurance costs	Price
Production Outputs	Reputation risk	Life/Heath
Outsourcing	Opportunity costs	Availability
Distribution/Sales	Trade diversion/creation	Employment/Consumption
Access to Financial Capital	Access to Financial Capital	Access to Consumer Credit
Profits and Costs	Profits	Changing Consumer Preferences/Behaviour

Source: Author

General impact costs for customers/consumers are summarised in Table 3.9. These costs include a possible decrease in economic demand and activity from a substantially lower population; lower employment, price increases and reductions in resource availability. Climate change is expected to affect resources supplied and change markets from trade creation/diversion. This provides economic benefits for flexible firms to adapt.

It offers significant opportunity and other costs to those not so prepared (Dyer 2018). Not just producers, retailers and logistics distributors but consumer preferences and habits may also be influenced to become more environmentally sustainable, to mitigate emissions slightly or penalise non-reformers. Climate change is likely to influence supplier decisions of sourcing material cost, type (if climate sensitive), quality and quantity including factors such as water supply, geographical location, distance (if ocean or large land-based), size, environment and risk negotiating, buying/pricing, strategic demand and supply. Customer demand and producer supply expectations or requirements may shift in adapting. This affects pricing, sales, distribution, order management, fulfilment and distribution along with the degree of customisation port users might require, as they may become potentially more or less flexible in response to climate change. The speed at which a stakeholder can satisfy demand, provide services, alter schedules and requirements involves being responsive, adjusting the price and quality/quantity of services for small harbours and marinas. This response rate is considered to depend upon the extent to which they prioritise climate change adaptation and resilience by an increasing number of sources.

Economic impact consequences of disrupting any commodity include increased customs, cargo handling, storage and distribution, port authority and transport delay, time, opportunity and reputation costs. Financial impacts threaten profits and port revenue from possible port congestion. This creates risk and uncertainty for all dependent stakeholders adversely influenced by the loss, damage or suspension of trade. Additional indirect impact costs to port authorities and other stakeholders include climate change risks to agriculture, aquaculture, forestry, transport, infrastructure, cargo, equipment and the overall economy. Examples include lost wages, business delays and interruptions, increase in operation, risk management, training and capital expenditure associated with port recovery, adaptation, repair, maintenance and cleaning costs. This further reduces overall small harbour and supply chain performance and associated economic activity. This research identifies subsequent impact costs for which it is difficult to obtain precise, quantitative cost estimates. These include reduced quality of life, environmental damage, loss of cultural heritage, essential infrastructure and services including labour productivity (even experience and skills from loss of life or damage). Becker cites customer reputation, loyalty costs from key port users, reduced inter-port competitiveness and other opportunity costs. Higher psychological impacts also include a productivity loss for ports and supply chains due to a reduction in spirit/morale from a climate change event aftermath. The actual impact costs, risks and extent of adaptation required is conditioned by previous and current disaster experience, information resources and preparation. It also however includes the will and capacity to acclimatise, enhance resilience

or respond. An alternative psychological risk may exist for the affected exposed coastal community. Climate change may temporarily possess an economic, health, social and security threat from an increase in potential migrants, especially for residents of Polynesia, New Caledonia, Micronesia, Marshall Islands and Palau, mostly a few metres above sea level. These might seek to escape to Australia, New Zealand and the USA, to escape the costs of related natural disasters and submerging of nations and entire blue economies

Overall supply chain, performance cost losses may expand significantly from submerged, damaged or destroyed facilities, equipment and cargo and from reduced physical access. This is identified through the Section 2 identified indicator examples include vessel waiting time for berths, average cargo dwell/clearing time, average customs clearance and processing time along with vessel, road and rail turnaround time. Average berth occupancy rates for existing vessels physically exposed to risk events' aftermath is expected to increase temporarily from supply chain congestion. It is expected to contract for the number of new vessels entering a port. Gross crane moves per hour, number of container moves per ship working hour, tonnage of cargo carried per running metre of quay and per unit of cargo employed/worker may decrease significantly from increased wind velocity and storm damage. Many operators being risk averse, may adapt through reduced output and minimising exposure to potential risks and costs. Average cargo capacity utilisation may become lower from reduced agricultural and fishing yields from droughts and heatwaves. This creates greater downtime for port labour reducing productivity, port and cargo dues and user willingness to pay for facilities. This can affect agriculture and other economy production variations in demand and supply through submerged crops, port, transport and storage infrastructure, reducing cargo throughput and revenue. Further impacts include reputational loss and subsequent possible trade diversion/loss to other less vulnerable forms of transport e.g. shipping/air from road/rail, affecting port trade flows. Alternatively, trade may divert to ports providing greater flexibility, fiscal resources and commitment in prioritising adaptation solutions. Therefore, ports and dependent maritime supply chain stakeholders are expected to experience significantly higher total costs per year. This arises from physical commodity and facility, damage, time delay, reputation loss, congestion and other impact costs from decreased port activity.

3.4.6.2: Short Term Impacts of Climate Change on Small Harbours, Marinas and Blue Economies

This section identifies short-term risks for small harbours and marinas concentrating on storms, tsunamis, cyclones, heatwaves, droughts and landslides as unexpected maritime disruption risks potentially affecting

a general supply chain. Table 3.10 summarises more frequent, literature cited, unexpected risks and impact costs for ports. This enhances small harbour and marina stakeholder awareness of potential consequences when failing to prioritise adaptation. Sudden risks provide similar damage and other costs to those summarised for long-term impacts (Table 3.8). These differ primarily through greater physical, economic, psychological, health, reputational, environmental and other impacts as threats to lives and facilities. This reduces port demand, capacity and performance throughput for a greater time duration, frequency and intensity. This review agrees with past sources (Dyer 2018) that more significant risk events such as Fiji's April 2020 cyclone Harold amid the COVID-19 pandemic possessing more immediate and costlier, direct consequences require more urgent and decisive action by key affected stakeholders throughout the Pacific and world, not just the port authority/state alone. When adapting, unlike sources which concentrate on generalised adaptation strategies, this research recommends a methodology considering the effects and necessary response may also differ in frequency, intensity and duration. They may be temporary or more permanent, direct or indirect for each affected small port, commodity, shipping, supply chain and stakeholder.

The most significant impact costs to ports and shipping are considered here as those to life and property (Table 3.10). These establish a potential economic loss from disruptions to production, consumption, management and labour force (particularly for primary commodities), reducing supply capacity for cargo throughput. This reduces port revenue and physical capacity to undertake port functions with significant, adverse implications via contractions in supply chain trade/economic activity. Other associated costs include possible damage to communications, information and related early warning systems, weakening preparation for further recovery and adaptation efforts. This scholarship contribution proposes an additional reputational cost risk exists. The extent of damage combined with the probability of risk exposure, may reduce business confidence in utilising a port. The more immediate the event, the higher the associated impact cost/ commodity damage; the greater the reputation, opportunity cost. Inadequate climate change responses decrease a port's reputation (Dyer 2018). Another sudden impact cost involves a physical threat to providing port bunkerage, water supply and other services causing minor delays to activities. Other port impact costs include increased customs, cargo handling, storage and distribution, port authority and transport delay, time, opportunity and reputational costs. Further costs add lost commercial profits and port revenue from possible congestion, risk and uncertainty, which affect shipping and overall MSCs. Additional short-term impact costs in Table 3.10 for shipping, (aside from damage to ports, vessels and cargo), include potential dangers to vessel navigation from increased storms, wave surges and spray/wind reduced visibility creating higher

associated economic, tourism, opportunity, legal, technical, environmental costs. Increased thunderstorms could place pressure on port area lightning deflector systems, lighting and vessel navigational aids. Vessel damage may also occur. Increased damage will also achieve increased construction, repair, maintenance and replacement costs to restore, shipping or MSC system, after a sudden risk. These may create impact consequences such as changes in shipping operations, markets, routes and port pricing, requiring equivalent adaptation responses for stakeholders.

A health and safety impact cost could occur from landslides and other risks, exposing waste disposal sites, increasing pollution and posing stakeholder productivity. Landslides could potentially submerge crops and infrastructure and restrict transport access. Health and safety disruption costs to workers and equipment threaten overall supply chain performance from increased temperatures and heatwaves, in creating idle capacity and other delay costs. Increased congestion and public health costs potentially delay cargo further. Safety risks include a direct threat to physical fatigue of supply chain infrastructure, equipment and operations, delaying berthing, mooring, cargo handling and other activities. Currently, asymmetrical information and lack of coordination amidst global supply chain stakeholders is noted by this research from previous sources (Dyer 2018) and experience. This complicates formulating effective awareness and early warning, disaster risk management responses. Table 2.3, identifies further vulnerabilities to specific port operations but also to the wider maritime economic hinterland from increasing congestion, reducing capacity and performance and from fewer vessels navigating the port safely. This significantly increases opportunity costs of disruption, for those failing to prepare. Shipping firms will therefore experience increases in maintenance, repair and related insurance premium costs, decreasing profitability on a route such as the Pacific. A further impact study limitation is noted for MSCs. A natural disaster event influences decisions to visit a port of containerised, dry and wet bulk cargo, fishing, and other strategic vessel callers including tramp steamers, repair, military and cruise vessels. This section also focuses on potential impacts; not just for creating supply uncertainty but also threatening economic demand, production and consumption for supply chains. Vessels may have to adjust trade routes, markets, commodities and shipping schedules to adapt.

Table 3.10: Short Term Impacts/Extreme Climate Risk Events for Small Ports and Marinas

Short Term Climate Risks	Impact Costs on Small Port/Marina	Impact Costs on Shipping	Impact Costs for Blue Economies
Storms/Superstorm surges	Increased threat to communications, information and early warning systems.	Physical vessel/port/ commodity damage.	Increased frequency, duration and intensity of long-term impact costs as

		Physical danger to vessel navigation.	short term, sudden cost changes summarised in Tables 2.2 and 2.3 Risk Changes In Species Migration/ Biodiversity Changing Rate of Innovation and Technology Global economic activity Changes in Seaborne trade Changes in access to maritime finance Changes in global and regional social-political/commercial/ environmental instability. Increase in insurance premium costs Changes in economic demand, supply and associated changes in economic activity, employment, production, consumption, exports and imports, inflation and exchange rates affecting possible purchasing power and trade competitiveness.
Hurricanes/Cyclones /Tsunamis	Physical damage to port infrastructure, vessels, equipment, cargo and related utilities, creating increased construction, repair, maintenance and replacement costs. Possible physical commodity damage decreasing a port's reputation, loss risk/creating increased insurance costs from reduced business confidence. Psychological costs, threat to life and property, creating a loss of economic potential, commercial profits, tax and port revenue. Higher Port Costs.	Higher insurance premium, repair, maintenance, labour, voyage, charter and other costs, Reduced port access, increased congestion, Physical navigation risk Threats to vessel navigation, safety, delays and congestion.	
Droughts	Physical threat to agricultural and fishery productivity reducing potential cargo throughput. Lower water depths may limit channel/port navigation and related vessels Physical threat to providing port bunkerage, fuel and other services.	Changes in demand, supply, port profitability and pricing Changes in routes, markets, trade diversion and reduction,	
Heatwaves	Physical threat to port productivity – health and safety of affected workers/ operators creating idle capacity and other delay costs Direct threat to physical fatigue of infrastructure, equipment and operations delaying port activity Damage to information/ communication systems	Production variations in demand and supply reducing cargo throughput and revenue	
Landslides	Increased soil moisture from precipitation, storms, tsunamis and cyclones can destabilise road/rail/ coastal erosion creating congestion delays from debris. Public Health Risks from exposed waste disposal sites.	Physical legal/technical regulatory compliance costs, increased insurance liability costs Production variations in demand and supply through submerged crops, port, transport and storage infrastructure, reducing cargo throughput and revenue	
All Risks	Operational/financial and reputational cost loss	Operational/financial and reputational cost loss	Changes in port pricing, taxes, subsidies to recover costs and finance adaptation.

Source: Author

Other short-term impacts for shipping in Table 3.10 consider the cargo type, value, quality and volume may also change from these risks, requiring replacement costs to avert or mitigate potential customer reputational costs from delays. This presents an opportunity cost to future business, increasing reputational loss and

financial risks, discouraging customers further. This review advocates cargo load sizes and subsequent vessel, cargo capacity utilisation may decrease. Shipping companies reduce profits further from increased stores, fuel consumption and bunkerage costs; crew wages required (including possible health and safety risk premiums from perceived and actual greater risk exposure), voyage and time charter costs. Costs include related administration, information and communication incurred in response to or adapting to disruption event consequences. This threatens a commercially profitable future for shipping. Continuous disruption risks also threaten locational and technical, economies of scale where shipping provides conventionally the lowest cost per unit of containerised cargo between road, rail, air and sea, which existing solutions fail to address. The International Association of Ports and Harbours proposed introducing port emissions, cost pricing as a mitigation solution. Yet this further undermines shipping and intermodal transport, cost-competitive advantages to smaller harbours and marinas. Risk events present increased uncertainty for tramp steamers and time/voyage charters. These base profits on avoiding ballast voyages with no/minimal cargo, adjusting to seasonal fluctuations in bulk commodities and irregular demand. However, some marginal callers calling in at smaller ports rather than more exposed and congested larger ports may benefit from temporary trade diversion opportunities from idle liner vessels. It may also increase reputational, trade and transport costs to Pacific liner companies. These companies may have to increase corresponding freight rates but also depend upon greater price stability, a fixed, regular sailing schedule and diverse cargoes. These requirements are increasingly threatened by greater congestion and associated delays to required functions; predicted as direct consequences.

3.4.7: Direct and Indirect Impact Costs of Climate Change on Small Harbours and Marinas

This study differentiates itself from previous literature (Dyer 2018) through distinguishing between the initial, direct impact vulnerability of ports and the indirect implications for affected supply chains when applied to a specific commodity. Direct impacts are defined as:

> '*The total additional consequence, activity, process or variable physically attributed to that initial source at that time and place*,' (IPCC 2015, pg. 164).

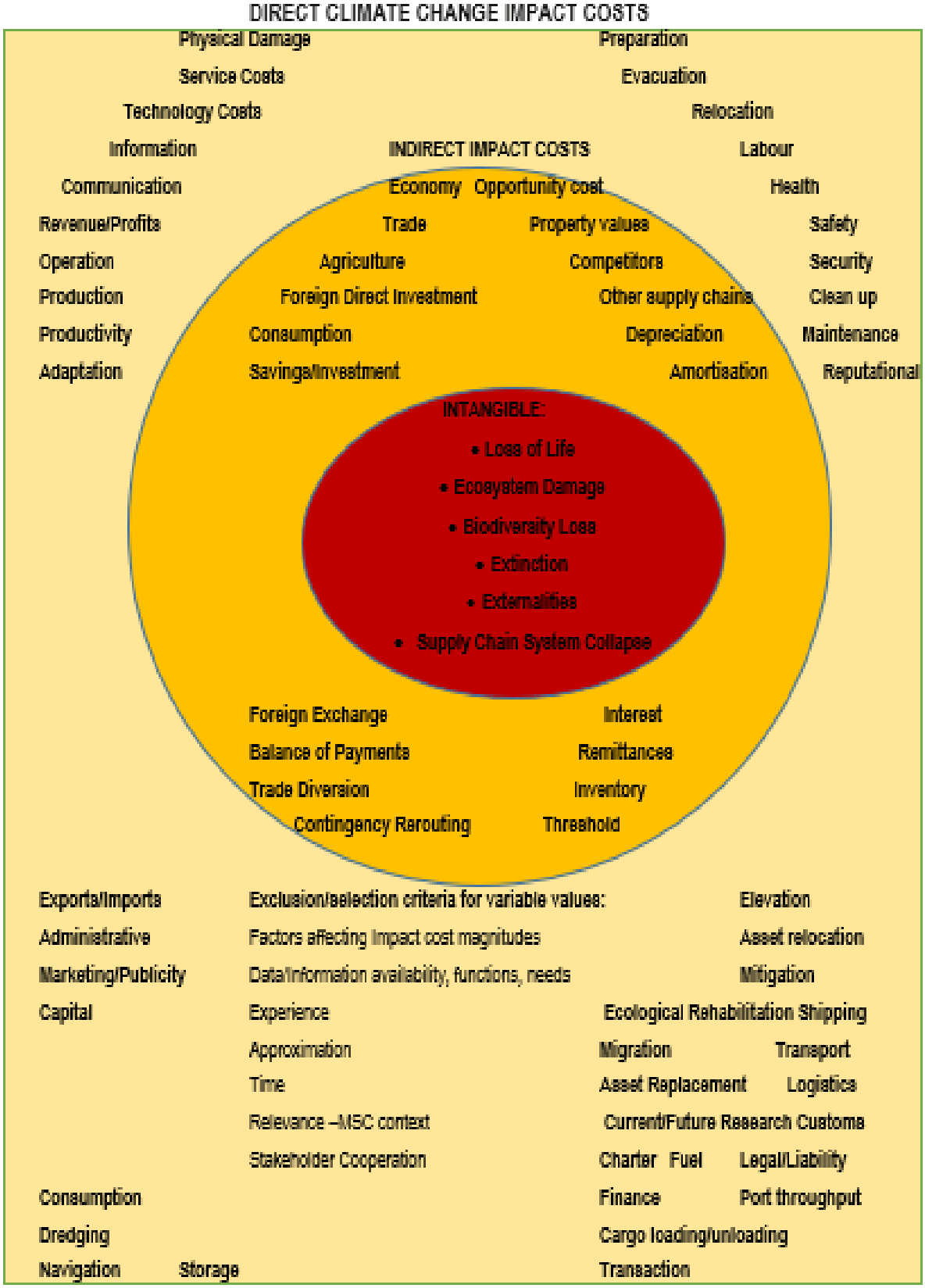
Indirect impacts are defined as:

> '*Those impacts which are often produced away from, or as a result of, a complex impact pathway.' They may occur outside the specified boundaries or time period of direct impacts.'*

Potential impact costs are summarised in Figure 3.3.5. Long term changes might include economic demand, supply and associated changes in economic activity, employment, production, consumption, exports and imports, inflation and exchange rates. This affects possible purchasing power and trade competitiveness. It influences access to maritime finance, insurance premium costs, in global and regional social-political, commercial, environmental instability, along with the changing rate of innovation and technology. Each disruption/delay increases associated transport, storage, insurance, labour, port and customs duty, administrative, marketing, information, cargo management, security, insurance and communication impact costs to overall stakeholders. Climate change can therefore cause significant impact costs for stakeholders not just to a supply chain but across the local economic hinterland

Fewer callers and reduced cargo throughput will create reduced tax revenue for government stakeholders. It reduces potential public budget expenditures and creates indirect opportunity costs to other supply chain stages and levels of economic activity. However, the ultimate economic impact threat climate change poses for small harbour, marina and maritime supply chain stakeholders includes the submergence of substantial sectors of (or entire) Pacific nations and economic markets. This risk is predicted to affect shipping routes/operations substantially. Potential shipping disruption may cause further threats to shipping operations, markets, cargo, sourcing of labour and related productivity. Risks include changes in global and regional, Pacific, social-political, commercial or environmental instability. Communities and stakeholders may become so desperate for survival; they provide a physical health and safety risk to ports, intermodal transport, vessels and crews, in seeking to escape from direct climate change risk impacts.

Figure 3.45: Direct, Indirect and Intangible Disruption Risk Impact Costs to Small Harbours


DIRECT CLIMATE CHANGE IMPACT COSTS
Physical Damage
Service Costs
Technology Costs
Information
Communication
Revenue/Profits
Operation
Production
Productivity
Adaptation
Preparation
Evacuation
Relocation
Labour
Health
Safety
Security
Clean up
Maintenance
Reputational
INDIRECT IMPACT COSTS
Economy
Opportunity cost
Trade
Property values
Agriculture
Competitors
Foreign Direct Investment
Other supply chains
Consumption
Depreciation
Savings/Investment
Amortisation
INTANGIBLE:
• Loss of Life
• Ecosystem Damage
• Biodiversity Loss
• Extinction
• Externalities
• Supply Chain System Collapse
Foreign Exchange
Interest
Balance of Payments
Remittances
Trade Diversion
Inventory
Contingency Rerouting
Threshold
Exports/Imports
Administrative
Marketing/Publicity
Capital
Exclusion/selection criteria for variable values:
Factors affecting Impact cost magnitudes
Data/Information availability, functions, needs
Experience
Approximation
Time
Relevance –MSC context
Stakeholder Cooperation
Consumption
Dredging
Navigation
Storage
Elevation
Asset relocation
Mitigation
Ecological Rehabilitation
Shipping
Migration
Transport
Asset Replacement
Logistics
Current/Future Research
Customs
Charter
Fuel
Legal/Liability
Finance
Port throughput
Cargo loading/unloading
Transaction

Additional increases in adaptation strategy costs, including those proposed in section 3.3.8, are further anticipated to reduce commercial viability and sustainability for shipping operations and stakeholders directly. Examples include increased staff, disaster response and risk assessment training expenses and improved vessel resilience. It involves updated research, communication and information measures, adapting market and shipping operations to minimise costs from Pacific climate change. An adaptive cycle for sudden shocks could be formed, involving adapting shipping schedules with fewer and smaller vessels, exploiting economies of scale. This section points out how shipping companies may have to diversify into new routes or markets, new consumer demand and supplies, diversifying into multimodal transport opportunities, to exploit trade diversion from those failing to adapt and to enhance financial and shipping market resilience.

Labour productivity may further decrease from increased humidity and temperatures, influencing heatwaves and droughts. It presents higher public health and safety impact costs. These may reduce available labour, creating idle capacity from increased employee absenteeism, diminished port performance and other delay costs. Potential adaptation solutions include improved training and adopting flexible working hours such as nocturnal shifts and weekend overtime, midday breaks, protective clothing, equipment and shelter to prevent fatigue. Technology and automated equipment are more susceptible to corrosion and less flexible in adapting. This also imposes additional cost constraints and increases local unemployment and related economic activity. Flooding can influence public health and sanitation through water supply contamination It leads to pollution contamination risks from overflowing waste disposal sites, reclaimed/polluted, industrial zone land and insufficiently adapted drainage systems. This affects not just port workers but the surrounding, coastal population, cargo and ecosystems, requiring measures such as greater filters/sedimentation traps.

3.4.8: How Small Harbours and Marinas Can Adapt in a Climate Change Age

In considering a response to climate change disruption risks to small harbours, marinas, maritime supply chains and blue economy stages, it is observed that existing literature has divided into five response strategy themes of mitigation, adaption, retreat, migration or ecological rehabilitation. Existing sources (Dyer 2018) have proposed these strategies as potential responses. Supply chains concerned with possible consequences could undertake these responses to minimise associated risks and connected impact costs to resources, economies, coasts, infrastructure and populations, as key factors affecting MSC performance. This scholarship's conceptual contribution is among the foremost of those seeking to specifically upgrade

these areas to be relevant in an age of climate change related uncertainty. It will identify and analyse specific adaptation strategies for small harbours based on experience and existing literature specific, adaptation measures for ports, shipping and overall supply chain stages.

3.4.8.1: Mitigation

The more common research trend, identified from several hundred, climate change impact studies, is a focus only on mitigation or reduction of CO_2 emissions as a response to the risks presented by climate change To reduce uncertainty, mitigation is standardised and collectively defined by the IPCC (2015), WMO (2015) and UNFCCC (2012) as:

> 'An anthropogenic effort or actual intervention aimed at directly reducing the sources or increasing the sinks of greenhouse gas emissions, and other aspects of climate change to decrease the associated costs, consequences, risks and uncertainty.' (IPCC pg. 129).

In reviewing mitigation literature (Dyer 2018), supply chain stakeholders which pursue mitigation focus on influencing global climate change causes and the probability or likelihood of a risk occurring. They do not adapt to potential consequences. Mitigation is considered essential by the above sources to stabilise both existing gas concentrations and reduce future emissions levels. This influences the potential rate at which climate change and associated disruption costs/risks occur. Recurrent mitigation studies are evaluated here as deliberate, conscious human efforts to reduce emissions, either through currently speculative, physical measures e.g. geo-engineering, carbon capture and storage technology, or through focussing on reducing actual emissions. This is favoured by an increasing number of supply chain stakeholders. Potential mitigation solutions identified by literature frequently include restricting emissions through renewable energy, increased infrastructure insulation and energy conservation, fuel efficiency, recycling and waste reduction. Solutions include investment in public awareness, research and technology, blue carbon reserves and afforestation as carbon sequestration sink. The International Association of Maritime Harbours has already concentrated on recommending similar standardised 2013 guidelines for associated port stakeholders to become more environmentally sustainable and reduce emissions through mitigation. As significant global attention has prioritised mitigation over other response strategies, this thesis proposes several reasons for not further contributing to existing, related studies. This researcher maritime economist has been invited to assist in mobilising and formulating a Working Group in April 2020 by the World Ocean Council to consider the private sector's response to climate change and ports, especially in relation to small harbours and marinas.

Disadvantages exist in seeking to reduce the potential impact upon small harbours and blue economy stages and coastal communities through mitigation. They are constrained further in possessing a limited capacity to influence global politics to encourage other countries to ratify and enact mitigation policies, being economically, culturally, resource, militarily and politically peripheral from the perspective of developed nations. In contrast, adaptation offers further advantages of being country, economic sector or supply chain stakeholder specific. It is within stakeholders' capacity to directly influence associated risks and specific impact costs, with a tangible, effective response or solution. Only emphasising mitigation also ignores other potential factors that influence the rate of global climate change including pollution, human overpopulation and unsustainable development. Mitigation appears reactive. It is based on emissions/risks that have occurred rather than proactive. This would aim at minimising current and future, risks and costs through enhancing key ecosystems, economies and stakeholder resilience. Restricting human attention to prioritising mitigation rather than adaptation solutions that address these factors, is increasingly considered likely to escalate projected uncertainty, business congestion and opportunity costs. Therefore, this research considers only relying upon mitigation as less efficacious than the alternative of adaptation. This is based on existing nations' slow implementation of the voluntary, self-regulatory cap and trade, emissions market approach, the 1992 Kyoto Protocol and 2012 UNFCCC along with the 2015 Paris Agreement. This perspective is further measured by increasing emission inventory levels of all nations and supply chains (not just the Pacific), according to IPCC (2015), and subsequent increased threats and cost consequences from more immediate risks to survival as climate change projections in Chapter 4.

3.4.8.2: Strategic Retreat/Surrender and Migration

Another seldom considered response strategy is strategic retreat or surrender. Climate change affected, coastal stakeholders, ports and shipping companies prepare to abandon the most vulnerable coastlines and infrastructure, retreating inland. However, strategic retreat is generally regarded by this source as impractical in the absence of a sudden population contraction, whether through warfare, medical contagions, natural disasters or space colonisation. This effectively means abandoning small harbours, marinas and communities which could only realistically be justified due to several criteria such as an insufficiently viable economic market; stakeholder requirements; a decreasing or stagnant population growth; the community, climate or ecological exposure including declining fisheries Many Pacific Islands have high population densities and limited land surface areas to retreat, (even less with predicted increases in sea level rise).

Given budget constraints of governments, this source considers the significant sunk costs of existing coastal infrastructure as another further constraint to strategic retreat. An alternative is migration. Yet migration is often subject to issues i.e. immigration border controls, loyalty to home, family, economic, social, political, cultural and personal pressures hindering mobility. Climate change as a genuine threat for refugee status was rejected as a non-immediate and indirect threat by the New Zealand government in a 2015 court case; (UNISDR 2015). This provides legal uncertainty for many communities and nations in retreating and migrating as a viable alternative.

3.4.8.3: Ecological Rehabilitation

This section identifies ecological rehabilitation as a fourth response strategy in existing research sources. This source, noting the absence of a formal definition to describe this process, proposes ecological rehabilitation to describe an intentional effort of restoring, renewing and acclimatising degraded, damaged or disturbed natural ecosystems of ports, coastal communities, populations, economies and associated blue economies or maritime supply chains. This includes mitigation, physical repair and eventual adaptation to as close to their original state and capacity, as practically possible. It initially proposed ecological rehabilitation as an alternative, response strategy with a community participatory approach based on simplicity, sound environmental management and indigenous, stakeholder solutions. This is seldom cited by climate change impact studies, from stakeholders favouring alternatives to adaptation and mitigation. Despite significant ecological damage reducing its current effectiveness, this natural coastal protection method pre-dates the origin of humanity. There are few identified academic sources that considers Earth provides natural resilience and protection, stabilising ports, ecosystems and the maritime sector. For example, green carbon emphasises mangroves' roles not just in biodiversity and habitat formation but in coastal protection from climate-related events (including natural disasters), from inundation and excess salinity, filtering pollution, carbon and coral reef health. Blue carbon relating to the oceans, cetaceans and other ecosystem components are also receiving increasing attention since the Seychelles launched the first one in 2017 and the 2018 UNEP Sustainable Blue Economy Finance Principles. Ecological solutions combined with an internationally implemented, joint committed response to adaptation can further provide natural protection for coastal assets, ecosystems and communities, reducing exposure and sensitivity. It also aids a natural resilience approach against subsequent potential ecosystem and supply chain productivity losses, from physically exposed coastal assets.

The ocean and coastal atmosphere/ecosystem serve a specific role in preserving, environmental and economic stability, enabling all life to survive. An indigenous approach of natural engineering/ ecological rehabilitation is particularly efficacious at enhancing resilience. A number of stakeholders including WWF, UNEP, UNDP and Commonwealth Marine Economies Programme favour utilising the environment to provide natural barriers and resilience to climate change. This is considered a more cost-effective and climate resilient solution than physical infrastructure, engineering solutions or only a simple emissions mitigation. However, ecological rehabilitation is a long-term, though necessary process. It provides significant environment co-benefits of resource, coast and infrastructure protection. For this thesis, adaptation is applicable to many supply chain stakeholders potentially affected by climate change. It provides a more focused, short term attempt for Pacific nations to pursue in reducing specific disruption costs.

3.4.8.4: Climate Change Adaptation Measures and Strategies for Small Ports and Blue Economies

This section focuses on another identified, literature response strategy of adaptation, a solution less often considered than mitigation. This solution, mentioned by various stakeholders (Dyer 2018) is defined by this thesis from these sources as:

> 'The physical process of deliberate actions and efforts adjusting, acclimatising, adapting and responding to actual or expected changes in climate/environmental conditions on natural or human systems, infrastructure and/or beings, with the intention or aim of moderating or avoiding externality/opportunity costs or exploiting beneficial opportunities occurring as a consequence of that change.'

Conceptually consistent definitions of adaptation can reduce risks of climate change maladaptation costs. It can assess the extent to which specific measures achieve adaptation, given literature all present diverse adaptation solutions. The advantages of adaptation and ecological rehabilitation over alternative approaches is that they aim to increase a port, shipping or other blue economy or maritime supply chain stages' resilience to physical risks. Additional advantages of prioritising a resilience adaptation strategy are considered. Primarily it allows forewarning and preparation to ensure continuity (or at least survival) of human economic, social and other activities at minimal disruption costs. These aim to reduce the extent to which it could threaten the survival of small islands and vulnerable coastal sectors, infrastructure and economies. This is crucial, given dependency on one or a few commodities providing a significant contribution to GDP and exports.

This section summarises and evaluates various specific adaptation measures implemented by ports and shipping in Table 3.11. These include increased environmental sustainability, rehabilitation and emission reduction. Examples include relocation, elevation, increasing inter-modalism, changed legal preparations, product operations, resource input sourcing, marketing and routes. In response to climate change impacts across MSC systems, stages and stakeholders, this thesis agrees with emergent sources. These increasingly focus on needing stakeholder coordination in information gathering, early warning systems, communication, planning, risk-vulnerability assessment and management, emergency disaster response training and education. Stakeholders must adapt across a supply chain. Martinez *et al.* (2011) identifies investing in new technology, equipment and infrastructure or modifying current processes. Stakeholders need to respond to changes in government or other authority tax, legal regulatory and other policy requirements. These proposed solutions are technically feasible, cost-effective and globally applicable, given developing country constraints e.g. those of the Pacific. Given climate change scenario assumptions (IPCC 2015) and specific projections, this review considers supply chain stages should consider adapting as soon as possible to minimise risk. These strategies could be endorsed by stakeholders as coordinated strategies in Table 3.12. This minimises previously identified risks and associated impact costs.

Potential adaptation solutions are proposed in Table 3.10 This table was devised by a combination of candidate innovations and existing literature sources (Dyer 2018). Solutions include strategic retreat or surrender, physical elevation of facilities and land reclamation. However, many territories face high population densities with limited land area and financial resources to strategically retreat or to relocate populations, ports and associated MSCs/economies with high fixed capital costs. These constraints, combined with geographical constraints that many nations, small harbours and marinas are only a few metres above sea level at highest altitudes and are based on weak soil foundations, undermine attempts to elevate many structures. Repeated event intensity and duration corrode attempts at progressive dredging and land reclamation. To adapt, this source points out the benefits of essential facility elevation wherever possible. This especially applies to pumps, generators, computers, records, other equipment and technology needed to retain port functions and emergency responses, when adjusting to risk events and associated impacts.

Physical engineering adaptation strategies such as levees, dykes and storm retention basins have been proposed by other sources (Dyer 2018). Without existing seawalls, related disruption cost would have been

far higher. Frequent anticipated and current climate risk exposure provides a progressive weakening of structural resilience over time. Increased dredging may assist for beach nourishment, crops, construction and land reclamation of submerged port areas. The source recommends port equipment, e.g. shore cranes exposed to storm surge, tidal change and flash floods/tsunamis, precipitation and wind within the port and adjacent roads/rail, will need relocation, revised maintenance or adaptation. They propose adapted training, flexible working hours, new equipment and new technology such as apps and simulation software. This is capable of assessing the impact of changing climate variables and related average productivity loss for port assets and operations. However, these minor port adaptation measures summarised in Table 3.11, provide certain disadvantages for Pacific nations. They are expensive to construct and inflexible to sheltering ports against repeated risk exposure from sudden disasters. Others in advocating coastal zone protection via strategic development retreat discourage these measures as weakening natural resilience. These measures contribute to coastal erosion, disturbing ecosystems and species habitat degradation. Excess storm runoff still presents a flood risk.

Aesthetically, coastal engineering adaptation measures, increased coral reef bleaching, ocean acidification and precipitation also discourage fishing, beach tourists and cruise passenger visits, reducing related commercial and port revenue. Global and individual minor port stakeholders possess alternative climate change adaptation solutions starting to be investigated and increasingly prioritised. Examples include revising technical standards, continuously updating existing and future port designs to consider climate change and investing in equipment and technology. It extends to improving disaster–emergency, risk management training and preparation. In addition, adaptation may require modifying port pricing policies and enforcing legislation to adjust to foreseen risks. Other climate change adaptation solutions include natural engineering, with increased coastal vegetation zones, beach re-nourishment, mangrove afforestation, siltation traps and urban planning controls through legal foreshore protection. These are recommended by academic and port authorities and summarised in Table 3.11. These measures reduce surface moisture runoff and coastal erosion, with minimal adaptation cost and resources required. Potential climate change impacts on minor ports include environmental costs identified in previous research. Examples include losses to ecosystems, biodiversity, reduced mangrove, coral reef and wetland shelters and an increased threat of overflowing pollution. This threatens natural coastal protection from SLR, increased ocean acidification, CO_2 concentration, pollution and sediment.

Table 3.11: Climate Change Risks, Impacts and Specific Adaptation Measures for Ports and Shipping

Risk Events	Long- and Short-Term Impacts	Proposed Adaptation Measures for Ports	Proposed Adaptation Measures for Shipping
Long Term Risks	Table 3.8	-Observatories and early warning systems. -Changes in technology, infrastructure design, technical standards, research and development.	Changes in routes, markets vessel design and technology, vessel pricing, marketing, research and development
Short Term, Sudden Risks **Storms/Superstorm**	Table 3.10 -Physical vessel/port/commodity damage. -Higher insurance premium, repair, maintenance, labour, voyage, charter and other costs, -Reduced port access, increased congestion, physical navigation risk -Threats to vessel navigation, safety, delays and congestion. -Changes in demand, supply, port profitability and pricing -Changes in routes, markets, trade diversion and reduction, -Reputational loss impact -Physical legal and technical regulatory compliance costs, increased insurance liability costs -Operational/financial cost loss -Planning, preparation or adaptation cost in devising solutions	-Observatories and early warning systems -Acquire new/upgraded port equipment -Natural Engineering -Climateproofing infrastructure, drainage Facility relocation, elevation, strategic retreat and land reclamation.	-Increased risk awareness assessment, monitoring, stakeholder education and training -Vessel engineering strengthening and redesign
Hurricanes, Cyclones, Tsunamis		-Critical port functions can face relocation, elevation or retreat inland -Physical Engineering levees, dykes, storm retention basins -Increased coastal vegetation zones and legal foreshore protection to reduce surface moisture/coastal erosion. -Redesigned water storage, drainage and infrastructure for greater protection. -Increased rainwater storage/improved drainage to reduce port area runoff	-Meteorological Stations, satellites and other early warning systems plus coordinated port stakeholder information, communication and training
Heatwaves		-Natural Engineering/ecological rehabilitation e.g. mangroves, afforestation, beach nourishment and coral reef restoration -Revised engineering designs, standards and technological adaptation -Anti-corrosion paint plus concrete additives, climate-proofing infrastructure -Port Pricing Changes	-Flexible working hours, shade, adjusted training, protective clothing/improved facility insulation and new equipment. -Improved cargo insulation, Renewable, sustainable energy powering emergency reefer points

Droughts		-Excess precipitation storage/ attenuation systems and water conservation and diversion plus efficiency measures e.g. education and conservation policy legislation, training -Increased monitoring/information sharing -Provide greater worker and equipment protection, improved training, flexible working hours and nocturnal shifts to prevent supply chain disruption costs. -Improve cargo throughput protection by reducing exposure, enhancing facility insulation and protection. -Greater information and communications updated periodically to reassure stakeholders.	-Wind breaks, -Physical engineering research and redesign standards, -- Facility relocation. -Mangroves/afforestation for natural protection -Adjust training, -Increased current monitoring systems -Short term intermodal transport shift.
Landslides		Provide emergency planning response training and equipment -Modify potential building/other code zones to reduce the threat of erosion on potential destabilised slopes. -Plant slope vegetation to increase evaporation and transpiration -Ensure sufficient waste locations and design standards are in place.	-Not applicable –except as landside cargo, infrastructure and cargo are affected in higher delay/opportunity, fiscal costs.

Source: Author.

Altered water supply from changes in precipitation affects port bunkerage, cleaning and other services. These risks spread when considering existing factors promoting vulnerability, including a port and supply chain's physical topography, land use, population density, natural resource endowment and extent of remaining vegetation. These risks further influence a port and coastal community's climate resilience, probability of survival and adaptation. Table 3.12 outlines ecological rehabilitation as a potent adaptation solution. Coastal buffer zones of mangroves, afforestation, seagrass, algae, marine ecosystems and coral reef restoration increase resilience. This review proposes climate-proofing of physical infrastructure. It also favours the natural engineering approach of planting mangroves, expanding coastal vegetation, stabilizing coastal beaches and improving coral reef health to enhance innate natural resilience. These provide the same benefits for risk changes across time for small Pacific nation examples as for densely populated ports of Australia. These ecosystems have historically protected ports, coasts and communities, whilst heightening vulnerability when removed. These provide natural wind breaks and coastal vegetation to absorb surplus precipitation runoff in addition to sea walls. Related legal/policy adaptation responses to minimise associated erosion costs include an integrated coastal management approach with increased coastal reserves, improved foreshore protection, environmental impact assessment legislation, land use and building code zoning. It extends to revised engineering and technical framework strategies. Another projected impact includes increased insurance risk premium costs. This arises from a growth in projected risk and uncertainty. To assist minor port and marina stakeholders to adjust coastal developments, this section proposes a pilot scheme for climate risk-based insurance similar to PCARFI for the South Pacific. This is conditional on enhancing natural, coastal and infrastructure protection and resilience; reducing potential asset exposure.

These adaptation measures have time and fiscal advantages for Pacific nations with significant technical, skilled labour, port equipment, financial and other constraints. They can adjust solutions to current and future supply chain infrastructure, equipment, training and cargo to minimise potential disruption risk costs from risk events. Other adaptation measures that apply to ports, shipping and overall MSCs include increased risk awareness assessment. Joint risk adaptation solutions are increasingly favoured. Examples include improved meteorological stations, weather monitoring, observatories and early warning systems to anticipate disruption risks and prepare with as much time and information as possible. Investing in stakeholder education and training allows time and flexibility to adjust to risks. This provides pre-emptive adaptation strategies. Increased global supply chain, stakeholder cooperation and coordination in information gathering, early warning systems, communication, research and planning are recommended in Table 3.12. This source

identifies multiple examples of cooperation benefits to lessen risks and impact costs. Examples include economies of scale, avoiding wasteful duplication of unnecessary resources, increased efficiency and supply chain performance. Potential congestion, reputational, business delay, economic, environmental and other opportunity costs are lowered. This section provides adaptation strategies considering the limited labour, technology, budget, land, infrastructure and institutional governance capacity, constraints of many entities, port authorities, stakeholders and nations. Whether climate change will permit a sustainable future for affected stakeholders depends on the extent to which they prioritise strategies summarised in Table 3.12.

Numerous research sources ignore or underestimate the disruption impacts climate change initiates on MSC stakeholders with limited resources, in proposing expensive climate-proofing solutions, especially those of the Pacific Developed World literature largely ignore these factors (Dyer 2018). They propose resource, capital, technology, skilled labour, education and wealth intensive solutions, e.g. hard and coastal engineering approaches, as common resilience strategies. Conversely, just how few existing sample surveys have been done for maritime stakeholder awareness and adaptation to climate change. Yet research gaps occur from ignoring the significant costs of paralysing economic activity globally from local port, small port, marina, supply chain and blue economy activities. Mutual cooperation in risk education, information, existing technology and policies alone could simultaneously reduce over $2 trillion worth of economic disruption costs to global supply chains. This enhances resilience of global ecosystems and blue economies simultaneously. Directly or indirectly, climate change will affect every port, commodity, maritime supply chain, connecting economic hinterland and dependent stakeholder, via sea level and temperature rise to varying extents

Table 3.12: Summary of Hypothetical Climate Change Risks, Impact Costs and Adaptation Strategies for Marinas, Small Harbours, Supply Chains and Blue Economies

General Risks	Climate Change Disruption Impacts for Supply Chains	Proposed Adaptation Strategies
Long Tern Risks Table 3.8	Increasing of greenhouse gas emissions/ climate change	Pre-emptive via mitigation, retreat/surrender, migration, Reactive –ecological rehabilitation
Long Term Climate Change Risks/ Associated Impact Costs **Short Term and Sudden Climate Change Risks/**	Physical vessel/port/commodity and infrastructure damage.	-Increasing vessel, equipment, infrastructure and operational resilience/training to minimise disruption threat costs. -A short term transport intermodal shift from road/rail to less affected shipping/air for vital cargo may occur Physical engineering Natural engineering

Associated Impact Costs Table 3.9	Higher insurance premium, repair, maintenance, labour, voyage, charter and other costs, reduced port access, increased congestion, physical navigation risk	-Adapting through increased disaster risk response, information gathering and early warning systems -Improved training, disaster emergency contingency planning and vulnerability risk management adaptation, physical adaptation of vessels
	Threats to vessel navigation, safety, delays and congestion.	Greater coastal reserves, adjusted courses, modified legislation, slow steaming
	Changes in demand, supply, port profitability and pricing, commodities and input sourcing	-Increasing market flexibility to favour smaller vessels/lobby for reduced port rates during disasters based on remote Pacific locations/increasing other inter-port competitiveness. -Consumers and producers may alter preferences
	Changes in routes, markets, trade diversion and reduction,	Flexible marketing, delivery arrangements and adaptation with smaller/fewer vessels, short term intermodal transport shift to less physically exposed alternatives
	Reputational loss	Improved and coordinated information/ communication, increased security and resilience training/disaster management -Prioritise mitigation/environmental adaptation solutions
	Physical legal and technical regulatory compliance costs, increased insurance liability costs	Increased access to political-legal information and participation through offering stakeholder advice/lobbying, to minimise uncertainty
	Operational/financial cost loss	Improved and coordinated information/communication to prioritise climate change awareness and risk management
	Planning, preparation or adaptation cost in devising solutions	Increasing support for research and technology endorsing solutions

Source: Author

This source points out the free-rider risk problem many will face in persuading others to join this network of mutual adaptation benefits. Comparatively few port adaptation pilot projects have been conducted or infrastructure financed such as Mangaia harbour in the Cook Islands, San Diego, Rotterdam, New York and New Jersey. Certain stakeholders desire others to finance adaptation instead. It further endorses a cooperative approach, so ports can enact climate risk evaluation, mitigation and adaptation strategies without losing their inter-port competitive advantage status. It once more primarily focuses on mitigating CO_2 port and vessel emissions. This ignores other significant contributing factors towards global warming and the need for diverse and more successful solutions to implement. This research favours the need to minimise disruption costs via the alternative of active stakeholder adaptation. The weakness of many adaption scenarios is that most contingency planning efforts are isolated not coordinated. They exclude Pacific nations

from direct formation and participation. This presents significant risks in response value. It misdirects priorities and wastes scarce resources, given Pacific constraints.

This review advocates effective adaptation strategies consist not only of minimising adverse consequences but exploiting any potential benefits such as additional commercial opportunities that climate change may necessitate for commercial ports, smaller ports, marinas and interdependent economic hinterland, ecosystems and communities. Opportunities include trade diversion from less climate resilient maritime supply chain stages. It incorporates outlasting competitors failing to adjust. Despite this heightened risk exposure, that sources seek to affirm, people seem reluctant to truly prioritise climate change and to pay the initial sacrificial cost. This is reflected in increasing gas levels, temperature and SLR. This section agrees with previous scholarship (Dyer 2018). Adaptation strategies provide an anticipation and behavioural adaptation to psychologically and physically acclimatise over time to long- and short-term risk events, pressures, impact costs, constraints, challenge, and consequences. This entails higher anticipated adjustment costs to be effective; rather than just a reaction approach to events. Without considering mitigation, retreat, ecological rehabilitation and adaptation strategies as potential responses, risks appear increasingly unavoidable. In conclusion, an effective risk assessment framework for Pacific MSCs would integrate mitigation, adaptation, retreat/surrender, relocation, governance and policy issues and ecological rehabilitation, where the risks and adaptation measures would be as summarised in Tables 3.9 and 3.10 to minimise Figure 3.45 impact costs.

3.4.9: Other Risks including Economic, Psychological, Social, Legal/Policy Uncertainty, Competitor etc

Certain risks include the challenge of ensuring coordination and cooperation; followed by issues in access to finance, to data and knowledge, over-regulation, lack of supporting policies and incentives, securing sufficient supplies and values, access to marine ecosystem resources, infrastructure constraints, technical and equipment challenges and ensuring overall project and marina/small harbour, ecosystem, economy and community sustainability. There is a lack of clarity in a forward vision for the sector whether in South Africa, Africa or in many countries, a reluctance to share commercially sensitive information openly and a lack of standardised performance indicators to measure possible progress over time or insufficient monitoring and evaluation, especially in lessons learnt from failure. With every action, not every reaction can be predicted

psychologically. Opportunity costs always exist of alternatives that could have more aptly catered for stakeholder requirements, wants and desires. There are often options that in hindsight could have been more enriching, more capable, more popular, eco-friendly, more stimulating and productive. Stakeholders may experience maladaptation costs, gambling on the wrong solution selected, technology, partner, product, discovery, idea or action. Other risks are exogenous -unable to always sufficiently predict psychological behaviour of people, species or environment and climate accurately enough. Other external risks include remaining competitiveness both domestically and internationally plus economic, social, political, technological and finance/investment cycles; the flow of ideas and innovation or the regulatory environment one will be able to operate into the future. It includes strikes, crime, cybersecurity, asset depreciation, interest rates, inflation and other factors. Data limits and the need to consider ethics, biosafety and security remain crucial in a COVID 19. There is also no guarantee as to ultimate success or failure and if it is sufficient to reverse not accelerate pressure on endemic and vulnerable species. Depending on existing equipment, waste disposal and manufacturing, current industry, consumers, producers and supply chains will incur considerable adjustment costs, in adapting to climate change risks, marine pollution reduction or inaction.

For Africa and particularly South Africa, significant commercial risks are involved for these more eco-sustainable new markets. To succeed, the government would need to persuade existing supply chain stakeholders to favour small harbours, marinas and communities. The question to consider is whether existing sources are prepared to agree. They would need to be persuaded to support marine waste reduction commercially as an infant industry project ensure a ready market and influence consistent standards, providing sustainable domestic production. This could be effective via a marketing campaign to encourage domestic consumption and consumer loyalty of the value and products of South Africa, whilst also encouraging autarchy or import substitution for brands. However, a significant market risk is the lack of cultural and religious tradition over waste minimisation for many regions.

Marine pollution reduction, the circular and zero waste economy have yet to be formally protected by official policies and laws or have significant gaps as lobbyists for the plastics, petrochemical industries and other continue to receive subsidies These will influence the extent to which small harbours and marinas are threatened by risks. International examples of both remain few and underpublicized or infrequently published. It is hoped that the limited testing of the concept “mare nullius” and ocean governance will be assisted by the November 2019 drafting and ratification of the UN High Seas Treaty. Other risks exist in sufficiently ensuring

equitable access to traditional custodians/fishing communities with responsibility enshrined of failing to address marine pollution reduction. Legally and from a policy risk, although nations, businesses, organisations and individuals have pledged to act as binding signatories, this needs to solidify and be monitored with sufficient penalties and incentives to ensure compliance. Whilst other governments favour the marine/blue economy; there is also the slight political risk, that the opportunities identified in section 3.5 remain subject to continuous, consistent support by government its voters and private sector funding and training. These could cease at any time, given public familiarity and lack of understanding of their purposes or the macroeconomic and other strategic potential from selecting them and the blue/green/circular economy of interest.

Developing any new or existing industry in a nation presents certain legal compliance risks with the financial and other expenses necessary to ensure that marine pollution reduction is properly established in the legal system with inspectors to ensure compliance/minimise health/ environmental and other potential externality costs with adequate enforcement resources. Therefore, to minimise legal compliance risks and uncertainty, any government, investor or supply chain component would benefit highly through familiarity with small harbours, marine and general waste and environment related policy framework/legislation and associated enforcement costs of reducing issues concerned with wild fisheries including poaching/other legal breaches. Communication and coordination risks exist in ensuring all stakeholders are sufficiently informed among processes to minimise maladaptation or inaction costs. There is a need to ensure access and provision of specialised research facilities, to marine organisms, biodiversity and risks information, to be continuously updated and linked to other core stakeholders/research publications, news, events and funding incentives.. Coordination is also necessary to avoid isolation and fragmentation of research in which participants are unable to mutually benefit synergistically.

A high risk exists over public mass acceptance of small harbours as an emergent blue economy sector which few consumers, financiers, policymakers, NGO's, individuals, businesses and communities are truly familiar. Hence this provides an additional incentive to motivate this systematic review as a guide towards partially rectifying asymmetrical information and collective ignorance. Consumers lack sufficient awareness of the benefits, risks and costs to generate sufficiently informed debate, to support commercial markets and interest/popular acceptance. High concerns may exist as to the long term ecological, social, economic and other implications of various industries such as those for seaweed, rare species, cosmetics etc. A need exists

to secure the most fragile and rare marine protected areas internationally, against pressures under the guise of blue economy lobbyists. Biosafety and biosecurity risks from invasive species migration, aquatic diseases, parasites and alien species also need to be addressed prior to any blue economy fisheries, aquaculture, biotechnology, offshore oil and gas, ecotourism, marine renewable energy or other planned activity.

Africa among other regions currently possesses a shortage of skilled small harbour, marina and blue economy, fisheries, aquaculture and marine biotechnology researchers, professionals, venture capitalists, other financiers and supporters or lobbyists. This needs to be rectified as a major labour risk to developing a blue bioeconomy. Skills audits need to be determined and existing experience/skills utilised and upscaled, possibly from study abroad and exchange programmes with access to continuously updated knowledge to mitigate against risks. This report emphasises the need-for a proposed extension service to train in productivity/ efficiency; resource conservation; eco-literacy; waste management, climate; risk management, commercial opportunities/ marketing, records; communication, technology and business/entrepreneurship skills. These become even more essential to ensure equity, environmental and economic externality costs are minimised from previously disadvantaged communities/individuals for the rural piloted projects and marketable investment recommendations outlined in section 3.5. Supply chain stakeholders would benefit from improving resource management, to provide mutual information and cooperation for information, communication and emergency response, minimise adverse externality costs. Existing and future new local universities and vocational FET (further educational training college could offer more courses and develop research on marine small harbour economy skills development, research and technology for example in engineering, Harbourmaster, inspectors and entrepreneurship.

3.4.9.1: Finance Risks

If the blue economy and small harbours economy need to thrive it needs to convince natural capital and other financiers to overcome an existing shortage of finance available and invest in the long-term advantages to securing marine ecosystems survive and flourish, protected as much as possible for small harbours and marinas. Certain investors need reassurance that functionality will not be impaired Finally, there remains a significant risk to potential funders. As with any potential investment decision for scarce fiscal resources, uncertainty remains over whether governments would get a rate of return on their investment as a reasonable risk of bankruptcy exists given a lack of past experience/other factors. Government funding would be initially

necessary as microcredit and formal capital for these sectors, is historically ignored by Africa's formal banking, insurance and entrepreneurial sectors/informal economy; yet this represents a significant long-term opportunity cost of public taxpayer revenue. Foreign aid and investment equally fail to recognise the promise of this sector and need to be persuaded or compelled to change priorities where necessary. Limited marine protected areas exist. They require major investment and support to become productive. One challenge for small harbours and marinas remains ensuring sufficient access to capital and funding, especially given climate change uncertainty, ignorance and inexperience for many prospective investors. Factors underlying their reluctance to invest for climate change are listed below. Specific information is required to effectively finance adaptation. Physical indicators are proposed measuring the extent to which an investment is effectively climateproofed. This is essential to consider how any investment is or will be influenced by these risks.

Factors affecting a Small Harbour/Marina Investment Under Climate Change

- Asset resilience under IPCC/Downscaled projections
- Conditional Probability of Failure, Timing, Intensity
- Extent of Vulnerability/Risk
- Event experience
- Impact Costs
- Implications for cashflow, gearing ratio, liquidity, solvency, profit, return on investment.
- P/E to growth ratio, P/cashflow, P/E ratio, Profit Margin
- Portfolio Exposure
- Projected Recovery Time, Projected Performance
- Opportunity/Inaction Costs
- Regulations, Taxes, Incentives and Penalties; Targeted benefits, cost savings, revenue and opportunities

Physical Indicators Measuring the Extent to Which an Investment is Climateproofed.

- Business Awareness over climateproofing resilience
- Change in Asset Performance
- Change in Conditional Probability of Asset Failure/Asset Resilience
- Change in communication, financial, information, physical, psychological exposure and leadership
- Change in Percentage of Assets Exposed
- Change in Risk Perception/People trained
- Competitors
- Coordination/Cooperation with other stakeholders
- Demand/Supply/Market Changes
- Development of a Business Continuity Plan
- Extent of Mitigation/Adaptation Investment
- Extent of Globalisation, Asset Interdependency and Supply Chain Exposure
- Future Earning Power
- Liability
- Projected Risk/Vulnerability –Long Run/Short Run
- Recovery time changes
- Resources Allocated/Reserves
- Resource Sustainability
- Stakeholder Reactions/Reputation/ Requirements

Existing research recognises this constraint but ignore these factors, (Investor Group Coalition Climate Change 2016). It aims to encourage uncertain stakeholders to become more proactive, recognising opportunities and the need to effectively respond to risks and impact costs. Climate change is worth investing against, being more profitable, sustainable and preserving stakeholder requirements more reliably than the opportunity cost of inaction. These thesis proposed indicators (Dyer 2018) can validate investment decisions over alternatives, forming factors that require attention for business stakeholders to finance/invest in climate change. Risks do exist in privatisation of marine ecosystem reserves, commercialisation of marine resources, if not accompanied by accountability, transparency and sufficient resource utilisation restriction limits. The most significant risks to the future of small harbours and marinas however, remain those of climate change, possible species extinction, external risks such as from space, pollution but most of all; high human overpopulation of Earth and population growth rate, which may challenge forming any mutually profitable ocean future for all stakeholders.

Other significant risks exist in the quest towards a pollution free, blue, green and circular economy future vision for small harbours and marinas including the uncertain rate of change of technology and knowledge growth; the extent to which people can be predicted to cooperate and act; the extent to which policies and plans will be effectively resourced, supported, implemented and monitored and the uncertainty of the

consequences of each action or inaction. For example, the extent to which organisms and ecosystems can adapt or perish/collapse makes it more challenging to obliterate/cleanse but also to avoid for species when encountering it. Marine pollution continues to present legal and ocean governance along with associated liabilities and responsibilities including determining sources in transboundary areas and the high seas. The source clarified the need to reduce legal uncertainty by extending producer and consumer responsibility, greater awareness; education, activism and devices such as litter traps. Risks also exist if solutions do not consider demographic, cultural, social, religious, economic, environmental, political, legal and psychological factors as determinants of potential success or failure. Sources need to identify it more as not only a risk but an opportunity necessary to be managed threatening African and global efforts to deliver the blue economy. Over 4.2 billion people rely on seafood but will have to stomach ever surging volumes of plastic. In Africa marine pollution up to $5.6 billion of fisheries imports and $6.7 billion of exports. UNECA cite it as a specific threat. The extent of social awareness and pressure along with vested interests of industry lobbying groups also will determine the extent of efforts that will be necessary. Increasing social activism could encourage greater acceleration of changes or reforms. Each proposed solution also creates possible risks if relying upon people to voluntarily comply, especially in the absence of affordable substitutes or capable monitoring and enforcement. However, many of these risks can be resolved.

Stakeholders need to consider legal uncertainty risks and impacts of previous, current and future changes in legal/technical policy requirements in the absence of international and domestic set standards and policies. Governments, ports and stakeholder associations are likely to endorse policies as an adaptation solution for activities such as small harbours and marinas. These are predicted to provide significant legal, technical and financial compliance costs. This further reduces potential profits amidst other fiscal constraints of conducting business in many nations In reviewing studies (Dyer 2018), an existing gap in current insurance and risk management literature comprises increased insurance premium costs, from perceived or actual, risk exposure, liability and vulnerability whether from COVID 19, climate change, digital disruption and other risks. This affects carriage of goods by sea, based on risk aversion and asymmetrical information. It touches shipping companies through increased reputational damage costs, unless insurance adapts. This area has yet to receive an official policy or guidelines from global maritime law associations and Admiralty Courts as a potential research area. An additional short-term impact may affect or be influenced by changing technology and innovation. This complicates the decision of which solutions, how, when and where to adapt, that small harbour, marina and dependent blue economy stakeholders facing significant constraints should endorse to

prioritise climate change mitigation or adaptation. These risks and short-term impacts may be only partially reduced by increased information, communications, risk management training and investing; supporting research and technology development plus other proposed solutions summarised in this chapter.

Finally; this review advocates the most significant supply chain or blue economy stage affected by risk events and associated impacts includes access to financing and capital investment sectors for climate change adaptation. New production, consumption and investments will be constrained by increasing reluctance by the risk-averse global financial sector to invest in these activities based on increased uncertainty, asymmetrical information over potential disruption risks, and sacrificed or delayed profits. This will deny commercial and investment opportunities not only for producers, but shipping companies and other transport distributors, retailers and access to consumer credit for customers. Climate change also threatens insurance companies and financial sector solvency (Schuster 2013) e.g. banking (who may underwrite voyages, cargo, products or other loans to consumers). This influences the capacity for other supply chain stages to transact and perform. This further confounds resilience adaptation strategies (KRQC). These have previously not been implemented across an entire supply chain, to extend beyond just individual ports and shipping.

3.4.10: COVID19 and other Public Health/Epidemic Risks to Small Harbours and Marinas

With over 210 countries/territories, 1,705,862 confirmed cases and 103,233 deaths as of 11 April 2020, COVID 19 presents among the most significant public health epidemics since the polio outbreak following World War 2 and the Spanish influenza outbreak after the First World War; creating significant risks to small harbours and marinas. Although no vaccine has proven successful as yet, estimates range from 3 to 12-18 months as the expected direct impact. However, the death rate globally hovers only around 3-5%, disproportionately spread by travel and contact with the infected, either directly or indirectly. SARS had a 9.6% case fatality rate and MERS had a 34.4% rate. The most directly observed risk is their susceptibility towards facing decreasing tourism demand and reduced activities/blue economy investments due to competing other priorities, a lagging economic recessionary effect and the actions of many authorities globally towards quarantines and travel restrictions. These could present possible public health risks as more resources are often significantly invested in larger harbours and marinas. Many lack appropriate sanitation, recycling and waste/pollution disposal activities. Small harbours and marinas however, do have other values and priorities in being easier/simpler to manage or control and as potential lifelines for food and essential

service securities especially among fisheries. They can provide additional, less congested access routes for humanitarian and conventional logistics including medical equipment and pharmaceuticals during disasters and epidemics; when larger ports are more congested or damaged/disrupted. Dependent blue economy services can function and be restricted more effectively, so that economic activity can function without other parts of the country being infected and vice versa. Small harbours and marinas may also experience increasing demand as more people choose to potentially flee land and seek more secluded, less exposed marine environments or anchorages -simpler to arrange supplies to be dispatched; as epidemics persist.

3.4.11: Digital Disruption and the 4th Industrial Revolution Risks to Small Harbours and Marinas

Small harbours and marinas also experience risks from digital disruption and the 4th Industrial Revolution. Increasing vessel and cargo sizes may reduce the demand and need for both larger commercial harbours and smaller ports. Increasing automation can reduce the need for as many seafarers, fisherfolk and logistics/port operators and subsequent economic multiplier effects from employment. Conversely technology may assist operators as detailed in section 3.5. Increasing automation brings risks not just mass unemployment risks and prospective social instability/inequity. Cybersecurity presents a previously unconsidered risk. The greater the interconnectivity, the greater the commercial value of the data generated and risk exposure to hacking. Technology glitches and digital disruption may be closely across the supply chains Limited research has focused on connecting digitalisation to physical asset protection or risk management.

3.4.12: Case of South Africa, Existing Stakeholder Issues, Challenges and Concerns

In crafting a future vision for small harbours, this study recognises the value of learning from contemporary insights, sources and personal experiences. Stakeholder consultation recognises the need for a stakeholder engagement model; maintenance plans; harbour precinct and environmental maintenance plans, a SME incubator hub, reviewing legislation; creating an investment framework and skills development plan along with formal establishing harbours criteria. They also observed the issues over uncertainty on lease security, community exclusion from local decision making; need to counteract poaching, crime, grime, poor pollution control, land rezoning challenges and excessive procurement bureaucracy. Existing assets face vandalism

and security threats and a lack of coordinated, proactive management has radically impeded progress. Stakeholders have not benefitted from competitive marketing of new leases and opportunities or land sales.

Table 3.13: Issues and Challenges in Forming New South African Small Harbours

Workstreams	Issues and Challenges
Establishment of New Harbours	• Lack of ownership, stewardship and sense of place for communities within proposed small harbour precincts •Limited dedicated spaces for community upliftment and community development along the coast • Poor functioning Ecosystem, preservation of ecological, aesthetic beauty of the natural environment for the enjoyment • Decision inertia on planning, investment and development Unclear roles and responsibilities as well as capacity constraints at local level
Redevelopment and Maintenance of Existing Harbours	• Ineffective maintenance, public health and safety, and unpleasant harbour environment • Incomprehensive implementation of environmental management practices • Insufficient information on the harbour cadastre (e.g., appropriately surveyed and registered land, with associated zoning schemes) • Low investment rates in harbours, including significant de-investment • No alignment between Harbour Precincts Plans and Municipal (SPLUMA) Spatial Development Frameworks.
Socio-economic Impact	• Poverty caused by unsustainable jobs due to poor skills base. • Fragmented value chain contributing to lack of investment • Limited development and support of SMMEs • Barriers to market entry • Limited access to credit and funding for SMMEs Value chains not mapped out and skills required not identified.
Institutional Arrangements	• Lack of clarity on mandate to drive implementation • Fragmented legislation and poor implementation of intergovernmental legislation • No structured funding model for small harbours Poor stakeholder management and communication model.

Source: Department of Public Works 2019.

At a February 2018 meeting, stakeholders mentioned a lack of progress by core stakeholders who work in isolation often embracing a silo mentality without apparent real progress. Limited budget and staff resources exist despite the willingness of the Chinese and European Union to potentially invest. Current businesses pay no or nominal rent for the most part and leases have yet to be renewed since 2008.No revenue is currently yielded from an entire province -the Eastern Cape! Small harbours do not charger current users tariffs other, as for many marinas outside commercial ports; in dramatic contrast to international best practice examples. South Africa lacks a separate coastguard or well operating Navy to protect small harbours from poaching, pollution and other threats, with few fisheries inspectors. Small fishing ports lack police. The Navy ignores crime. Fishing quotas are often awarded based on potential political patronage or race rather than

heritage or merit. These all present significant risks in addressing South African and similar global small harbour and marina issues with finite constraints.

3.5: Opportunities for Small Harbours and Marinas

In crafting a future vision for small harbours and marinas in a Blue Economy Age, myriad prospects and opportunities exist for those prepared to invest sufficient resources within them and to listen to stakeholder or emerging market requirements. Small harbours and marinas can provide a less regulated, congested, ecologically sustainable and cheaper/commercially viable alternative to larger, more commercial and established ports. Often, they could provide more climate resilient, safer anchorages with greater land availability, reduced zoning, traffic and other requirements. This research's conceptual contribution is to consider their future may be in serving as a catalyst for other blue economy activities; a refuge or trade diversion source during the COVID 19 or other global epidemics and have even loftier potential from a Digitised, increasingly technological epoch of the 4th Industrial Revolution. It also contemplates the specific examples of existing South African Fishing Harbours as a basis for local and global equivalent projects being developed.

3.5.1: Connecting Small Harbours and Marinas to the Blue Economy Age and Activities

In creating a new future for Small harbours and marinas, this scholarship's aim is to reimagine their capacity to provide a land, coastal and marine location for various emerging blue economy activities as previously summarised in Table 1.2 This moves beyond the limitations of relegating minor ports to traditional ocean economy activities, becoming more obsolete if restricted to fisheries and lessor tourism. Many of these ideas are based on similar work from personal global experience from ports across Brazil to the South Pacific to Africa and the Mediterranean/North Europe along with in devising opportunities for the first African city level blue economy approach but to be downsized and scaled down. Although not every recommendation and activity is appropriate for every marina or small harbour; detailed market and stakeholder analysis will consider which of these areas provide promise. Additional opportunities exist in the direct employment, expenditure and value chains provided by endorsing more residents and businesses to support each activity as well as those involved in government/other services needed and staff essential to service and maintain the marina/small harbour and surrounding community, environment and economy.

Table 1.2: The Ocean Versus Emerging Blue Economy Opportunities

Ocean Economy Activities	Emerging Blue Economy Opportunities
Fisheries, Aquaculture, Circular Economy	Cabotage
Shipping; Transport and Ports	Marine finance and insurance; Dry Ports
Marine and Cargo Services	Undersea mining/Bioprospecting
Navies - Ocean and Coastal Governance	Drones, Robotics/Marine Protection
Offshore oil and gas	Marine Renewable Energy; Desalination
Marine, Cruise Tourism and Recreation	Marine Biotechnology; Blue Carbon
Education and Training	Maritime research and development, Technology e.g. sensors
Ship Repair	Vessel automation and conversion
Sea Rescue	**Small Harbours**

3.5.1.1: Marine, Cruise and Coastal Tourism: A Maritime Museum

Figure 3.46: A Maritime Museum – Interactive Ship Exhibit

Source: www.msn.com.

Project Description/Overview:

Several coastal cities internationally have used interactive Maritime themed museums as catalytic attractions to place them on the map. For example, the entire African continent has only 2 minor maritime museums (Durban's Natal Maritime Museum and Cape Town's Iziko Maritime Centre). The establishment of Maritime-related Museums (rather than simply the existing 3 vessels and small hall in Durban) is a standard and attractive feature of most port cities, which any small port or marina could develop an iconic, spectacular tourist attraction. Although it does not need to be dramatic, it could showcase local and regional or even national maritime heritage, with gift shop, restaurant and viewing deck. with simulators. If locals, government, local museums, libraries and businesses are known to have a vast amount of memorabilia and historical items which could start as a foundation for an interactive museum. However, the municipality could try to encourage more vessel/exhibit donations.

Linkages to the Blue Economy

A spectacular Maritime Museum clearly facilitates marine, cruise and coastal tourism or recreation as a complementary target for visitors. It can also extend to conference and hospitality tourism for delegates through offering conference and reception facilities along with private guided tours or cruise vessel shore excursion packages. Any historical interactive vessels and adding of wreck salvaging exhibits from certain of coastal wrecks will support maritime industry and ship repair/diving/salvaging services. Maritime education and training facilities will have more opportunities for various graduates including marine conservators, archaeologists, tour guides, historians and others. It provides a destination for local and international yachting and coastal marina developers. It could support local value or supply chains favouring aquacultural products, selling marine biotechnology and industry processing products and powered by marine renewable energy. A Hall of Blue Economy Future Innovations and Technology could publicise awareness of subsequent developed opportunities.

Benefits

It can be catalytic with economic multiplier effects– e.g. Hong Kong, the Titanic museum at Belfast, (a catalytic project which attracted 3 million visitors from 145 countries, and added R2 billion to the Belfast economy in 3 years and other iconic maritime museums such as Sydney, Maine, Kobe and Liverpool. It also offers potential as a significant year-round attraction with domestic and International Tourism potential. Myriad employment opportunities exist as identified in Table I. these in turn add extra income, production, consumption and tax revenue, countering any marginal impact in additional rates revenue. It provides marketing and publicity. It has socio-cultural and educational/research benefits in encouraging the public and visitors to appreciate the area' s impressive maritime heritage and history, complementing the natural heritage of the area. It also has significant publicity and psychological benefit. It is also recommended that site visits/desktop studies are specifically considered for equivalent leading global maritime museums in particular; the Titanic Museum in Belfast, the National Maritime Museum and Cutty Sark at Greenwich, which have engaging interactive experiences, Gulf-quest Museum in Mobile Alabama, the Hong Kong and Sydney Maritime Museums.

Table 3.14: Potential Maritime Museum Employment Opportunities

Reception and cashiers	Administration, IT and Management
Curators and exhibition managers, Historians, Divers	Stewards and guides
Restaurants and catering	Security, Cleaners
Preparation of guide books	Souvenir and gift shop

Time Frame Estimates: 4-6 months for the prefeasibility study. 1.5-3 years for the preliminary reports, designs and approvals, 3-5 years for construction and implementation

Other tourism opportunities extend beyond a museum as provided examples in Chapter 2 of this report to those summarised in Table 3.15 below as specific enabling conditions to facilitate small harbours and marinas as integrated into coastal communities, ecosystems and economies.

Table 3.15: Enabling Factors and Opportunities for Small Harbours and Marinas

Themes / Interventions	Infrastructure Creation (Consider more public-private partnerships and incentives)	Entrepreneurial and Skills Development (Emphasise on Jobs, Opportunities, SMME's, "Low Hanging Fruit"	Conservation and Sustainable Use (Brand …); Increase Awareness; Greater Enforcement of Bylaws	Policy and Planning (Align with existing policies and strategies)	Innovation Consider a Blue Economy Transformation Charter; Create a Stakeholder Database for each sector	Improvements on Existing Operations / Systems
A Maritime Transport, Shipping, Ports and Logistics	**1. New Cruise Terminal** **2. Coastal and inter-city Ferry** 3. Truck only road from port to areas/railway. This will reduce both traffic congestion and traffic fumes/pollution. 4. Investor friendly releasing of municipal/port land to encourage development **5. Encourage the movement of more freight to rail.**	8. Empowerment of women in the maritime sector 9. Providing greater ownership, support and development 10. Youth development 11. Private cargo and passenger trains 12. Smart port city and skills development 13. Introduce maritime awareness and subjects in schools, preferably primary schools.	**14. Reduction of Pollution** 15. Identify waste recycling initiatives 16. Increase market access **17. Cleaning up Harbour/Port Hinterland** River and stream clean-up for rivers feeding port.	**18. Minimise onerous logistics, planning, economic and other regulations** **19. Amend TNPA/Durban leasing and licensing/zoning processes to simplify -applies to all themes.** 20. Plan port as a full-service port including bunkerage, ship repair, humanitarian logistics, LNG, offshore oil and gas; safe seafarer nightlife etc. 21. Link with ports along the coastline along with smaller harbours and marinas -	22. Digitise Shipping and Transport Operations -Smart Cities, Smart Ports, more free Wi Fi, link to Internet of Things, Fourth Industrial Revolution 23. Prepare for COVID19 and other public health pandemics 24. Link to circular economy	**25. Improve efficiency at Port/Reduce Congestion** 26. Coordinated Back-of-Port planning with an emphasis on communication 27. Integration of road, rail, freight and water transport among tourism attractions within the city 28. Consolidation and improved links to sister cities to extract learning from cities with similarities. 29. Mobilise silent players and others into action -motivate and incentivise

	6. Second access to Durban Container Terminal (ETA are already moving towards the implementation of these 7. More truck stops and staging areas (conceptual design stage at present)					
B Maritime Manufacturing, Industry and Infrastructure	**1. Establish / Maintain / Refurbish current ship repair facilities**	**2. Train TVET College graduates** **3. Workplace-based Experiential Learner Programmes in scarce and critical trades** 4. **Increased/Targeted career awareness**	**5. Reduction of carbon footprint -link to IMO policy** **6. Reduction of pollution/emissions -link to IMO policy.**	7. Longer leases for Ship Builders and other property 8. Support local registry of vessels, crew, shipowners **9. Incentives for using SA flagged ships for cargo and coastal operations** 10. Incentivise Shipbuilding and repairs	11. Unlock investment in port facilities	12. Further support for the boatbuilding industry including a database -link to EEMC and South Coastal Boat Building Cluster 13. Direct municipal water access to shipyards 14. Increased public private partnerships
C Maritime and Coastal	**1. Improve and extend/revital**	11. Increase food and beverage		25. Revise beach swimming regulations	**32. Development of Blue Flag Beaches**	**39. Hop on/Hop Off Ricksha Bus**

Tourism and Recreation	**ise Maritime Museum** 2. City and Coastal Ferry Service **3. Develop tourism spots** 4. Add a raised viewing platform tower with paid telescopes **5. Beachfront Promenade Extension** 6. Additional valuing and development of waterfront and Esplanade real estate 7. Improvement of Small Craft Basin infrastructure, services and lease security 8. Bayside waterfront development including yacht	outlets on beachfront **12. Establish micro-kiosks lending beach umbrellas, loungers/chairs along beach promenade** **13. Employ "tourist ambassadors" to improve security** 14. **Hiring local Lifeguards** 15. Encouraging local boating industry including visiting yachts. 16. Prioritise Embankment regeneration 17. Port culture 18. Port and community cultural integration	**19. Cleaning up the beach/beachfront** 20. Automatic Street Sweeper/Litter Picker 21. Invite Water and Sanitation to future meetings in considering anything involving inland dams, rivers etc 22. Clean up of city pump drainage points and outlets 23. Additional street lighting and benches 24. Creating more pocket parks	**26. Safety of tourists – swimming and on beaches** 27. Crime / safety and security. E.g. relocate vagrants to safe centres 28. Maritime Museum Revamp and Extension Feasibility Study/Market Research 29. City and Coastal Ferry Feasibility Study/Market Research 30. Easy accessibility 31. Consider Hinterland, rivers, lakes, dams etc.	33. Aqua tourism **34. Multi-Attraction City Pass** 35. Developing Infrastructure Facilities and Diversified Products/Services 36. Develop Centres of Yachting and marine leisure Vessels 37. Promote yachting lifestyle 38. **24/7 Comprehensive Precinct management at all tourism hotspots**. No drug dealing on city streets. Women must feel safe at all times of day and night.	**along attractions** **40. Blue Economy Festival, Beach Party Festival; Maritime Festival** 41. Canoe, surfing, fishing competitions, other sports and recreation related to the sea e.g. diving, swimming, kitesurfing, jetski, wakeboarding, 42. Bus to events such as Sardine Run 43. Coastal Railway -more frequent day train trips **44. Guided and unguided tours of Lighthouses** **45. Marine heritage precinct** **46. Walkways to improve connectedness**

	clubs and associated value chains 9. Point waterfront development. 10. Support development of the cruise industry					47. **Improving the Image and Awareness of the area** 48. UIP Additional Police Visibility
D **Marine Energy and Extractive Industries**	**1. Marine Renewable Energy Pilot Projects** 2. Desalination Plant to provide fresh water.		3. Marine Renewable Energy Devices that minimize impact on biodiversity **4. Prevention of 'spills'** **5. Upstream river rehabilitation** **6. Water safety and sustainability awareness**	**7. Marine Renewable Energy Research Institute** 8. Marine Renewable Energy Processing Incentive Zone	**9. Harnessing Wave & Tidal Energy** **10. Large-scale Sea Water Desalination Plant** 11. **Harnessing Offshore Wind Power**	12. Offshore oil and gas exploration servicing
E **Maritime Knowledge, Research and Development**	1. Maritime Centre Campus 2. Maritime Student Villages 3. Support existing maritime	**6. Blue Economy Innovation Hub** 7. Ocean Academy 8. Bursary schemes 9. Additional berths and options for local graduate seafarers		**11. Prioritise Oceans Research Programmes** **12. eThekwini Blue Economy Sectors Support Committee** 13. Blue Economy Partners Network 14. Blue Economy Implementation Committee		16. Career expos and workshops 17. Increased/Targeted career awareness (ESSA) **18. Research Identification and Mapping Blue Economy activities**

	centres and campuses 4. Coastal Research Vessel 5. Boatbuilding industry - artisans and experience	10. Supplier Development		15. Link to other regions/provincial/national		19. Research valuation and value chain analysis of Blue Economy 20. Unbundle and improve upon participation and demographics.
F Marine Ecosystem Protection and Conservation	**1. Marine Ecological Sanctuaries**	2. Local community "biodiversity representatives" 3. Picking litter/plastic from coast/beach/ocean -Circular Economy Community Recycling Initiative 4. River waste trapping areas	5. Coastline clean-up 6. Coral rehabilitation 7. Carbon Footprint Offset Scheme 8. Coastal Dunes/Ecosystem Rehabilitation	9. Source to sea initiative aimed at preventing waste from land-based sources into the marine environment **10. Reduction in the production/consumption of non-recoverable/single-use plastic products** 11. Marine Protected Areas (MPAs)	12. Apps to monitor various marine ecosystems' health	13. Promote awareness of diversity/sensitivity of the coastal/oceans environment 13: No sewerage spill 14: Litter control.
G Fisheries and Aquaculture	1. Hatcheries sites and value chain development. 2. Improving demand and supply for aquaculture 3. Aquariums	7. Increase participation by coastal communities/ previously disadvantaged groups 8. Entrepreneurship training for subsistence fishing	10. Sustainable Fishing Permits 11. Training 12. Market access 13. Beneficiation (Processing and packaging)	**14. Aquaculture Hub/Research Centre** 15. Aquaculture processing Incentive Zone	16. High value aquaculture 17. Ornamental/Commercial Aquaculture	18. Ecotourism 19. Identify sites for aquaculture 20. Allow businesses to enter this space; provide facilities and support/incentives.

	4. Cultured pearls 5. High valued seafood/products 6. Fishing fleet revival	9. Skills inventory and needs analysis				
H Maritime Technology	**1. Marine Biotechnology Research Facility -only valued if perceived to be not city operated**	2. Bursary schemes	3. Ocean Clean up Technology	4. Marine Processing Incentive Zone	5. Marine Data Solutions	
I Ocean and Coastal Governance	**1. Protection of infrastructure (cables and antenna) from increased theft** 2. Capitalise upon and expand navy base		**3. Patrolling of MPAs** **4. Increased policing/reduce crime**	**5. Drone Port and Distribution Network** **6. Alignment of policy and regulation**	**7. Port and Coastal Surveillance Systems** **8. Drone Technology**	

Further Blue Economy Microeconomic Opportunities for Stakeholders

- Extend Ricksha Bus routes to include a Hop On/Hop Off function with more routes including new proposed harbour/ North and South Coast/river ferry and train routes -linking tourists; higher priced commuters etc. Add tap and pin/municipal parking booking and payment apps;
- Create park and ride bus services
- Consider greater bus/train route access for the area, beaches etc.
- Create ferry services extended up route through various rivers such as Umgeni/others
- Enable more marketing opportunities - in maritime films, documentaries and other events
- Extend a Blue Economy Festival, Beach Party Festival; Maritime Festival etc.
- Enable more pirate and dinner cruises; beach parties; concerts etc.
- More coastal and other tourism opportunities in windsurfing; kitesurfing; banana boats; Hobie Cats; Jet Ski Hire; Aqua-bikes; cargo barges; kite-boarding; glass bottom boats; submarines; wake-boarding, surf-skis; cycles for hire; more whale and dolphin watching.
- Catering to elderly and disabled -solar powered electric golf carts; mobility scooters; self-guided Segways and other transport along the coast.
- More high value aquaculture including lobster/abalone/coral rehabilitation and marine biotechnology opportunities.
- Multi-Attraction Area Pass -including private ones, maritime museum; lighthouse, Heritage and other precincts.
- Guided and unguided tours of Umhlanga and other lighthouses.
- Guided Maritime Heritage city and walking tours -volunteer -recounting maritime heritage
- Introduce a harbour/beach recycling initiative and centre -for calling in vessels; yachts; cargo; cruise ships etc-recycling. Promote micro-enterprises.
- Nightlife Security guides/guards and experiences -promote safer tourism; seafarers and locals for the area at night.
- Consider an inflatable beach/North, South Coast and harbour playground for children.
- Host more beach/coastal events and enterprises relating to children, youth, the disabled; women etc.
- Rent out underwater cameras; diving equipment etc;
- Create a Float Parade; equivalent beach and dance festival with Fireworks at New Year and other Carnival events.
- Create Turtle/Sea life breeding marine reserves; aquaculture and other farms -private and aquariums/biotechnology centres etc.

Additional Recommendations to improve the potential prospects of the blue economic ocean strategy framework for small harbours, marinas and interdependent value chain stakeholders.

- Base economic rents and opportunities not on perceived market related values (often inflated and not effective) but on a nominal rent that does not provide competitive market entry barriers.
- I.e. promote the local Market and other markets to become viable -not charging them excessively high rents; get more small and medium enterprises; individuals and cooperatives.
- Promote greater security of lease to existing maritime recreation clubs, yacht clubs, beach vendors etc.
- Fix piers for ferries

- Extend free Wi-Fi hotspots across the area.
- Clear up Esplanade, other derelict land and buildings Heritage Tour/Walk and other opportunities for volunteer guides.
- Ensure greater enforcement of traffic laws/violations including double parking etc to reduce congestion for traffic logistics -delaying port/back of port activities.
- Investigate sustainable fishing permits and other processes for local fisherfolk. Consider fishing tournaments and events at local dams, rivers and coastlines -using aquaculture etc.
- Consider an Ocean/Maritime Cuisine festival/tours etc.
- Development of area as a marine heritage precinct with museum, ferries, accommodation; cafes; shops and tour guides etc.
- Reduce regulatory requirements as much as possible for small and medium enterprises.
- Focus on harbour, river and coastal estuary/ecosystems and coastline clean-up; ensure effective pollution fining; monitoring and enforcement
- Target beach and costal dunes/ecosystem rehabilitation across entire city and coastlines
- Work with other stakeholders to clean up areas around Dams and associated reserves for experimental aquaculture; marine biotechnology and leisure resort
- Expand Ocean Champions/marine environmental education network to other areas and Sea Scouts/other programmes to have voluntary youth conservation rangers, marine careers/conservation and outreach/community programmes/local museum etc.
- Work with aquariums, marine research institutes, universities etc to focus on coral and sea life rehabilitation etc.
- Extend the lifespan of the previous policing and security/tourism volunteers in high crime visibility potential hotspots; waterfront/beach etc -reduce tourism crime risks and perceptions
- Work with shipping companies, airlines, railways, ports, professional associations, Chamber of Commerce, Maritime Cluster; businesses, individuals and others to create a carbon offset scheme - green carbon utilising afforestation programmes in peri-urban and urban areas to plant more trees including fruit; avocados and nuts for export as labour intensive, high value;
- Position smaller harbours/marinas as among the pioneers globally to ensure blue carbon offset programmes through marine reserves.
- Work with airlines/cruise companies for marketing, Museums, tourism, Transnet and others to research and record maritime heritage; including capturing stories from past and present seafarers, fishermen; tourists; navy; port workers; communities and others. -Create awareness of blue economy.
- Consider commemorative maritime and blue economy coins; stamps; medals etc -with the Post Office/Mint etc.
- Work with Maritime Cluster/professional associations etc. to have blue economy prizes; events; Champion contributors etc.
- Promote more sailing and other beach sport tournaments; races, regattas and events.
- Create a Life-saving/surfing and beach related sport museum at the clubs.
- Consider more ocean viewing platforms inland at existing parks and reserves to remind people of the area and its attractions.
- Promote wrecks for archaeology and diving
- Extending more small businesses for local artisans/crafts/souvenirs at a nominal rent

- Address the crime/grime/litter perception through eco literacy and environmental education awareness in schools, etc. Greater enforcement of existing municipal bylaws. Employment of more local youth as security guards to protect those using beaches.
- Improve Esplanade - mosaics, art in underpasses - opened up, cleaning up - removing squatters.
- Plant more clusters of palm trees and add more sand to the beachfront. Allow more cafes and bars actually by the beachfront/sand even if a zoned off area,
- Promote beach sculptures/art along the beaches.
- Enhance the value of marine/coastal real estate through these areas; refurbishment of the apartments along the beachfront and Esplanade following Cape Town, Barcelona, Sydney etc.
- Improve public transport connections, publishing timetables at all bus stops and increasing the frequency of buses.
- Virtually all tourists and visitors to beaches, marinas and small harbours would prefer to be able to eat and drink while there, preferably while sat as close to the sea as possible. There are still insufficient food and restaurant outlets on the beach front at peak times, particularly by the beach/outdoors. It is noted that the average restaurant employs between 15 and 50 staff. The construction of more outlets, leasing at reasonable rents (acknowledging the seasonality of the business) and consideration of small kiosk-type outlets has the potential to quickly create jobs and micro-enterprises. These can range from up-market cocktail operations, to casual umbrella-covered beach diners, to fixed point kiosks for ice creams and light snacks.
- Almost all overseas tourists enjoy lounging on the beach and enjoying the ambience. However, unlike most international beaches there are no facilities to hire chairs, loungers or, critically, sun umbrellas. Without shade, tourists cannot spend long periods of time on the beach in peak season, (maybe as short as a few minutes in December) and hence are driven to move on. This aspect lends itself ideally to the creation of micro-enterprises where individual youths could be established as rental kiosks. Such youths could then be recruited into the tourism industry and add to the security of the beach in watching people's bags and clothes while swimming.
- The lack of tourist items which are branded with the local area, and made there. This lends itself to promoting manufacturing and supply opportunities. Many of the tourism items for sale will have been seen by well-travelled tourists elsewhere and hence are less attractive to purchase. Localbranded items provide free advertising. This area lends itself to Co-operative involvement.
- One of the key incentives to visit a marina or beach front is for a tourist to be able to say they swam in the Ocean. Extending the flag range on beaches that people are permitted to swim so as not crowded in one small area of a few dozen metres would encourage tourists to spend longer on the beachfront. This contributes to increased spend. If necessary, this could be accompanied by signs such as "swimming at own risk", "suitable for strong swimmers only" etc.
- Promote more sport events such as parasailing, kiteboarding, jetski, kayaks, windsurfing, pedal boats, snorkelling, glass bottom boats (coral reef gardens) undersea walks and other marine sport tenders. Consider events such as lantern releases.
- Beach side entertainment. All tourists are entranced by traditional dancing, and other l entertainment. There is a lot of scope for regular rosters of entertainers to occupy spots along the beach promenade, particularly during weekends and holiday periods, and solicit donations for their performances. This aspect lends itself to micro-entrepreneurial and Co-operative activities.
- Most residents and many tourists at the beach front are up-market shoppers. Yet there remain no up-market shops aimed at higher income visitors and residents, e.g. luxury food store, other niche food stores, pharmacies etc. Each store could employ up to 50 people.

3.5.1.2: Shipping, Transport/Ports and Logistics: Municipal and Coastal Ferry Service, Boat Building and Repairs.

Figure 3.47: Renewable Energy Powered Ferries

Source: www.eccomarinepower.com

Project Description/Overview

Small harbours and marinas would benefit from attracting additional commuters and tourists possibly via offering local and regional ferry and other transport services including for tourism and recreational callers This would require the rehabilitation or provision of appropriate embarkation piers in these areas and sheltered berth anchorages or the vessels. Assuming environmental and ocean conditions are prudently monitored, a regularly operating series of ferries with scheduled, regular and published timetables and stops would facilitate the movement of people to support less accessible people, tourist attractions and businesses within those areas. It might potentially assist employment in those areas. It could also enable boatbuilding opportunities to provide the vessels to support the repair sector's local value chain. A boatyard is further considered to need the ability to conduct damage condition, cargo, hull, machinery, salvage, wreck removal, general average, third party liability and other surveys. More efficient docks have established supply chains to procure parts sufficiently in advance so as to minimise vessel turnaround time and idle berthing capacity costs. Vessels consider drydocking costs in close proximity to existing and scheduled trade routes. Quality and speed are frequently perceived as more essential than cost in determining projected market demand and potential efficiency. Other ship repair industry challenges include labour, an absence of locally registered ships including a declining fishing fleet, issues over port competitiveness, environmental, quality and productivity concerns. This research advises specifically targeted localised component opportunities for the shipbuilding and repair industry. Certain basic shipyard components essential to ship repair, that can be targeted to assist local dockyard capacity is summarised in Table 3.16. This aimed to reduce the extent of exemptions for imports of maritime manufacturing/industry related products.

Linkages to the Blue Economy

The ferries can be experiments for solar, wind, tidal and marine renewable energy powered craft following examples in Brisbane, Hong Kong and Singapore. They can further provide linkages to the blue economy through marine manufacturing and ship repair industry by being locally assembled, supporting supply chain employment. It supports local maritime education and training through the employment of seafarers as crew

and others. It assists cruise/marine coastal tourists given erratic and infrequent municipal bus or unsafe train alternatives. Tourism dinner ferries at night would offer further opportunities. They could connect aquaculture pilot projects, marine biotechnology sites and ecological sanctuaries/offshore reserves.

Table 3.16: Local Ferry and Boatbuilding Supply Chain Component Opportunities

Metal fabrication - (forming and joining of aluminium, mild and stainless steel/Titanium)	Power Distribution Systems-220 Volts	Blasting Cable
Watertight doors	Lightning Distribution Board	UVG cable
Fluid storage tanks	24 Volt Direct Current Distribution Board	Landing lightning cable
Valves	Interior Push Button Box	Multicore cable
Compressors	Exterior Push Button Box	Copper conductors
Air accessories	Switch socket and junction	Pullkey cables
Solenoid valve for compressors	Gooseneck Ventilator	Specialised coating
220-240 Volt Cables	Mushroom Ventilator	Sea water coating
Marine Navigation Lights	Exhaust Nozzle	Swing Check Valve
Basic Design of Vessel	Water mist system for engine	Ball valve
Garbage Compactor	Control board and fire sensors	Wafer Check valve
Ventilation Grid and cover	General engineering	Epoxy resin
LED Searchlight	Low instrumental cables	Machinery
Main Switchboard	Optical Groundwire cables	Components
Sails	Reverse Engineering services	Low Voltage cable
Power Distribution Systems - 440 Volts	Refurbishment of valves, piping, pumps	Signal cable

Benefits:

Locally constructed ferries would support maritime industry as in Table 2. Renewable energy powered ferries also reduce a city's carbon footprint and contribution towards accelerating climate change being more ecologically sustainable. It provides less noise disturbing people and wildlife with less air and water pollution, improving local health. These would include reduced traffic congestion for the N2 north and southward bound. Various physical transport and socio-economic benefits exist in improving coastal connectivity for passengers. It can also provide a pattern or despatched cargo and couriers of the highest priority/perishable/fragile cargo. It would provide additional macro and microeconomic benefits such as employment opportunities (Table 3) and related supporting value-added production, consumption, income, tax revenue and expenditure across the supply chain and stakeholders. Local kiosks could be present at each stop or existing ones supported to acquire tickets, refreshments and gifts. It is recommended to consider equivalent ferry services abroad such as those of Sydney's Circular Quay, the tourism ferries of the Thames, the commercial distance and local ones of Athens' Piraeus, Singapore, Hong Kong and Brisbane's Swan River.

Table 3.17 Ferries and Small Harbour Boat Employment Opportunities

Port expansion and upgrading construction and repairs	Logistics -high priority cargo
Pilots, cargo equipment operators	Seafarer crew/support staff
Ship Repair -floating/dry docks, bunkerage	Banking/Finance and Insurance,
Port Security, Drones, Legal, terminal operators.	Administration, HR, Marketing, IT, Finance,
Education and Training	Salvaging, Diving and Surveys
Chandlery, Catering, Entertainment, Transport for crew	Tourism -Cruise etc,
Communication, Information, Electronics	Marine/Port Engineer/Naval Architect, Consultant
Freight forwarding agents	Technicians

Source: This Study:

Time Frame: 4-6 months for the prefeasibility study. 6 months-1 year for the preliminary reports, designs and approvals, 2 years for construction and implementation

3.5.13: Education and Training: Development of Blue Economy Innovation Hub and Maritime Centre Campuses/ Maritime Student Villages.

Figure 3.48: Shanghai Maritime University

Source: Shanghai Maritime University

Project Description/Overview

A small harbour or marina could host within its community or precinct any number of universities, public and private vocational training providers, artisanal apprenticeships, high schools, public and private colleges or educational institutions. A local municipality or other stakeholders could several initiatives to further develop this sector through the provision of additional area and other zoned land/buildings to extend physical capacity to provide maritime education and training in emergent areas for all linkages to the blue economy and these/other emerging curriculum opportunities. It could assist in marketing/targeting maritime students and researchers through specific student villages/campuses etc, given a comparative advantage and scarcity of facilities outside certain areas. The Municipality could create or reform the Maritime Cluster to specifically produce a Blue Economy Innovation and Incubation Hub with direct access to industry requirements and projects; the recruitment of suitable experts to voluntarily or otherwise paid to share their experiences and insights/awareness of opportunities. It extends to providing the community and students through blue economy career and opportunity guidance. Each incubation hub concept would target identifying those most promising and offering them highly concentrated support as accelerators to ensure their concepts actually develop to be self-financing eventually, especially those benefitting the community, economy and environmentally sustainable in the circular economy.

It extends to the provision of specialised entrepreneurial facilities to overcome the barriers to entry for many small and medium enterprises which need targeted intervention and support. These are identified in the submitted Report 3 including: Professional business registration address and mail forwarding service; website links, access to fully furnished workspace units; High speed Wi-Fi network access; printing; Kitchen facilities and access to catering services; a central reception; just one bill; access to information and a centralised database of networking contacts. It extends to public speaking, mentorship, Identifying and Active

Listening/Evaluation of Needs and Networking – Forming mutual entrepreneurial support/marketing of activities. It can incorporate peer to peer learning; links and developments of websites, social media platforms (Blue Economy Future organisation; Facebook, Twitter, Instagram; YouTube videos; Linked In) and Peer to Peer Learning – Sharing Experiences/Successes/Failures. Others include favourable media exposure in the municipality newsletter and podcasts recording all presentations and pitches for evaluation, reflection and learning. In contrast the student villages would be self-contained campuses with halls of accommodation, a library, banking, entertainment, sport, academic and cultural facilities whilst the existing maritime schools and universities both public and private could gain incentives and physical space to expand, to directly target African marine and maritime/blue economy students and researchers.

Linkages to the Blue Economy

The Maritime Cluster needs reviewing to provide specific linkages for the support, research and discovery of employees, employers and entrepreneurs across all blue economy areas. It can directly connect to cruise and marine tourism; shipping, ports and logistics; aquaculture, maritime industry including drones; marine renewable energy and biotechnology; along with the development of ecological sanctuaries/reserves. Many need continuous, ongoing education and training to access the blue economy area. Courses could therefore be developed with existing industry for artisan training and industry. They could be also developed for aquaculture, marine renewable energy, biotechnology and cruise/marine tourism specifically to support these areas. Entrepreneurs specifically need training in the Developing of IP, Innovation; Acceleration, Incubation/Commercialisation and Expansion Skills Development. Awareness would also help with Public debates over issues relating to the Maritime Cluster, entrepreneurship, and the Blue Economy

Benefits

This value proposition opportunity and business plan subsequently recommends the Municipality can further assist the development of this sector through maximising awareness, funding, training, a legislative framework conducive to facilitating employment and employment and otherwise supporting the following Table 3.18 sectoral job opportunities to derive income. If the Municipality wish to aid the nation to develop the education and skills set for the blue economy; it could work with the Maritime Cluster and other training/education centres for facilities and programmes to support the curriculum. This provides additional value chain opportunities to exploit the economic potential value of existing and future maritime education and training facilities for the blue/ocean economy. Additionally, it could work with these maritime education institutions to create more foreign student halls of residence (public/private) and visiting staff accommodation as student lifestyle villages to capture the local and international regional market.

Table 3.18: Maritime Education and Training Sector Employment Opportunities

Lecturers/Academics/Researchers	Hosting Conferences and Events
Administration, HR, Logistics, finance, other staff	Repairs, gardens/grounds and maintenance
Providing catering, stationery, tools, equipment	Entertainment, Culture, Insurance, Security, IT services
Student halls of accommodation, shopping,	Simulators, Electronics; plumbing etc.
Medical services	Consultancy
Sport	Technicians, Artisans
Legal -patents etc;	Student enterprises and other spillover economic activities from pilot research projects etc.
Workshops, training and other courses	Supporting Alumni visits

Time Frame: 4-6 months for the prefeasibility study. 0-2 years for the preliminary reports, designs and approvals, 3-5 years for construction and implementation

3.5.14: Marine Manufacturing and Industry: -Establishment of Marine Biotechnology Research Facility and Processing Incentive Zone

Figure 3.49: Marine Biotechnology Centre and Great Barrier Reef

Source: www.futurebrahmapur.com

Source: Great Barrier Reef -Self.

Project Description/Overview

The municipality or local small harbour/marina authority could provide specific marketing and other incentives to concentrate marine pharmaceuticals, cosmetics, nutraceuticals, biotechnology areas as an emerging opportunity in a research centre, science park, laboratory testing facilities and subsequent industrial development/free trade processing zone with logistics distribution network; to develop commercialised products. This also entails the establishment of specific marine ecological sanctuaries or reserves to preserve existing marine biodiversity and species. It would entail cooperating with other institutions to provide/establish suitable reserves, research, training and materials to support this for long term sustainability of the blue economy, replenishing any species used in testing or commercial production. It would mean linking it to local medical centres, pharmacies and other stakeholders to develop suitable, adequate testing of any innovations or discoveries on volunteers. It includes the development of databases and protected sanctuaries (volunteers, drones etc) to test all applications of each aquatic species for possible potentials.

Linkages to the Blue Economy

Developing this sector could support marine and coastal tourism through assisting reserves, aquariums/marine centres. Guided tours could offer tourism opportunities. It further strengthens possible support for the development of marine ecological sanctuaries -those to preserve species in their natural habitats and those to consider the implications of artificial conditions and environments. This provides a direct commercial market or applications from the development of aquaculture species and value chain products. It provides more employment opportunities for maritime education and training graduates along with other spillover externality benefits from increased research. Installations could be powered by various marine

renewable energy components. The assemblage and construction could support maritime industry and associated supply chains along with interdependent logistics, port and shipping/intermodal transport stakeholders from marketed commercialised products and services. Further prospects also exist for the drone industry needed to adequately protect and monitor the species and sites from poachers, environmental-climate hazards and other prospective risks.

Benefits

This report subsequently recommends the small harbour authority/municipality can further assist the development of this sector through maximising awareness, funding, training, a legislative framework conducive to facilitating employment, income, tax and rates revenue, customs, imports, exports, transhipments, and otherwise supporting the following Table 3.19 sectoral job opportunities. Certain other benefits exist from research, development and subsequent commercialisation. It includes providing income to potential volunteers from less advantaged homes both to experiment products and in the sustainable harvesting of various resources and inputs needed (i.e. aquaculture). Individuals could gain improved health, diet and psychological benefits (cosmetics etc), enhancing welfare and economic productivity. Ecological externality benefits exist from conserving species diversity, bioremediation and marine ecological rehabilitation. Other options exist for volunteer scouts and rangers to assist in conservation and learn more about these various areas with social benefits from increased youth participation (i.e. for example expand the sea scouts volunteer initiatives). It is recommended to consider equivalent marine biotechnology parks being evaluated, considered or established in Europe such as Spain's Sirens Reef National Park, Brazil's Manuel Luis Marine State National Park, India's one in Andhra Pradesh, Hawaii's Ocean Science and Technology Park and Mauritius.

Table 3.19: Marine Biotechnology Employment Opportunities

Hydrographic surveyor; geoscientist; Electronics	Intermodal transport and storage, ports, bioprospecting
HR and Recruitment, Procurement, Administration	Medical, Health and Safety including Volunteers
Marketing, Distribution and Logistics, IT, Software/Simulations, Environmental Monitoring	Education, Training, Testing, Research and Development, Lab Technicians, Chemists, Pharmacists,
Aquaculture -as per previous table, Vets,	Pharmaceuticals, Cosmetics, Gene therapy, Genetics
Wholesaler, Retailer, processing	Biotechnicians, Biologists, Psychologists, Biochemistry,
Drones, diving, inspections	Banking, Insurance and finance
Servicing and repairing equipment/infrastructure	Value added products, Nutrition etc. Nutraceuticals,
Fermentation and process; cell and tissue biotechnology	Marine ecological capital reserves, blue carbon bonds
Nanobiotechnology, Bioinformatics, Bioweaponry,	Biofuels and electricity, Biomimetic and biomaterials
Bioremediation, Marine Ecological Restoration	Microbial Enhanced Oil Recovery, Chemicals,

Source: This Study:

Time Frame: 4-6 months for the prefeasibility study. 1-2 years for the preliminary reports, designs and approvals, 2-3 years for construction and implementation

3.5.15: Marine Renewable Energy Pilot Projects, Research Institute and Processing Incentive Zone

Figure 3.50: Marine Renewable Energy

Source: www.marei.org.ie.

Source: offgridenergyindepedence.com

Project Description/Overview

The project would work with various small harbour and marina stakeholders and others to provide a marine renewable energy research institute and power station testing facilities involving wind, wave, currents, solar, tides, ocean thermal energy and other prototype onshore and offshore facilities. It would consider experimental shore-based connections and various applications including potential testing and a free trade incentive/export processing zone for various opportunities. It would extend to specific careers guidance via the Maritime Cluster and targeted support to aid entrepreneurs to contribute towards initiatives.

Linkages to the Blue Economy

Guided tours and direct observation of the marine energy research centre and various installations could provide a minor benefit for various cruise, marine and coastal tourists including attracting other African and international researchers. Providing these facilities could directly benefit the provision of electricity to power marine biotechnology, aquaculture sites and ferry services. Connections could aid vessels in port or outside anchorage, awaiting entry into the marina or port. The assemblage, maintenance and development of technology, devices and physical infrastructure could further stimulate marine manufacturing and local industry. It should further stimulate related maritime and marine related employment for graduates of education/training/research centres. Offshore ocean governance prospects for maritime drones will provide further opportunities and linkages to support the progress of the area's blue economy.

Benefits

As with the other value proposition opportunities, various myriad employment and economic opportunities exist, as summarised in Table 3.20. It would further assist nations in efforts to ensure an environmentally sustainable and energy secure source of generating electricity, given emissions, pollution, fluctuating unreliability and instability of alternatives. It aids social service delivery of essential services. It would provide significant social, environmental and health benefits, given high pollution levels of substitute sources, gaining the endorsement of community support. Improved electricity access and security would improve reputational, marketing and adverse psychological risks that has consistently hindered foreign direct investments, the expansion of industry, shipping, logistics supply chains and economic activity. It is recommended to consider

equivalent marine renewable energy prototype facilities and installations being evaluated, considered or established such as Ireland's Marine Renewable Energy Institute, Hawaii's US Navy Energy Test Site, sites in Washington, Oregon and Cape Cod, Fabtest in Falmouth harbour, Singapore, Malaysia and Japan.

Table 3.20: Offshore/Marine Renewable Energy Job Opportunities

Drilling/energy/mining engineer; geologists, geochemist	Vessel repair and maintenance, tugs and barges
Construction of tidal, wave, wind, solar, current, thermal energy conversion and other energy types infrastructure, vessels, offshore platforms, tidal stream devices	Equipment -pipes, drilling, tools, lubrication, paint, spools, wind tensioning cables, turbines, various sensors, installations, operations and maintenance
Hydrographic surveyor; geoscientist; Electronics	Intermodal transport and storage, ports,
HR and Recruitment, Procurement, Administration	Medical, Health and Safety
Marketing, Distribution and Logistics,	Seafarers, Officers, Shipping, Training, Testing
IT, Software/Simulations, Environmental Monitoring	Deployment, Recovery and Monitoring, Array Design
Security, Legal, Environmental, Insurance,	Technology, Technicians, Research and Development
Drones, diving, inspections, ports, shipping	Catering, entertainment, bunkerage services
Subsea and pipeline engineers, Electricians,	Refineries, petrol stations, pipelines, processing, retail
Banking, Insurance and finance	Desalination plants; Salinity gradient technology;
Hydrodynamicists, Sales managers,	Oceanographers, Riggers, pipe fitters and wielders

Source: This Study:

Time Frame: 4-6 months for the prefeasibility study. 1-2 years for the preliminary reports, designs and approvals, 2-3 years for construction and implementation.

3.5.16 Aquaculture and Fisheries: KZN Aquaculture Hub, Research Centre and Processing Incentive Zone

Figure 3.51: Small Harbours and Aquaculture

Project Description/Overview:

For aquaculture, the Municipality or small harbour authority could identify local and existing sites potential for seafood, seaweed and other aquaculture including inland dams, rivers, coast and oceans. It could work with various stakeholders to develop prototype farms, a research centre and aquaculture incubation/innovation hub for the most promising and interested entrepreneurs and priority customs, free trade and industrial processing/beneficiation. Examples include fish feed production. Other opportunities include fish medicine,

physical equipment, technology, services and chemicals. The Maritime Cluster and associated stakeholders could also particularly focus on career guidance, network establishing and support.

Linkages to the Blue Economy.

This initiative directly links to developments in aquaculture and fisheries but also supports the blue economy area of marine manufacturing and industry based on the produced products. Fixed project costs offering value chain opportunities for small and medium enterprises in the production process outlined possibly include the physical land, construction materials, buildings with moorings and walkways, initial technology, equipment, transport, fuel, records, stationary, postage and capital costs. Equipment may include freezers, sorting tables, tools, aerators, harvesting, storage, monitoring, evaluation and pumps. Variable costs are conditional upon costs of initial fingerling, feeding stock, nutrients, packaging, chemicals/drugs to preserve health, those relating to water, electricity; insurance; security, storage and safety along with marketing, research and development costs. Aquaculture also has potential research advantages to contribute to knowledge in; ecology, health, nutrition; maritime; climate change to specialise in indigenous species; expand technology and experience. It offers marine education and training graduates. Specific skills and training that aquaculture could potentially provide include asset fixing, repair, maintenance, construction, nutrition, aquatic/human and environmental health, promote rural soil, water, afforestation, conservation, water/resource/ecological conservation, plus general management, marketing and business skills. This can provide a source of recurrent employment for unskilled labour with little mechanisation or formal education required for many projects and production/processing stages. Another potential advantage includes tourism for rural tours of projects/cafes including minibuses to convey people from urban centres, combined with other rural visits as a tourism tour opportunity. Commercial aquaculture products for sale could be sold retail as gifts such as pearls and jewellery from oysters, chutneys/spreads. It can further support ferries and the boatbuilding/ship repair sectors for those situated in the ocean. Aquaculture could also be powered by marine renewable energy. It can provide sustainable inputs for marine biotechnology while, reducing pressure on wild fisheries and marine ecological reserves.

Benefits

There are significant advantages to aquaculture as a sustainable future for agriculture and over wild fisheries. It can lower consumer prices/production costs compared to wild fisheries; facilitating local trade, incomes, economic development; employment; training and work experience, saving and investment. It reduces environmental and market failure externality costs. Aquaculture also has potential to improve food security and satisfy emerging market demand against a significantly expanding global population. Currently, South Africa lacks product variety with limited existing consumer sovereignty choice despite reasonable local and Asian demand for trout, other luxury fish and abalone all worth a minimal $25-$50 per kg based on price, taste size, colour and production cost. Allowing aquaculture would discourage poaching of wild stocks from lower prices and increased supply. The other economic possibility is to export indigenous species upon which South Africa has a comparative advantage from aquaculture stock such as kabeljou, abalone, yellowtail and kingklip, Market potential exists in establishing a reliable supply of related seafood, cosmetics, seaweed, pharmaceuticals, fish oil and fishmeal to deal with a projected 8.6 billion people by 2033. State provision of school, hospital and prison meals offers a ready, captive market. Social advantages could include crime and poverty reduction for those employed and economically dependent but also lower food prices for consumers. There are also certain health advantages. It is recommended to consider equivalent aquaculture facilities being evaluated, considered or established e.g. Namibia, South Africa, Lake Malawi, Lake Victoria and Kenya. Other facilities include Tasmania and Southeast Asia e.g. Vietnam, Indonesia and Thailand.

Table 3.21: Aquaculture/Fisheries Sector Employment Opportunities

Input/Stocks e.g. hatcheries, Feed, supplies, transport, fuel, records, and other equipment/services. Equipment may include freezers, sorting tables, tools, aerators, harvesting, storage, fishmeal, fish oil and pumps.	Producer/Production Processes (pond, ranch, tank, aquaponics and cage), fertilising/monitoring, land, stationary, postage construction materials, buildings with moorings and walkways; stimulating real estate; Labour, Capital, Technology
Species maturing and fish husbandry; Vets,	Cultivation and harvesting stages, packaging
Storage/Processing	Education and Training; Research, Technology
Marketing/Distribution Logistics, Insurance,	Design and construction, engineering Security
Retailer/ -shops, Wholesaler	Recreational and game fishing/tourism and events
Restaurants, Cafes	Marine Ecological Capital -Blue Bonds
Ornamental pet fish, Aquariums and Tourism/tours	Jewellery cosmetics
Value adding beneficiation e.g. cans, ready meals	Marine biotechnology; dieticians, medical,

Time Frame: 4-6 months for the prefeasibility study. 1-3 years for the preliminary reports, designs and approvals, 2-4 years for construction and implementation.

3.5.17: Ocean Governance and Defence: KZN Drone Port and Distribution Network

Figure 3.52: Small Harbour Drone Prospects

Source: Rwanda Drone Port.

Project Description/Overview

Following the 2015 example of Rwanda, the municipality or small harbour authority could investigate the blue economy value proposition and business plan/feasibility study of the establishment of a drone port testing facilities, airfield, humanitarian and cargo logistics hub, warehousing, manufacturing industry processing facilities and equivalent free trade zone with financial and other incentives. This could encapsulate the Innovation Hub and a specialised drone research centre with connections to the current drone industry. For example, as in the main report, future research could investigate amphibious capacity, biological propulsion, minimal electricity, renewable energy, sensor fusion, hover to sea and hybrid AUV-ROV capacity operating 24/7. Physical UAV, UUV's and USV systems require similar physical characteristics, networks, supporting infrastructure and personnel, irrespective of mission objectives. Each requires the vessel, ground based operators and communication/information processing network with control, navigation, recovery and launch capabilities. Data requires modems, transmitters and amplifiers, satellite, fibre optic or other communication equipment. It's also advantageous to have transportability, fuel and maintenance/spare parts access where

possible. Transponders assist aerial safety, with voice relays to airspace users. Real time data for more accurate responses rather than delayed reactions enables missions to be updated, revised and reprogrammed/re-planned. For fisheries monitoring, equipment needs synthesis with vessel monitoring systems, Automatic Identification Systems, IT software, Internet and satellites to provide effective ocean governance and enforcement. This extends to information sharing and cooperation with registered users. Therefore, a drone industry would need access to maritime and other data.

Linkages to the Blue Economy

Developing a drone industry can aid in the secure protection of marine biotechnology, ecotourism and other reserves; inspection and security of offshore marine renewable energy facilities and the continued maintenance and repair of ports; shipping and various coastal/logistics assets. Climate, climate change and environmental risks can be monitored and ocean floating structures, fisheries and aquaculture. Comparatively few places offer related education and training for drones. As demand expands; this report advises the opportunities to create specialised schools and drone ports, especially in aviation, related electronics, technology and manufacturing/repairs, capable of recruiting from across the continent. Drones offer the potential for effective ocean governance in education and research through the ability to understand ocean processes and respond accordingly. Future drone research opportunities exist for based drone companies from renewable energy and greener vessels to underwater robotics to, photography, surveys and software. Drones are also becoming popular for tourism and recreation and have marine/coastal applications given many restrictions presently existing under Civil Aviation Authority regulations in flying them within 10 kilometres of an airfield or over a significant number of people.

Benefits

Aside from various socio-economic opportunities deriving from Table 8 employment options, drones can monitor emissions and improve the observation of environmental, trade, security and health laws, helping to internalise and identify localised, adverse externality costs; given scarce and few enforcement resources; with high monitoring costs. Component redundancy, miniaturisation, nanobiotechnology and biosensors enhance drone potential to conduct underwater human and ecological asset surveying as another specialist area. 2,000-3,000 wrecks could offer treasure troves, historic answers, species' homes or ecotourism and recreation opportunities but only if drones supplement human capacity to examine, record and defend underwater cultural heritage, whether for existing or new wrecks. Drones could assist myriad other research missions both for locals and any external organisations seeking to conduct research in Africa. Existing sensor networks could be expanded to cover the South Atlantic, Indian and Antarctic Oceans. A mere 3000 floats exist for Global Ocean Observing System Argo. These could assist SAMSA in monitoring marine pollution, damaged vessels and other incidents; the South African Weather Service and local municipalities for storms, other weather and climate related, natural disaster phenomena as an early warning system; to ensure minimal disruption risk. Drones can assist with marine archaeology, tourism and conservation from conditions of floating museum ships to wrecks, port infrastructure, pipelines and aquariums. Developing drones could also aid in overcoming post issues including delivering messages and cargo out to anchored yachts, fishing boats, shipping, oil rigs and marine renewable energy platforms. It is recommended to consider equivalent general drone industries in South Africa along with specific maritime drones being evaluated, considered or established. Examples include Denmark, the UK, France and the USA.

Table 3.22: Maritime Security/Drone Industry Sector Employment Opportunities

Pilots, electronics industry, technicians, photography,	Design and construction, value adding, tools
Payload and remote operators, weapons specialists,	Those in operations, maintenance, repair and upgrade
Electronics, engineering, metal fabrication	Data processing analysts and IT
Drone port operators; training, legal	Sensors and precision components; telecommunication
Marine, aerospace, security, insurance, research,	Materials, Paint,
Surveying, consultancy, logistics	Law Enforcement, Anti-Poaching
Testing Facilities; Simulators	Marketing; Research and Science
Medical -Nurses, doctors, psychologists	Nanotechnology, biotechnology; security

Time Frame: 4-6 months for the prefeasibility study. 0-1.5 years for the preliminary reports, designs and approvals, 1-2.5 years for construction and implementation

5.5.18: Marine Ecosystem Protection and Ecotourism/Recreation: Marine Ecological Sanctuaries

Figure 3.53: Blue Carbon, Marine Ecosystem and Blue Economy Resources

Project Description/Overview

This section recommends small harbour authorities, municipalities or other stakeholders could provide marine coastal reserves and sanctuaries, banning fishing and local boats to replenish existing fisheries as no-take areas for blue carbon reserve sinks for climate change mitigation and to preserve biodiversity. Parallel marine protected areas would produce sustainable sanctuaries to provide inputs for marine biotechnology, aquariums and aquaculture. Other reserve areas would include wrecks, diving and other marine eco-tourism opportunities such as submarines, underwater art galleries and museums. They Municipality could work directly with local communities, tourists, businesses, various stakeholder and provincial/national governments to extend its bylaws and capacity to monitor/supervise and protect marine coastal and offshore protected areas.

Linkages to the Blue Economy

The development of marine sanctuaries and associated related activities directly links to the blue economy initiative to facilitate marine and coastal tourism. It also provides sustainable blue economy sources of reserves and inputs for aquaculture, fisheries and marine biotechnology. Eventually, this subsequently

supports other supply chain activities from products and services demanded by additional tourists and maritime industry/value added products. It also offers opportunities to improve coastal and ocean governance through the need for additional drones, supervision and enforcement reserves i.e. volunteer rangers and ferries. It also extends marine related education and training opportunities to secure the ecological reserves and tourism. Facilities can also be powered through marine renewable energy.

Benefits

Direct and indirect economic multiplier benefits will materialise through the outlined employment prospects in Table 3.23 and other emergent opportunities. Ecological externality benefits exist from conserving species diversity, bioremediation and marine ecological rehabilitation. Benefits exist in climateproofing ports, coastal communities and infrastructure as marine ecological rehabilitation has been identified as forming among the most significant physical resilience barriers against climate related natural disasters. Other options exist for volunteer scouts and rangers to assist in conservation and learn more about these various areas with social benefits from increased youth participation (i.e. for example expand the sea scouts volunteer initiatives.

Table 3.23: Potential Marine Reserves Employment Opportunities

HR and Recruitment, Procurement, Administration	Volunteers, Rangers
Marketing, Distribution and Logistics, IT, Environmental Monitoring	Education, Training, Testing, Research and Development, Lab Technicians, Chemists,
Diving, surveyors, salvaging, Vets,	Ferries, Refreshments, Gifts, Toys
Tourism -guides, marine archaeologists	Biotechnicians, Biologists, Psychologists, Biochemistry,
Servicing and repairing equipment/infrastructure	Value added products, Nutrition etc. Nutraceuticals,
Bioremediation, Marine Ecological Restoration	Marine ecological capital reserves, blue carbon bonds

Time Frame: 4-6 months for the prefeasibility study. 1.5-3 years for the preliminary reports, designs and approvals, 1-2 years for construction and implementation

It is recommended to consider equivalent marine sanctuaries or parks being evaluated, considered or established such as the Seychelles, Caribbean, the Marae Moana in the Cook Islands, the Great Barrier Reef National Park, the Coral Sea, Réserve Naturelle Nationale des Terres australes françaises and Ross Sea among others in Antarctica, Papahānaumokuākea Marine National Monument in Hawaii and Parc Naturel de la Mer de Corail in New Caledonia. For wrecks and diving examples could particularly focus on the Caribbean. The Maldives, Cancun in Mexico, Baia Underwater Park in Italy, Herod's Harbour in Israel and Lanzarote have their own underwater art galleries and museums to inspire the local municipality or small port community or Australia's Great Barrier Reef.

3.5.2: COVID 19- and Other Pandemic/Epidemic Opportunities

As previously stated, although an epidemic can create risks of quarantine and reduced tourism from lockdowns and other travel restrictions immediately during an event; this research's updated and unique research contribution is to recognise the potential for small harbours and marinas during the COVID-19 pandemic and other epidemics threatening public health. For example, as imports decrease; food security

and pharmaceuticals become even more essential; offering prospects for fisheries, aquaculture and marine biotechnology including food and pharmaceutical products. These offer alternative processing and port of entry facilities, smaller and safer, with fewer movements of people and cargo, simpler to monitor. This research previously indicated the desire for a refuge for many travellers who wish to use their yachts to be physically safer or if they cannot travel from conventional cruise vessel, ferry and harbour restrictions. The greater the number of commercial port restrictions, the more open the opportunities for alternatives. The various financial incentives could be restructured and targeted towards smaller harbours and marinas. Ultimately without being dominated by China, EU and US exports and trade dumping; domestic companies across the world may assist in the need for greater anti-globalization and domestic economic autarchy, facilitating substitutions in local investment, consumption, demand and employment. Certain supply chains may benefit with shipping companies that are prepared to face the significant range of cargo restrictions and ports; whilst ports and companies that are more resilient or able to adapt swiftly, can profit from trade expansion and diversion.

Various stakeholders including the World Health Organisation, International Maritime Health Association, IBIA, International Chamber of Shipping and the IMO have published website advice relating to addressing the COVID 19 catastrophe since it was first diagnosed in Wuhan on 7th January. These focus on port screening, sanitation and health awareness/quarantine, outbreak management plan and public health information processes. It incorporates advice on Hygiene Measures for Seafarers on Ships, Managing High Risk Exposure, Case Handling, Isolation and Cleaning, Disinfection and Waste Management. The International Chamber of Shipping also includes posters which can be printed out and placed onboard ships as well as a Sample Pre-Boarding Passenger Locator Form and a WHO COVID-19 Support and Logistics Supplies List. The International Maritime Health Association also advised against resupplying of fresh seafood, meat and groceries from China since the 14th January. A 14 day quarantine period at many global ports places unprecedented impact costs across maritime supply chains, especially for more time sensitive cargo. Crew cannot be replaced and mandatory port health screening is intensified. Singapore, Kuwait and Indonesia have restricted crew, passenger and vessel arrivals from China, France, Germany, Iran, Italy, South Korea, Thailand and Spain in the past fortnight. Other countries such as Portugal have exemptions for local citizens. 40 South Africans were quarantined onboard an MSC vessel calling into Durban port. The MSC Orchestra only managed to sail and return when it changed its intended Pomene Mozambique port destination to 5 days at sea. Malta have had crew from infected countries as restrictions since 24th February.

Since the 15th March, the entire Philippines, Netherlands, France, Spain and Italy have all been under quarantine. Argentina extended the ban to the US, Japan, UK and European Union. Israel, India, Taiwan and other nations have banned those entering from China. Australia, South Africa and other nations are restricting entry to those undertaking 14 days quarantine. Bangladesh has banned those from the European Union and China. Bulgaria, Cyprus and Cameroun favour quarantine. The Dominican Republic have banned cruise vessels and flights for a month from high risk areas. Gabon has restrictions for 24 high risk countries. Aside from essential services, Iraq has imposed a curfew on people's movements since 17th March. Malaysia imposes the need for sanitizers, gloves, face masks and other equipment for companies still operating. Panama has suspended air travel from Europe and Asia. Papua New Guinea have suspended crew changes. Saudi Arabia only allow voyages and air travel related to cargo, trade and evacuation of citizens. Yemen has closed borders, except for humanitarian and aid but is far from self-sufficient.

Chinese coronavirus stimulus measures include 156 billion euros in direct support along with customs and trade exemptions for core US imports such as agriculture equipment, food and medicine. Potential suggested solutions include minimising risks to various impacts such as human labour; transport routes, customer demand; supply; information; needing proactive risk management and emergency operations centres/coordinated focal points with designated responsibilities throughout a supply chain. It includes identifying risks to ach supply chain stakeholder. The need for reserves, redundancy and back up plans or strategies remains essential for COVID 19. The need for more local supplies is recommended to be available. Stakeholders will experience increased need for automation and technology; less physical access to staff as many move home and restrictions for ports and intermodal logistics, curtailing flexibility and efficiency. Greater transparency over supply chain processes and information sharing may be needed to stop speculative buyers from impulsively hoarding. In extreme cases such as Australia and the United Kingdom, nations may even have to introduce rationing. The National Health Service has shops in England opening an hour early just so emergency workers can in fact get access to the basics. Many legal contracts also have to keep being reformulated given uncertainty of the coronavirus for the force majeure clause.

In response nations such as the UK are offering a 350 billion pound direct financial support, loan extensions and a 12 month tax holidays for the airline, hospitality and other industries, especially small businesses although uncertainty exists as to eligibility and access criteria among myriad stakeholders. UK solutions

include a small and medium enterprise sick pay package and business grant funding for rate or rural rate relief. It includes grant funding of £25,000 for retail, hospitality and leisure businesses with property with a rateable value between £15,000 and £51,000. It extends to the Coronavirus Business Interruption Loan Scheme to support long-term viable businesses who may need to respond to cash-flow pressures by seeking additional finance along with the HMRC Time To Pay Scheme to help with tax. In Australia citizens will be able to access their superannuation or pension funds without penalty at an early age and the Prime Minister Scott Morrison announced a $17.6 billion stimulus package. Government bonds are receiving higher support and demand, given global Reserve Banks are heavily penalising depositors. The Australian government have prompted the banks to offer $ 8 billion in support to small businesses. Certain of these resources may indirectly have potential to benefit smaller economies.

3.5.3: Digitisation, Technology and the 4th Industrial Revolution

Globally the presence of increasing technology and digital disruption offers unprecedented techniques to assist small harbours and marinas including upgrading port equipment and increasing service connectivity. It extends to utilising drones and robotics for improved asset maintenance and risk management along with improved ocean governance, monitoring and resources. The Internet of Things and increased sensors could monitor and process data related to safety, security, environment, trade and business processes with real time situational awareness and predictive heuristics of possible risks. Other examples include social media, Drone deliveries, robotic sensors, Internet of Things, Big data and quantum cloud-based storage holograms, augmented and mixed Virtual Reality, digital immersion and sensory isolation from reality, AI, nanotechnology, biotechnology and cybernetics and others reflect just a few trends with possibilities. It includes blockchain technology to reduce physical vulnerability of a single data storage and enhanced cybersecurity.

Individual technology can aid marinas, small ports and MSC's against specific risks, re-engineered against projected sea level rise and utilising nano/biotechnology via algae/seaweed and other based processes for more resilient vessels from higher global land, ocean and air surface temperatures. Each technology trend also provides greater capacity for emerging profitable cargo such as for nanomaterials, nano and biotechnology, robotics and customised goods from 3D printing. Effective drone deployment can facilitate governance through overcoming existing infrastructure constraints and failures. In 2015 Rwanda became the

first global nation with a civilian Droneport specifically devoted to humanitarian and other logistics from medicine to postal deliveries, electronics and commerce. This could counter poor historic records of postal and other forms of postal delivery for urgent, expensive, fragile and remote destination cargo, if effectively secure against theft, cybersecurity, sabotage and other risks. Drones could resolve poor roads and other infrastructure conditions. In 2016 Rwanda partnered with Zipline drones for medical deliveries and GAVI/Vaccine Alliance for vaccine and medicine delivery to rural clinics. An $800,000 UPS Foundation grant will establish 21 blood transfusing centres. The drone port aims at over 100 deliveries per day for a 120 kilometre radius.

Biomaterials can also be utilised including collagen nanofibers extracted from hoki skin for cosmetics and air ventilation filters. Japan produces biogas electrical energy with algae and waste water. Korea use red seaweed. Malaysia and Indonesia devised algal systems via photobioreactors for biofuels, waste water management and CO2 sequestration. Singapore use sponges to purify wastewater. Macroalgae and seaweed has been suggested for multiple uses including carbon sequestration, energy, food, fertiliser, pharmaceuticals, cosmetics, oxygen production, fertiliser, fish feed, nutrient uptake and other purposes. It can provide biofuel, biodiesel, bioethanol and biomethane. Algae produces up to 10,000 gallons of oil per acre compared to 18 for corn, 48 for soybean, 102 for sunflower and 635 for oil palms. Mussels have also been suggested for nutrient uptake, textiles, energy, feed, fertilisers and nutrients. Reeds have also been suggested not only ecologically but for energy, construction materials, nutrients and effluent/water purification treatment, tourism, boats and protection against coastal erosion. Brazilian microalgae have laboratory evidence for effluent cleaning. Jellyfish also possess biotechnology prospects and are envisioned to multiply under climate change conditions globally. China also utilises seaweed and other textiles to produce protective, biodegradable fishing gear from seaweed.

Implications for emergent risks include reducing the time taken to recover from a risk event from greater blue economy opportunities and increased profit margins for more efficient vessels with greater cargo storage capacity and optimised fuel performance. Other environmental applications for marine biotechnology, drones and robots include coral reef restoration and bioremediation processes for polluted coastlines, oceans, waterways and oil spills via nutrient additions and manipulating of organisms/processes. This risk exceeds over 1.3 million tonnes of marine pollution just from oil spills on average each year. The prime aim is to manipulate at a molecular, cell and organism level to ensure or accelerate biodegradation of polluting

particles. This research echoes EU maritime transport policy objectives in emphasising these trends aid with competitiveness, decarbonisation and digitisation via diminishing emission, energy/resource consumption, carbon footprints and emissions. Economically it empowers the green/blue economy via opportunities for logistics and a source of eco-sustainable electricity from marine renewable energy sources, LNG, biofuels and alternatives. Determining the extent to which any of the aforementioned technology trends are worthy of investment will be measured by performance criteria to costs, efficiency, performance, resilience and vulnerability.

The 2016 World Economic Forum viewed digitisation benefits as worth US 1.5 trillion by 2025, with predictive analytics swiftly accelerating in usage to assess market demand, supply, bookings, vessel deployment, routes and management. It argues benefits of electric battery port equipment and vehicles; telematics for fuel, health and safety management plus dynamic scheduling. The EU have created a harmonised electronic cargo declaration and e-Manifest. Singapore, Rotterdam and other ports have devised a Port Community Management System to try and coordinate a single source for data submission to save time, resources and physical paper risks. Blockchains, telematics and the Internet of Things provide the need for reduced paperwork, optimised vessel and berth usage and reduced idle-deadweight capacity across intermodal transport. Small harbours, marinas and dependent supply chains or blue economy activities may gain from greater use of e-ecommerce platforms and digital container tracking platforms. The Internet of Things, divided into operational or physical and information technology; requires the capacity to process “Big Data,” often stored not only on individual computers but via an online “Cloud” or series of “Clouds” remotely. The aim remains to minimise disruption time, maintenance and fuel or energy inefficiency costs via enhanced remote sensors. This can extend to risk events via greater sensory awareness and ability to diagnose or forecast potential risks along with asset lifespan available. Examples can assist vessel warehouse and shore logistics cleaning, upgrades, coordination of cargo operations, improved safety and optimised performance, whilst simultaneously reducing adverse externality/environmental costs. Blockchains can ensure commercial smart contracts, protect documents and offer flexible payment options via cryptocurrency. It reduces congestion and cybersecurity risks with less altered or lost data, reduced fraud and greater traceability. Blockchain can aid consumers to identify origin and more product information for ethical consumption; digital signature security, data transparency, verify smart contracts and property rights. It can aid customs, many of which are still operating manually globally. One prototype application included protecting information among a

pharmaceutical supply chain with over 1500 transactions per second and over 7 billion unique serial numbers. It reduces each supply chains' waiting time via instant confirmation of arrival

Small harbours and marinas may be able to fabricate specialised components through 3D printing for those based in remoter locations such as Canada The Global Ghost Fisheries app enables reports of any abandoned or lost assets or gear that would threaten conventional fisheries, aquaculture and marine recreation or other activities. Other apps, satellites, drones and sensory monitoring can improve safety, security from crime, reduce poaching, pollution spills and observe climate or the environment more efficaciously. Locals may not only gain directly from improved technology efficiency it can be utilised to aid local productivity inn fisheries, aquaculture and other activities along with improved quality of life and ecosystems indirectly or potential in servicing technology and other upgrades.

3.5.4: The Circular and Green Economy

Small harbours and marinas can increasingly remarket themselves to be far more ecologically sustainable and efficient then at present, compared to many of their larger, more commercial competitors as examples of best practise worth emulating. Examples of eco-efficient ports are highlighted in Table 3.24 and proposed pricing mechanism incentives are provided in Table 3.25. Given increasing global concern towards the adverse environmental and other externality cost implications of small harbours and marinas, this source urges the need for these to participate in the circular and green economies as fundamental to becoming a part of the blue economy. Certain principles including enabling stakeholders to minimise waste, water, carbon and ecological footprints as possible, recycling and reducing as much as they are capable of. It should endorse a lifecycle based approach throughout all phases from planning to construction and execution to operation to decommissioning and repurposing. Stakeholders could also consider investing in the circular economy and prioritise solutions towards marine waste reduction and recycling including strategies as in Table 3.26. This includes minimising all section 3.4 and 3.5 risks as much as necessary.

Table 3.24: Suggestions for Eco-Efficient and More Sustainable Ports

Port	Solution	Relevance
Belfast	• Preservation and extension of open space networks for community use/ offset emissions	• Integrate open space panning for port and Back of Port development
Bristol	• Port electricity is provided since 2007 by 3 wind turbines at Avonmouth Dock. Each produces 2 megawatts - 75% total of port needs, saving 15000 tonnes of carbon emissions per year	• Renewable energy would reduce emissions and ensure a reliable electricity source
Bristol	• Bristol has strict policy measures for resource use ○ Energy is used with optimum efficiency –low energy lightbulbs, photocells, self-contained wastewater and water recyclers at port, drainage and waterways are monitored. ○ Redevelopment of decrepit brownfield over greenfield sites (conserved as carbon offsets) • Materials from demolition work are partially recycled ○ Only timber from renewable sources is used • SUDS-Sustainable Drainage Systems are installed to improve water quality • Over 70% of vessel and port generated waste is recycled. Employees are trained to recycle – used motor oil, paper, print cartridges etc and favour environmental charities	• To ensure emission and waste reduction plus renewable energy as mandatory – part of port lease for port facilities and Back of Port area • To utilise existing /port infrastructure and recycle where possible
Darwin	• Port authority monitors effects of port on local ecosystem	• Little or no monitoring takes place and is necessary to reduce externality effects of impact, understand environmental state
Kaohsiung	• The port authority has required and established a recycling process for all port users/ local community	• This minimises waste and related pollution.
Rotterdam, Antwerp	• For areas of ecological sensitivity, ecological loss has to be offset by greenfield sites established elsewhere • At Delfland, a 23 hectare foredune was created as a flood/ climate change barrier • 35 hectares of dunes/reserves were created to offset potential effects on existing reserves. • A 25000 hectare sea bed marine ecosystem reserve at Maasvlakte II was created to offset losses to North Sea ecosystem.	• Ecologically sensitive areas need protection
San Diego	• San Diego port is working with its Zoo to establish home reserves/ breeding sites are conserved/ established for affected species	•
Sydney	• The Sydney Ports Corporation have prepared a document on minimising waste use for employees, tenants, port users and businesses related to the port – part of lease/tender policy	•
Sydney	• As part of port expansion permission, Sydney Port had to establish an “enhancement” plan for the existing Penrhyn saltmarsh estuary ecosystem	•

To favour more eco-efficient port users and marginal callers (i.e. repair, cruise vessels, hybrid powered vessels etc) and to finance the above proposals, the municipality/port authority could adopt the following 13 tools, as set out in Table 3.25 below, that are commonly utilised by other port authorities. Providing these financial incentives to encourage more environmentally-sustainable practises/vessels for ship traffic, cargo handling and stowage, intermodal connections, industrial activities and throughout designing and operating the port/ back of port development process can further assist port authorities to improve the environmental quality of life. Imposing fines and penalising those inefficient/higher polluters can assist in mitigating the corresponding environmental consequences of any proposed port or marina development. Consulted environmental activists and concerned community stakeholders including identified these environmental concerns as a key stakeholder priority. This might persuade more port users to perceive the value of further small harbour developments, if the related social and environmental costs are discouraged through pricing incentive mechanisms.

Table 3.25: Ecological Pricing Solutions.

Tool Types	**Penalty Pricing**	**Incentive Pricing**	**Monitoring and measuring**	**Market Access Control and Environmental Standard Regulation**
Ship's Traffic	Surcharge to docking fees	Ships meeting Environmental Ship Index scores receive discount on GT Eco-efficient vessels could receive a reduction in port dues	Ship Greenhouse Gas Emissions All submit sustainability report – Antwerp.	Sulphur fuel/ greenhouse Gas emissions cap e.g. Marpol IV, SIN – Singapore Regulations, SHA – China Regulations Regulation on oil pollution casualties e.g. IMO Intervention Convention 69 - Regulation on pollution to marine environment by vessels could be included in a co-signed agreement between shippers, terminal operators and port authority e.g. Rotterdam.
	-Fines on vessel/ port user emissions/ marine oil/ pollution spill As in MARPOL, SIN, SHA			
Cargo handling and stowage	e.g. MARPOL, SIN, SHA	Crane, vehicle and other equipment conditions, eco-fuel, renewable energy powered –part of ANT/ sustainability report	Monitoring and analysis of policy developments i.e. using AN/ Sustainability Report	- Cargo handling vehicles with sulphur fuel limits e.g. Rotterdam. - Terminal concession criterion on sustainability e.g. Amsterdam

				- Regulated operation activities
Intermodal connections	Fines and penalty delays for non-compliance using road not rail or ecologically sustainable vessels/ processes/transport	None recommended	None recommended	Agreement on Modal Shift Agreement between port authority and service providers/port users
Industrial Activities	Fines on pollution damage to the marine environment by dumping etc	Fiscal incentives – state, city or port to companies that carry out energy audits and sustainability reports - further fiscal incentives to those endorsing renewable energy/ reduce dumping/ lower pollution etc	- Quality of dock water - Oxygen and nutrient concentration monitoring - Port Authority/User Sustainability Report	CO2 emission reduction e.g. Rotterdam Climate Initiative. Regulation on Marine pollution e.g. Marpol
Port Expansion	Fines/contract cancellation of firms involved in constructing/operating including shipping that create environmental damage/lack eco-sustainability e.g. China Regulations	-None recommended	Ecological port design and construction following international examples e.g. Melbourne, Singapore.	Regulation on firms involved/port users/ community to minimise externality e.g. Antwerp Flemish Port Decree.

Table 3.26: Various Strategies and Solutions for Purging Marine Waste

Literature Review	**Opportunities -This Research**
Increased Research	Nature -climate/environment
Increased stakeholder engagement, information and awareness	Education
Cooperation	Awareness and Activism
Recycling	Technology and 4th IR
Extended producer responsibility	Biotechnology
Voluntary industry cooperation	Physical Solutions -collecting. monitoring
Surveys -quantifying the impact and extent of marine litter	Drones, Ocean Governance
Laws and policies	Law Enforcement
New recycled materials products and alternatives	Nanotechnology
Bans and regulations -i.e. plastic bags	Fiscal incentives

Source: This Study

For those who may be considered just to view nature as the solution to marine litter and pollution, it will just decay organically are deluded to consider the environment and climate will resolve the issue. I have personally experienced living in two cities in South Africa, Pietermaritzburg and Durban which are truly atrocious in their litter discarding habits where the local residents simply do not care. As with many global

residents, they think the solution will just be resolved for them. I also spent considerable time out in the South Pacific and although conscientious of the need to recycle and avoided littering; only personal awareness, experience and information really made a difference. It was only when I hiked up to the obscurity of the noted author Robert Louis Stevenson's grave up at his Valima estate up a hill in Apia, Samoa (Figures 3.54/3.55) that I encountered a sign mentioning that a single plastic bottle took over 450 years to decompose. A single plastic bag takes over 500-1000 years to decompose naturally. Glass can take 1-2 million years. So as humans we cannot expect Gaia to simply cleanse our mess for us; as perhaps possible with restoring ecosystems and ecological damage, provided further damage was not undertaken.

Figure 3.54: The Lifespan of Marine Litter Rules Out Nature Based Reduction Solutions

Figure 3.55: Sign Site, Robert Louis Stevenson's Grave Valima, Samoa

A virtual realm may reduce the need for physical components and subsequent marine pollution or destined litter for small harbours and marinas. With more usage of technology, however blue bioeconomy value chain companies will be able to focus more on quality, customised logistics and personal customer service eco-sustainability, reducing waste, pollution, carbon footprint offsetting and corporate social responsibility. It means how to process high volumes of information rapidly to extract necessary information, being updated to new events, news and threats or factors affecting performance as they develop. It means digital transformation and interaction with people -staff, customers, suppliers and others to be continuously updating, training, available and engaging with progressively shorter attention spans. Technology also means other solutions such as biotechnology and nanotechnology in generating both organic (algae, bacteria and other species) and inorganic (nanobots) to physically destroy microplastics and other marine debris. This source also considers that physical solutions will be needed such as litter traps, increased deployment of boats, drones, robots, people and technology to physically prevent more litter from simply being discharged into land and water sources. Improved waste collection and recycling infrastructure/services are necessary to pre-empt the issue and deal with the accumulated garbage extracted physically from the oceans such as cleansing the 5 Great Garbage Gyres.

Globally, drones, satellites and other solutions can support an entirely new blue economy sector industry few have formally conceptualised and envisioned as an emergent investment horizon such as increased surveys, and other needs for improved actions. Enhanced ocean governance, physical law enforcement and transboundary management along with investments in marine protected areas in which many pollution generating activities are curbed or prohibited; will assist ecological rehabilitation, eco-tourism, blue carbon financing and other opportunities. Others may benefit from various bans, fines, penalties and tax/investment incentives as chances to profitably convert towards a waste minimisation or circular/green/more recycling based economy. However, this remains conditional upon the immediate termination of subsidies and other support to the non-recycled sector industry for small harbours, marinas and the adjacent blue economy hinterland.

3.5.5: South Africa

As previously stated, South Africa's decision to invest in 3 new fishing harbours and 12 proclaimed fishing harbours (Figure 3.56) provides useful opportunities for other global small harbours and marinas to prioritise.

These harbours would benefit from many of these opportunities chronicled above. In 2012 a previous study was conducted providing a detailed socioeconomic assessment of the prospects for each existing port (Kaiser Associates 2012). However, subsequent stakeholder consultation publicly revealed that many of these projects had failed to result in the subsequent generated opportunities, yet were still relevant 8 years later. It recommends the need to consider international best practise examples and develop local value chains.

Figure 3.56: South African 12 Proclaimed Fishing Harbours of the Western Cape

Source: Kaiser Associates 2012

Therefore, this research counsels the need to preserve existing economies, ecosystems and communities, taking proactive responses to ensure viable futures where needed and demanded by markets and the communities themselves, whether in fisheries, tourism, crafts, boatbuilding or repairs. It identified opportunities as scenes for film, music, theatre, entertainment and events. The need for greater marketing and research into local heritage is needed as inducements to preserve that heritage along with the economic activities and revenue from those activities. For example, Kaiser Associates estimated aquaculture contributed over R400 million, fisheries over R3.75 billion, artisanal foods R25 billion and tourism R25 billion with boatbuilding and repair (R400-800 million), of which small harbours greatly contribute. Fishing communities could benefit from improved marketing, storage and harbours, vessel charters, supplies, events

and entertainment, crafts, tours and accommodation with enough willingness and supporting resources. This source advises greater stakeholder cooperation, coordination and mutual resource pooling as a joined Fishing Heritage Tourism route. It includes reducing procurement and other excessive bureaucracy such as securing a lease. The source advised particularly considering opportunities for women, youth, those with disabilities and naval/military veterans. It is also imperative to consider the need for opportunities or upskilling retraining for older fisherfolk and seafarers to remain inclusive and support them.

It proposes cooperating with NGO's on wildlife sensitive and ecotourism practises including reducing marine litter and increased pollution awareness. It includes marketing the marine leisure and boating tourism lifestyle to attract younger, newer generations. It even considered boats and floating barges or platforms for conferences, concerts and other events. Stakeholder consultation and community engagement remain pivotal. From the existing 2012 study it appears that entrepreneurship and initiative have been seriously undermined with minimal investment in the research, awareness and support of blue economy opportunities as potential for both local communities and from those further away. These harbours need to comply with all prescribed legislation including the Marine Living Resources Act, the linked 2004 Regulations, the 1996 Schedule 4 and the Integrated Coastal Management Act along with provincial and municipal laws and development plans but are very seldom integrated to consider all aspects.

Lamberts Bay possesses a former fishmeal and lobster packaging plant now a crisp factory and Bird Island Reserve (Figure 3.57). Although fishing has declined due to restrictive lobster permits, certain crayfish still remains active due to an annual Crayfish Festival attracting up to 20,000 tourists and certain interest was historically expressed in an abalone aquaculture farm, a "Fish and Chips" festival and markets. St Helena Bay Fishing Harbour (Figure 3.58) has a small entry fee, active snoek and pelagic fisheries and coastal tourism businesses. It offers boat repair facilities and 3 fishmeal/sardine factories but many buildings remain vacant, open to new options. It also hosts abalone and mussel aquaculture facilities. It also hosts markets, festivals and a historic trek. Issues remain over ta viable small harbour authority securing revenue from local users. Saldanha Bay offers close proximity to the commercial port of Saldanha aside from fishing and tourism. It hosts festivals and events such as sailing regattas. It offered one closed seafood restaurant but opportunities for several more plus shops, restaurants and a yachting marina that could be established near the old yacht club. The Sea Harvest Fish Processing Factory at 4000-5000 employers is one of the greatest regional employers, employing 15% of the town's employment and 10% of its GDP in 2010. Several mussels

and oyster aquaculture farms are present with a former salmon experiment trial hatchery. Opportunities exist for local museums and further species beneficiation/processing facilities including potential marine biotechnology.

Figure 3.57: Lamberts' Bay Fishing Harbour.

Source: Kaiser Associates 2012.

Figure 3.58: St Helena Bay

Source: Kaiser Associates 2012.

Figure 3.59: Saldanha Bay

Other Saldanha Bay proposed initiatives have included walking tours and a community amphitheatre. Stakeholders could reduce the extensive threats of marine pollution, converting it into biogas, bioenergy and waste recycling. Laaiplek Harbour (Figure 3.60) offers a canned fishmeal and pilchard factory, fishing vessels, takeaways, restaurants, boat repair and a private slipway. Port Owen offers a yacht marina and Pelican Harbour -community tourism. A Water Carnival and Harbour Festival exist. Limited integration exists of all three. The need for accommodation facilities has been previously identified. Hout Bay offers fishing and small

boat marina, food venues, community tours and tourism. It offers a yacht and fishing club and Duiker Island seal tourism, craft shops and market, tour operators, the Oceana fishmeal factory and boat repair yard. Rock lobster, tuna and other game fishing remains popular. Vandalism remains high along with crime fears. It offers Bike, Surfing, Sailing and Sandcastle competitions aside from markets.

Figure 3.60: Laaiplek Harbour.

Kalk Bay (Figure 3.62) includes a small craft marina, cradle and slip repair facility, whale watching tours, anchovies and snoek processing, restaurants and active if declining rock lobster and line fishing. Stakeholders previously noted the need for fishing crew accommodation, the need for deepening to accommodate yachts and for security measures to overcome crime rates. Gordon's Bay (Figure 3.63) concentrated on providing navy based facilities including the naval academy, a marina and Blue Flag beach status (Bikini Beach) to attract users. It offers a yacht club, sea rescue station, dining options and boat repairs. Stakeholders have expressed interest in a sailing school, informal trader options and youth activities as potential community uses. Events have included a Winter Wonderland Lights Festival, the Gaul Sailing Regatta, the Gordon's Bay Anchor Classic, Broadbill Fishing competition and Wine on the Water festival.

Figure 3.61: Hout Bay

Figure 3.62: Kalk Bay.

Hermanus (Figure 3.64) focus on whale watching, coastal and marine tourism. It has preserved its old Fishing Harbour as a museum and has a sea research institute facility. The bay hosts abalone ranching and aquaculture processing along with a fishmeal plant, dining, bars, shops and boat repair along with ski boat yard. It offers land and potential for arts and crafts, other vendors, sportfishing and possible yacht races. Annually it hosts Whale and Sea Rescue Music Festivals, a Wilf Flower Show, Canoe Race, Christmas Concerts and Wine, Food and Flower/Hobby Fairs. Gansbaai has old and new Harbours, and 3 abalone ranches plus a fishmeal plant (Figure 3.65). It offers chances for takeaway, café, retail, boat charter and whale watching tourism activities. In 2011 Gansbaai had one fishmeal factory supporting 597 people and R250 million to the local economy. The challenges often remain in retaining existing business enterprises as viable and ensuring lease security. Opportunities exist especially for whale watching and shark cage diving tourism. Arniston focuses on fishing, cultural heritage and tourism as among the few to be declared National Monuments. It also offers fish cleaning amenities. A previous abalone project was discarded as not being climate friendly. It would benefit from restaurants, accommodation and others. Struisbaai (Figure 3.66) has a linefish buying facility and active fisheries, fish cleaning, fishmongers along with heritage, adventure and stingray tourism. It also hosts an annual Linefish Festivals. Stilbaai focuses on line-fishing only with no tourism facilities (Figure 3.67) and has fish cleaning and cooling facilities. It hosts a Strandlooper festival.

Figure 3.63: Gordon's Bay

Figure 3.64: Hermanus

Figure 3.65: Gansbaai

Figure 3.66: Struisbaai

Chapter 4

A Future Vision for Small Harbours in South Africa

In conclusion, in order to align to the future of the African Union Integrated Maritime Strategy, Operation Phakisa, the South African Department of Transport, Comprehensive Maritime Transport Policy and the Ethekwini Blue Oceans Economic Framework, the future vision for Small Harbours within South Africa and the drafting of the Small Harbours Act; should heed the following factors and blue ocean economic risks and opportunities. This source also recognises the immense potential of small harbours and marina's as its unique conceptual contribution towards achieving the blue economy, away from traditional ocean economy activities. It especially considers the possibilities and changing stakeholder requirements to consider climate change; COVID-19 and other pandemics in public health; the need for a circular green and blue economy as well as preparing and exploiting modern technological upgrades, avoiding digital disruption, climateproofing and futureproofing as much as possible.

Reviewing existing examples revealed the need for significant stakeholder consultation and engagement; evaluating of previous research for case study successes and failures. It includes considering a sustainable lifecycle analysis and previously provided Site Selection Criteria and integrated Risk Management Framework. Effective Small Harbours and Marinas form need to consider effective Plans, Management Guidelines, the establishment of a functioning authority and possibly a comprehensive Act as in Chapter 2. Stakeholders would be advised to maximise advantages; reduce disadvantages; mitigate emerging risks and

exploit the various blue economy activities across areas such as fisheries, aquaculture, marine biotechnology, offshore oil and gas, possible seabed mining, desalination; marine renewable energy; boatbuilding and ferries, cruise, marine, nautical recreation and ecotourism and other emerging opportunities.

This vision projects Small Harbours can become the pivotal epicentre of coastal communities, sustainable, restored ecosystems, livelihoods, families and marine ecosystems. It includes a holistic, integrated minor cargo logistics network connected by road, rail, local flagged cargo and ferry services across South African coasts. This reduces road congestion, accidents, maintenance costs, time delays and strike issues at commercial ports. It includes a hub for various aquaculture projects and fishing fleets. Maritime industry would not only encompass existing value/supply chain activities via higher value fisheries processing, vessel supplying and repair; but extend to new opportunities via marine biotechnology, drones and robotics, bioprospecting and other services. Special one stop investment and application zones with online available services could fast track EIA's, water user licenses and other bureaucracy hindering current development elsewhere; to accelerate the establishment of industry and entrepreneurs. Prototypes in renewable energy -solar, wind, offshore tidal, current, wave and thermal along with desalination and other water conservation measures could pioneer South Africa to take small harbours off existing grid connections. Marine waste could be recycled into roads and construction material with opportunities for vessel suppliers and bunkerage services. Marine financing, insurance, small markets and even a stock exchange could be formed for investment along with entrepreneur and innovation incubation hubs or science parks.

Refurbished, climate resilient harbours hosting marinas and events such as regattas and sailing events, new minor museums, shops, restaurants, accommodation and other sites could significantly attract entire flotillas and fleets of lucrative yachts, leisure vessels, sports fishermen and many other tourists, whether by ferry, road or rail as an influx of tourism, along with hospitality tourism. It could provide either day trips for cruise passengers from the nearest commercial port or vessels could launch tenders. Mixed use, and valuable marine real estate with parks and services could form the centre of vibrant, employed communities, addressing social ills, benefitting from increased marine research such as biotechnology and aquaculture. Small harbours can also contribute to increased marine ecosystem protection through a series of marine protected areas and coastal reserves to ensure aquatic ecosystems can regenerate, preserving fisheries; whilst permitting tourism opportunities via wreck diving, underwater museums and eco reserves/boat trips etc. It can involve the youth not only in protecting tourists and entrepreneurship but by following upon the

mentoring and other opportunities of the successful Ocean Champs and the Bremen-Durban Marine Environmental Education Network and Wild Ocean's Marine Stewards' Program for South Africa. Local high schools and TVET colleges can be marine orientated, as the new proposed introduction of marine subjects into the national curriculum envisions. They can contribute to maritime safety, security and ocean governance via production of local marine equipment; textiles and telecommunication. Aside from supporting the drone sector; it can create a voluntary network of SAMSA/Navy/coastguard/SAPS and community volunteers whether on local made speedboats, fishing, commercial, tourism, leisure and research vessels to diligently arrest and attack any foreign poaching vessel, to safeguard living marine resources for South Africans and future generations. This enhances employment, reduces imports; expands exports, tax revenue, investment, production, consumption, entrepreneurship and ecological-social welfare; indirectly reducing poverty, crime, rugs and other issues

Proposed Implementation Plan

- The Establishment of a Technical Secretariat (as previously proposed and suggested)
- The establishment and selection of Working Groups with designated responsibilities and progress.
- The drafting, agreeing and implementation of a Future Vision for Small Harbours, a proposed Implementation Plan (such as the one above) and Action Plans for each group and involved stakeholders with clearly designated roles, responsibilities, timeframes, actions, resources required and identifying of risks/concerns -how to overcome them along with potential opportunities.
- A Literature Review and establishment of other comparable small harbours and related blue economy/environment initiatives, policies, activities etc globally to establish best practise methods, approaches, standards and implementation/identify similar risks and opportunities
- A Review of all legislative policies/frameworks etc hindering potential development and implementation and subsequently leading to the Establishment of a Small Harbours Act
- A Pre-Feasibility Study of the Proposed Pilot Project and Various Small Harbour Sites to Focus on the Specific issues, advantages, opportunities, infrastructure, climate, environment, stakeholders etc of each harbour. -Joint research in teams etc.
- The Formation of Viable Market/Business Proposals and subsequent Investor/Financial Lobbying Support.
- Subsequent creation of pilot sites and implementation via EIA's/Zoning etc but creating an online and physical base connecting all stages so stakeholders can apply for them simultaneously as suggested to accelerate development.
- Public consultation; NEDLAC etc-to pre-empt labour union strikes etc.
- Creation of online and learning exchanges; entrepreneurship and innovation hubs -linkages to existing training institutions etc.
- Publicising of opportunities for specific jobs and industries.
- Connecting to other government agencies/private sector -coordination to maximise various socio-financial incentives etc.

- Significant marketing efforts via conventional and social media to maximise awareness including hosting events etc.
- Subsequent Monitoring and Evaluation; extension of activities and scaling up to other sites

A Series of Indicators to Monitor Implementation Progress

Physical/Administrative:

- Have the various stages of the Implementation Plan above and 3 Foot Plan been implemented?
- Have all elements of the future vision above been implemented?
- Has an updated website and social media/regular media channels for updates been established?
- Has a legislative review to reduce all policies
- Has a One stop centralised online and physical zoning/EIA/water license/tax registration and finance centre been established at each pilot/proposed port site?
- Has an innovation and entrepreneurship hub been established?
- Has the Small Harbours Act been drafted, passed and implemented?
- Have all relevant stakeholders been contacted and involved?

- The fundamental questions to enquire are over timing –"Has the project attained its goals within the timeframe available?

- Which resources were required?
- Has it utilised its resources efficiently, economically and environmentally sustainably?
- What additional resources are needed to sustain the project/network and how can these be most optimally allocated?
- What is the quality/degree of success over its human resources, training/education?
- What is the most optimal form of awareness, communication, information sharing or cooperation established during the project?
- What are project risks/concerns, benefits/advantages or opportunities?

- **Environmental:**

- Is the project environmentally sustainable?
- Has it reduced the pollution/damage output to the river/coastal/marine environment?

- **Fiscal/Financial:**

- Is the Project financially sustainable/viable/self-supporting over various time frames?
- How have costs changed?
- How much additional port revenue has materialised?
- How much additional tax income; has occurred?
- How much additional port charges/revenue?
- How much additional foreign investment

- How much additional revenue has occurred from fines/law enforcement
- How many additional fishing/cruise/recreational/research/other vessels have called in?

- **Economic**

- How many jobs have been produced?
- How many small/medium enterprises have been established?
- How many existing businesses have opened up?
- How much sales volumes, exports, customs revenue, consumption, production have arisen as a direct or indirect consequence of the small harbour, marina and surrounding area being developed?

Process Indicators

- No of events organized to promote awareness and entrepreneurship
- Number of people educated or impact through events.
- Number of training events organized.
- Number of patents/IP filed
- Number of first contacts
- Number of projects selected after feasibility study.

Performance Indicators

- No of business plans produced
- Number of Start Ups
- Number of jobs created in startups/SME's.
- No of jobs created by clients
- Enterprise survival rate 3 years from their creation
- Number of SME's created/supported

- **Technical/Infrastructure**

- (Has the project proven to be technically feasible)?
- How Many Small Marinas have been established?
- How many miles of quay/breakwater/other port infrastructure has been constructed?
- How many have been refurbished/maintained?
- How many benches etc have been created?

- **Training/Education/Awareness**

- How many students have been trained?
- How many teachers have been trained?
- What have they been trained in? What skills and tools have they picked up and how have these been used?

- To What Extent Are Stakeholders Aware?
- How has awareness changed?
- How has behaviour changed in relation to the ocean/marine environment and conservation?
- I.e. the multiplier effect -have these stakeholders gone out and spread awareness, recruited others; implemented successful projects etc.? If so why? If not, why not?
- How have perceptions changed?

Social/Other

- Have there been any other social-environmental-economic-educational or other benefits, costs, risks, concerns or opportunities?
- Number of spinoffs (academic/research/industrial)

Cost-benefit ratio

- Cost per job created
- Public financial contribution per job created

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