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Barriers and Enablers for Short Sea Shipping in the Southern African Development Community

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Abstract: The Southern African Development Community (SADC) region is an economic community comprised of 16 countries in Southern Africa with a goal to achieve development, peace, security, and economic growth. Developing the regional freight transport system is essential for accomplishing these objectives. This paper investigates the potential of short sea shipping (SSS) in an African context, highlighting policy initiatives related to SSS development and identifying barriers and enablers of SSS to support international trade in the SADC region. According to our findings, SSS has the theoretical potential to work in the SADC given the large geographic region, projected freight volumes, and customs and trade policies the SADC region is pursuing. Such a system would have three main roles: to offer unimodal freight transport between port cities, to offer the main leg of an intermodal route, and to offer feeder services to deep sea shipping in a hub-and-spoke cycle. However, freight transport in the SADC region has a number of shortfalls that need to be addressed—of note, port competitiveness, customs provisions, and policies for intra-regional trade require impetus. Additional work is required in terms of policy to support SSS. Furthermore, considering the importance of synergies, the role of policy makers in improving trust, and developing cooperation among transport chain members needs to be explored.

Keywords: Southern African Development Community; maritime policy; short sea shipping; freight transport; modal competition

1. Introduction

The Southern African Development Community (SADC) region, covering 5.5 million km^2, and with a coastline spanning 15,000 km, is a regional economic community that comprises 16 Southern African countries (Figure 1). The SADC was formed to achieve development, peace, security, and economic growth. It plans to accomplish these objectives by alleviating poverty and promoting regional integration in line with sustainability and democratic principles [1,2]. The need to develop the regional freight transport system has been identified as a major activator to the SADC's development objectives to achieve social integration, economic development, and intra-regional trade [1].

According to a recent study of the SADC's Regional Infrastructure Development Master Plan [1], the SADC region has an inefficient and ineffective freight transport system that faces numerous challenges relating to providing an adequate regional infrastructure and related transport services, a setting that urgently requires strategies to improve and expand the freight transport system to meet emerging demand. Freight transport in the SADC region is furthermore characterised by extreme polarisation in favour of road transport [2]. The setup translates into a situation in which there are numerous negative externalities, including a high rate of transport-related accidents, road congestion, high infrastructure expenditure, and environmental damage [3,4].

Figure 1. Map of the Southern African Development Community (SADC) region [5].

To address these transport problems, rail has traditionally been favoured as an alternative to road. Accordingly, most SADC countries have invested heavily in the construction and maintanance of railway lines and associate infrastructure to accommodate freight transport demand, and there are more major plans to revitalize the railway sector across the region [1]. However, historic developments regarding rail have made it unlikely that rail will ever again be a serious competitor to road unless reforms address the poor and declining performance of rail and its reputedly poor reliability in terms of safety and timeliness in the region.

Against this backdrop, short sea shipping (SSS), which can provide transport services by sea within a region [6], or even nationally, is considered within the SADC region. The role of SSS is generally twofold; namely, to offer the main leg of an intermodal route and to offer feeder services to deep-sea shipping in a hub-and-spoke cycle [7]. Thus, SSS could provide three roles in SADC: to offer unimodal freight transport between port cities, to offer the main transport leg of an intermodal freight transport chain, and to offer feeder services to deep sea shipping in a hub-and-spoke cycle. Developing SSS could bring numerous benefits to the SADC region. As a mode, SSS can address imbedded transport problems and meet development needs in the SADC region [8–10]. In particular, SSS has been identified as a key strategy to achieve sustainable development in freight transport, particularly intermodal transport [11,12]. SSS has various socio-economic benefits that motivate policy support worldwide [13–16].

The aim of this paper is to understand the complexities and challenges involved in using SSS in intermodal transport chains in the SADC region. To that end, several studies have been conducted focusing on different regions of the world such as Europe [17–19], North and South America [20–22], Asia [23], and Oceania [14], but none of the research articles in the literature search investigated the potential of SSS in an African context. Substantial developments in the SADC region imply that SSS may play a significant role in improving the sustainability of the logistics system. The main objective of this paper is, therefore, to highlight policy initiatives related to SSS development and use these to identify a series of barriers and enablers of SSS in the context of sustainable development in the SADC region.

The paper follows a case study approach whereby we try to reveal an in-depth, multi-faceted understanding of the SSS industry in the context of SADC. This is done through an extensive review of international literature, SADC country policies, and regional vision statements on freight confronted over a series of potential barriers and enablers. The research was based on the European short sea shipping case study.

The paper is structured as follows. First, we consider the regional benefits of SSS, then we consider attempts to develop SSS in the SADC region, followed by policy initiatives that have been implemented to enhance SSS development in Europe, where SSS is widely practiced; and finally, we consider the barriers and enablers of SSS and potential challenges in the SADC region.

2. Regional Benefits of SSS

To begin, where distance and volume are beneficial, SSS has a low transport cost compared with rail, road, and air [24]. This strength lies in the tremendous potential of SSS to achieve economies of scale and energy efficiency. Economies of scale in shipping are additionally enhanced by attaining economies of distance [25]. In shipping, particularly, some trip-specific fixed costs are not affected by the distance of the journey. For example, port charges, as well as loading and discharging costs (i.e., terminal costs) are paid for at a fixed rate regardless of the distance travelled. As a result, in shipping, the total transport cost per ton-kilometre decreases as the trip distance increases. In the existing literature, the use of different methods in different geographical trade corridors and the inclusion of dissimilar factors in cost analyses yield different transportation costs. Cost structure depends on multiple factors such as vessel and route characteristics, type of cargo, utilized capacity, and vessel speed and age. On the basis of the origin–destination generalized cost calculations for both road haulage and SSS, Ng [26] in this respect found that for the distance between 0 and 1100 km, road transport is competitive, whereas SSS is competitive for the distance between 1100 and 2500 km. For road haulage, the generalized cost from Leige to Riga, St. Petersburg, and Tallinn is about 80, 105, and 97 (in euros per ton), respectively, while for SSS, the corresponding cost is 69, 101, and 79 euros per ton, respectively. In a similar study, Galati, et al. [27] identified that from Jaen to main Italian cities, the unit cost for road haulage is between 0.14 to 0.20 (euros per kg), while for SSS, the cost is between 0.11 and 0.14 euros per kilogram.

Secondly, shipping has low associated-infrastructure maintenance costs, partly emanating from the doctrine of 'freedom of navigation', which allows foreign ships to use any part of the sea freely. Linked to this, floating and moving on water comes at a low infrastructure cost [28]. Even where seaports are needed, port investments and maintenance costs are lower than are their corresponding infrastructure costs for road and rail. Port investment and maintenance costs vary depending on the geographical location and the ownership structure. According to the report by Carruthers [29], the initial port investment cost for building a 300-meter container berth in Mediterranean countries is 16 million U.S. dollars, while for road and rail, it accounts for 3.5 and 1 million U.S. dollars per kilometre, respectively. In addition, the annual maintenance cost is 1 million dollars per container berth per year, and for road and rail, it is 125,000 and 3000 dollars per kilometre per year, respectively.

Moreover, SSS has a comparatively low negative external cost and is often more sustainable and environmentally friendly than road and rail [17], but in the roll-on-roll-off (RoRo) segment, a low load factor and high speed make emission performance similar to that of road transport [30,31]. Well organised and at reasonable speeds, however, SSS is energy-efficient shipping [32]. López-Navarro [33] used the external cost calculator for Marco Polo freight transport project proposals in order to compare the environmental performance of road haulage and SSS. Air pollution and climate change in SSS are considered in the Marco Polo calculator coefficients; they are measured in euros per ton-kilometre and depend on the speed the RoRo/RoPax vessels operate at, as well as the type of fuel they use. For example, according to Marco Polo calculator coefficients, the external cost of a RoRo vessel that operates at 15 knots and uses low sulphur fuel is 0.0045 euros per ton-kilometre compared with road transport, which accounts for 0.0185 euros per ton-kilometre. Nevertheless, the external cost of road transport is lower than that of a RoRo vessel when it operates at high speeds or uses high sulphur fuel. This fact is also supported by Hjelle [22], who pointed out that RoRo shipping represents the greenest transport alternative, only in the case that NOx abatement technologies and low sulphur fuels are used, operational speed is low, and the utilisation rate of the RoRo service is high.

Statistics show that in 2014, the volume of world seaborne trade accounted for an estimated 80% of total worldwide merchandise trade [34], while the share of shipping in global transport energy use was only 6–9% [35]. This advantage comes primarily from the inherent nature of floating on water, which requires little power to move the vessel per unit weight [36]. In addition, increased consumption of fossil fuel in the transport sector of some developing countries, owing to laxity and lack of control regulations, led to the rise in air pollution and energy consumption from freight transport in these countries [37]. In this context, the low energy consumption of maritime transport per unit of transport work would be beneficial for abating air pollution and developing a more sustainable transport system [38]. On the other hand, some studies reflect that using the SSS as an alternative to unimodal road transport may imperil logistics performance, as successful implementation of a modal shift plan may be impeded by a number of factors, including increased transit times; lower reliability, flexibility, and frequency; as well as a higher risk for cargo damage [39–41]. SSS may offer shippers lower freight rates compared with road transport, but as Blauwens, et al. [42] argue, if costs were the main and only criterion for mode choice, then rail and SSS should have a remarkably bigger share of the total freight transport market than they have today. SSS can compete with road transport only if it meets shippers' logistical requirements and fits into their supply chains. An inherent risk is then that the high frequency and speed of the road transport sector reduces the sustainability arguments [43].

3. Policy Initiatives to Develop SSS

3.1. Policies and Attempts to Develop SSS in SADC

In the SADC region, developing SSS has long been considered both at national and region levels. In 1995, the SADC Protocol on Transport, Communication, and Meteorology ("Protocol") was passed to establish viable, sustainable transport systems in the region [44]. In the Protocol, the SADC committee foresaw the development of an integrated maritime transport system in the SADC. Chapter 8, Article 8.1 of the Protocol [42] provides for the following:

> *"Member States shall promote the economic and social development of the Region ... [amongst many things] which-*
>
> *c) Promotes a safe and clean marine, maritime and inland waterway environment; [and]*
>
> *d) Encourage the provision of accessible, viable and productive landside infrastructure."*

At a national level, South Africa has pushed for developing SSS and has accordingly set targets in its millennial goals to achieve key objectives in realising an integrated maritime transport system [45]. In addition, Namibia considers SSS a viable way of increasing the transportation network and easing pressure on road infrastructure development, particularly for cargoes destined to neighbouring coastal countries, and has cited SSS as a key development point in the draft white paper on the Blue Economy [46]. Lastly, in Mozambique, the Mozambique public maritime and river transport company, Transmaritima, recently signed an agreement with a French group, Peschaud, to develop SSS in Mozambique. Under this agreement, Peschaud will place ships in Mozambique to carry freight between Mozambican ports [47].

At the continental level, the Africa Maritime Transport Charter (AMTC), adopted in Addis Ababa in 2010, calls for African countries to "promote [maritime] cabotage and effective participation of private sector operators at national, regional and continental levels" [48]. Proposed political actions include recognising and developing African regional coastal shipping as part of the 'domestic' transport network planned, complete with cargo consolidation hubs and intermodal maritime corridors linked to inland regions [49].

Despite these efforts, the SADC, as a collective, has yet to act to develop SSS. Further, it is not clear whether opportunities for SSS exist in the SADC given the complex nature of maritime transport and transportation realities in the SADC.

3.2. Regional Policies to Develop SSS: Lessons from Europe

In Europe, where the development of SSS has been extensively pursued, SSS accounts for 37% of intra-European Union (EU) trade [50] and is the only mode to keep up with road. Road now accounts for 45%, while rail accounts for 10%, and air and pipelines account for 5% of intra-EU trade. These achievements are primarily attributable to efforts by the European Commission (EC), which has funded several projects and actions aimed at strengthening the competitiveness of SSS and achieving a modal shift from unimodal road haulage to intermodal SSS.

The success of European SSS is said to be attributable to political actions taken to improve the competitiveness of SSS. Today, in Europe, the main policies for SSS include policies dedicated to funding SSS transport infrastructure (TEN-T projects) and those dedicated to supporting SSS operations and activities (PACT and Marco Polo I and II) [18]. Marco Polo and Motorways of the Sea, which are parts of the Trans-European Transport Network (TEN-T) program, Energy Law (HR 6), and Short Sea Shipping Co-operative Program (SCOOP) are some initiatives that represent the intent of European policy makers to promote a modal shift [21,51]. In addition, the EC´s latest white paper of 2011 [52], in this regard, stipulates that 30% of road freight over 300 kilometres should shift to alternative modes such as rail or waterborne transport by 2030, and over 50% by 2050. These policies and projects aim to achieve a modal shift by removing barriers to using SSS as an alternative to unimodal road haulage or integrating SSS into an intermodal transport system to complete a door-to-door transport sequence.

Beside the above, it is purported that a key step in developing SSS in Europe was the liberalisation of shipping services in 1985 [53]. Liberalisation meant rights for cabotage services were extended to all regional shipowners and the larger geographic Europe and later entirely removed. This ensured a larger market in which short sea services could operate, and it gave vessel operators access to longer routes, ensuring new corridors of sufficient length to allow coastal shipping to compete with land-based alternatives [14]. This note is useful for developing SSS in the SADC, as the African Union recently approved the Comprehensive Maritime Transport Policy [45], which, amongst many things, introduces a cabotage regulatory framework that could limit the carriage of goods between African ports to African registered ships. This point is revisited later during the carrier component, when we gauge the views of carriers on cabotage in the SADC and the impacts of their participation in SSS in the SADC.

Another challenge identified in Europe during the early years of SSS was customs related, particularly the non-uniformity of cross-border operations and documentary requirements between countries within the region [54]. Because of this, there were delays in the commencement of cargo operations in SSS until all customs clearances were received; and moreover, the non-availability of customs services in ports on a 24-hour basis further inhibited the development of SSS in Europe [55]. Europe addressed these problems with electronic authorisation, registration in operator systems, and electronic notification and customs (cargo does not need to be presented) [55]. In particular, the conception of the Blue belt—'the sea area surrounding the European Union, where intra-EU maritime transport can be operated with as little administrative burden as possible' [55]—has allowed the use of surveillance to help provide guarantees to customs and simplification of the goods clearance processes. Further on this point, policy initiatives to boost the competitiveness of SSS have included guidelines for customs procedures, the identification and elimination of obstacles and research, and technological development such as the application of electronic data interchange for customs procedures [50]. Short sea focal points have also been set up in major European cities to improve the image of maritime transport by providing concrete information on SSS to EU member states by promoting SSS as a valid alternative to road haulage and collecting useful statistical information [46]. There were also actions to create 'one-stop' offices for administrative and customs formalities to enhance interoperability and intermodality in Europe.

4. Determinants of SSS

Despite the policy initiatives, there are natural determinants for SSS, and these must be considered in the context of SADC. Ma [28] states that the terrain to grow SSS is typically a large geographical area that is industrial, where there are sufficient waterways navigable by ships and where sufficient ports connect these waterways. Large, highly integrated regions such as Europe and North America, where there are long coastlines, or Asia, with its many habitable islands, have been ideal for SSS activities [28]. In addition, the development of SSS is significantly influenced by freight volumes, port efficiency, geographical features such as weather and climate, and the regulatory environment in which SSS must operate.

The conditions of a region's ports are crucial for developing SSS. The port is a vital component of SSS and the logistics supply chain such that its competitiveness has a direct effect on relevant economic variables including export competitiveness and final import prices [56]. With over 80% of inter-continental trade by volume and more than 70% of its value being carried by sea and handled by seaports worldwide, the importance of maritime transport in sustaining a robust supply chain for trade and development cannot be overemphasized [57]. Port charges are the main contributor (up to 70 percent) to total SSS costs as indicated by Tzannatos, et al. [58] and Paixão and Marlow [17]. However, the implementation of MARPOL sulfur regulations requiring the use of high-priced marine gas oil (MGO) as bunker fuel might become the largest cost item in SSS cost. The cost per unit time spent in port is far more for a parcel of cargo compared with any other stage of the maritime supply chain [28]. This is also where most delays happen [59]. The drivers for port competitiveness include port pricing, service quality, reliability in terms of service delivery, customisation, and responsiveness of services to customer needs (both shipper and carrier).

Poorly performing ports are known to reduce trade volumes, especially for developing countries [60]. Studies by Blonigen and Wilson [56]; Clark, Dollar and Micco [60]; and Sanchez et al. [61] have shown a positive correlation between port efficiency and growth in national trade. Port competitiveness also plays an important role in enhancing economic growth and reducing poverty. Diversification is also firmly established in this regard [62]. High port costs and poor-performing ports are thus a deterrent for SSS because road users do not have corresponding intermediate handling costs. Empirical evidence presented by Wilmsmeier, et al. [63] indicates that decreases in port costs coupled with increases in port efficiency, port infrastructure, and inter-port connectivity can reduce overall maritime transport costs.

4.1. Freight Transport in the SADC and Inhabitants Regarding SSS Development

The SADC region had a collective gross domestic product (GDP) of US $706 billion in 2017 and a combined population of 337 million [64]. Its freight transport sector entails road, rail, air, and maritime transport characterised by a coastline spanning 14,700 km and a total road network spanning approximately 900,000 km, of which 100,000 km are primary roads that connect major cities and freight transport corridors and 14 interconnected national railway networks, which span 10,000 km and connect major ports of the region [65].

South African ports dominate the extensive port system in the SADC region, both in terms of sheer numbers and capacity and volumes handled. South African ports also serve the majority of landlocked countries (LLC) in the SADC region. Most ports in the SADC region were primarily designed to serve the needs of the individual countries and their natural hinterlands, and thus there is an apparent fragmentation in the general transport networks that connects the ports [66]. Many of the SADC ports are also general ports focused on a variety of imports and mineral exports and hence are not adapted to SSS [9]. Additionally, the high average growth rate in Africa over the last few years has had a marked effect on the utilisation and efficiency of these ports, and many are operating around their design capacity [66]. Opportunities for new operations are emerging slowly, such as the specialisation of ports for container handling or dry bulk handling, especially in high-potential markets such as Namibia and Tanzania.

Further, the SADC region has an extensive network of freight transport corridors (Figure 2). These freight transport corridors were first established in the 1980s because of the many LLCs in the region, but a particular motivation was to bypass South Africa in rejection of the apartheid government in South Africa at the time [67]. The corridors were mostly identified starting from a port and developed protruding inwards towards LLCs. Today, the SADC transport corridors are regarded as some of the most successful corridors in the world [67]. Some features that made them successful include common political objectives, adopting a common language (English), similar road and rail design and operational standards, cooperation among member states, and the establishment of corridor-specific secretariats. The SADC corridor approach to regional development is based on well-maintained and operated infrastructure and the provision of seamless transport services.

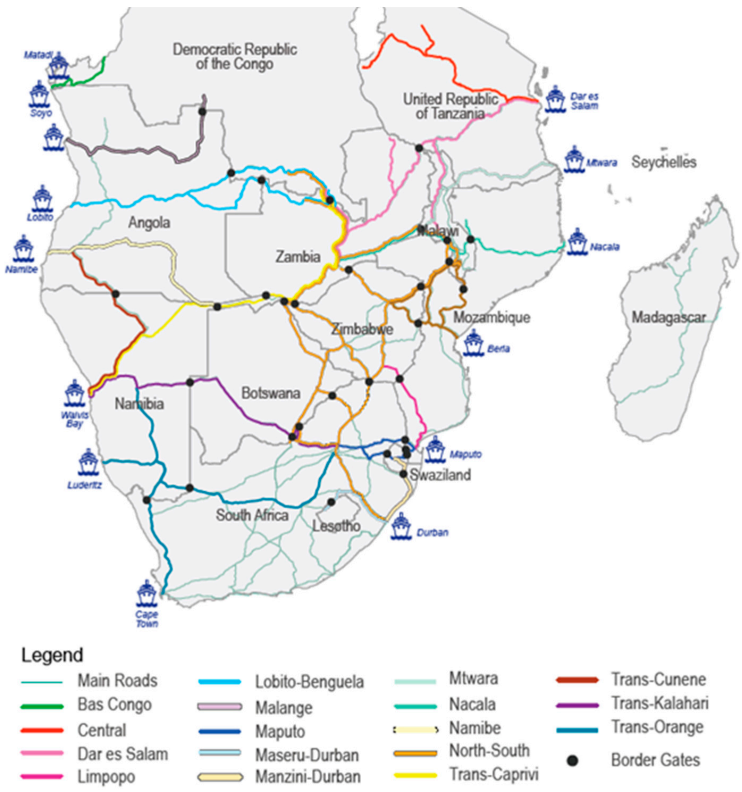

Figure 2. The key SADC transport corridors [68].

4.2. International Trade

As a region, SADC relies heavily on international trade. Containerized goods make up the biggest share of total goods imported, while exports are primarily bulk cargoes [66]. According to SADC, international trade projections forecast exponential growth of freight movement in the SADC region in the next 20 years with expected growth of goods passing through its maritime ports from 92 million tonnes in 2009 to 500 million tonnes by 2027 [1]. That said, however, it is predicted that this growth will put immense pressure on the regional transport network (Figure 3).

The World Economic Forum's (WEF) transport infrastructure score, which is assigned out of 7, with 1 being lowest and 7 being best, is compiled from the perceived quality of overall infrastructure, quality of roads, quality of railroad infrastructure, quality of air infrastructure, and availability of airline km per week. It provides a score for the business operating environment and competitiveness in over 140 countries [69].

The WEF score for transport infrastructure for 12 SADC member states (excluding Comoros, Seychelles, and Mauritius) was aggregated as a WEF score for SADC and compared to the freight projection in SADC. Figure 3 shows a graph of the SADC transport infrastructure level score [70] pegged against the projected levels of freight volumes passing the SADC region's maritime ports [68]. From this, we see an inversely proportional relationship between freight growth and level of infrastructure, indicating that the transport infrastructure in the SADC region reduces in standard despite the many infrastructure development projects in the region, and thus it will soon not be able to cater to the projected freight volumes in the region (Figure 3).

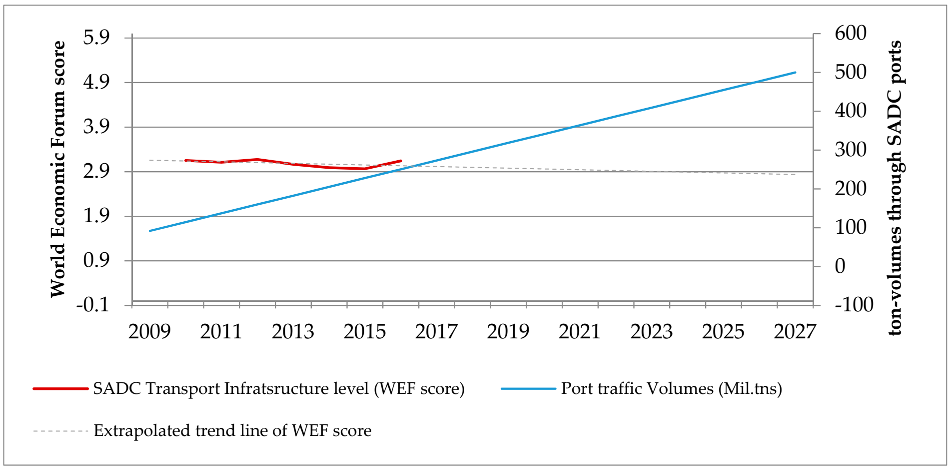

Figure 3. Transport infrastructure versus freight growth projections in the SADC [68,70]. WEF—World Economic Forum.

4.3. Intra-Regional Trade and Freight Flows

In contrast to inter-continental trade with the SADC region, intra-SADC trade grew very slowly in the last two decades [71]. This has been the case despite the focus placed by SADC on changing the situation in the form of free trade agreements and policies to boost intra-regional integration. Traffic across the SADC corridor borders is typically around 300 trucks and 500 cars per day, which is not very high.

That said, however, the SADC region has made significant progress in eliminating tariffs for intra-regional trade, particularly with the inception of the SADC Free Trade Area (FTA) and the establishment of the SADC Customs Union [72,73]. It was anticipated that lifting tariffs for intra-regional flows would lower transport costs and lead to more intra-regional trade. However, a 2011 audit of the implementation of the SADC Trade Protocol revealed that member states found the SADC rules complex and difficult to apply. Internal customs border controls still exist, and new rules are not being applied uniformly [74]. As a result, intra-SADC trade stands at a mere 10% [75] of the member states' total trade. Chidede [75] argues that compared to other regions in the world such as southeast Asia (24%) and the EU (40%), 10% for SADC is very low.

With regard to trade patterns between SADC member states, a majority of intra-regional trade is dominated by South Africa, which accounts for approximately 68% of exports and 15% of imports [76]. The remaining SADC countries are net importers from South Africa. Around 59% of all imports into, and 46% of all exports out of, SADC member states are destined for, or respectively originate in, South Africa [76]. Fittingly, South Africa is also the biggest economy in the region, forming about

55% of the SADC's GDP. Domination by South Africa has in part resulted in unbalanced trade flows, whereby trucks leave South Africa fully laden and return empty [77]. This setup has contributed to the high cost of freight transport in the SADC, as truckers have to account for the empty return leg when they invoice a shipper on the head leg [77]. Furthermore, trade projections show that this will continue into the distant future, indicating a potential concern for the growth of SSS [69].

That said, however, a consoling factor is the political stability, which has become a characteristic of the SADC region due to a significant rise in the economic, political, and security cooperation at the regional level [78]. Subsequently, factors that have hindered the industrialization of SADC member states, such as war and conflict, have decreased. As a result, we might see more development and with it, growth in the potential of other SADC member states to trade intra-regionally. For instance, from Tables 1 and 2, we note strong projections for intra-regional trade. For example exports for Mozambique in the manufacturing sector and Zambia in the agriculture sector are set to grow more sharply as these countries develop.

Table 1. Intra-regional imports on the Southern African Development Community (SADC) mainland, in thousands of tons [69].

	Agriculture			Manufacturing			Mining		
Country	**2013**	**2019**	**2044**	**2013**	**2019**	**2044**	**2013**	**2019**	**2044**
Angola	111	126	236	974	1159	2339	32	37	147
Botswana	374	397	514	1897	2158	4069	165	189	335
Democratic Republic of Congo	74	104	385	1537	1984	6080	72	101	426
Lesotho	218	225	259	757	866	1382	53	63	96
Malawi	136	1507	511	535	636	1546	44	48	144
Mozambique	155	164	280	1450	1768	4335	45	57	94
Namibia	154	168	260	1741	2047	4091	78	94	202
South Africa	597	666	1243	4063	5077	13,054	3032	3469	6994
Swaziland	191	197	234	730	830	1499	118	139	200
Tanzania	96	122	392	542	684	1786	12	18	25
Zambia	41	48	88	1596	1930	4451	909	1212	2067
Zimbabwe	439	497	1028	1110	1282	2610	117	151	448
Grand total	2591	2869	5431	16,933	20,420	47,242	4677	5577	11,179

Note: data for some SADC members were not available.

Table 2. Intra-regional exports on the SADC mainland, in thousands of tons [69].

	Agriculture			Manufacturing			Mining		
Country	**2013**	**2019**	**2044**	**2013**	**2019**	**2044**	**2013**	**2019**	**2044**
Angola	0	0	0	5	5	7	2316	2707	6007
Botswana	8	8	17	214	265	477	334	388	787
Democratic Republic of Congo	1	1	3	93	120	359	486	725	935
Lesotho	2	2	2	85	109	299	25	27	34
Malawi	61	73	205	158	204	651	10	16	22
Mozambique	154	171	443	2830	3574	9734	129	140	284
Namibia	248	291	602	403	485	1132	379	432	955
South Africa	1415	1488	1861	11,168	13,053	26,082	746	882	1462
Swaziland	47	49	58	514	654	1759	45	48	61
Tanzania	111	141	372	670	802	2402	78	99	224
Zambia	346	419	1171	840	1047	3093	46	52	115
Zimbabwe	199	212	454	486	600	1508	226	233	552
Grand total	2591	2855	5188	17,465	20,919	47,504	4821	5751	11,438

Note: data for some SADC members were not available.

With regard to freight flow patterns, Figure 4 depicts the projected freight flows along major corridors in the SADC region taken from the regional Freight Model developed by TRANSNET. We can see that most of these freight flows are concentrated along major corridors in SADC. We can also see the growth of trade across SADC and, particularly, the emergence of new transport corridors away from South Africa to other SADC member states [69]. New trade corridors such as the Lobito–Lubumbashi and Namibe–Lubango corridors in Angola are expected to grow. Strong growth projections are also visible on corridors connecting port cities. For example, the corridors connecting Nacala and Beira, Durban and Maputo, and Luanda and Matadi all show strong growth, which opens up avenues for the development of SSS.

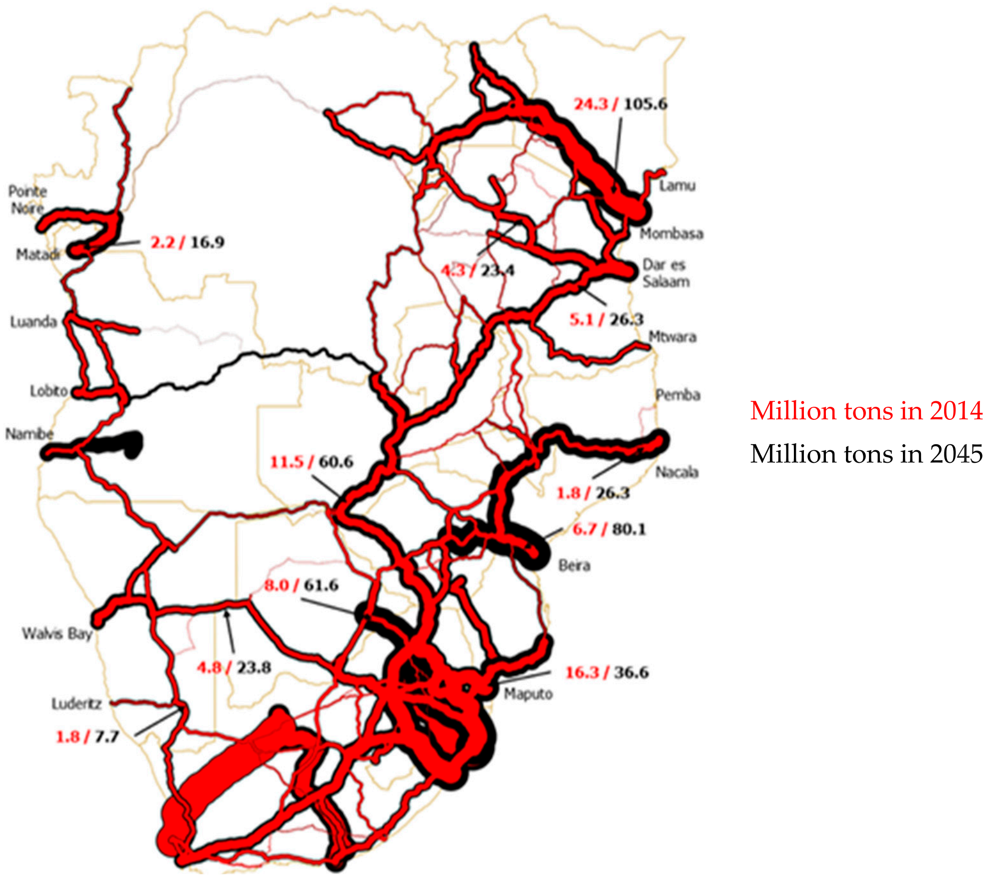

Figure 4. Intra-regional freight projections [66].

5. Potential Impediments to the Development of SSS in SADC

Notwithstanding the success of freight transport corridors in the SADC region, bottlenecks and freight transport impediments exist. Most of these centre around poor logistics performance, poor performing ports, the high cost of freight transport, and population locations.

As a start, transport and logistics performance is cited to be generally poor in the SADC region [79]. A 2017 survey of the logistics conditions conducted under the auspices of the Trade and Industrial Policy Strategies revealed that the majority of SADC members scored very low under the World Bank's Logistics Performance Index [62]. The underperforming areas are customs and infrastructure levels [79]. A consoling fact, however, is a general improvement trend in the overall performance of the SADC as a region (ibid).

Furthermore, ports in the SADC region, as critical nodes along the maritime transport chain, are said to be unprepared to address the needs of fast cargo movements [9]. The average turnaround time for a deep sea container ship is three days in the SADC region [80], while the average transit time of a container through the port is roughly five days according to port officials. The causes for these long transit times include obsolete procedures, lack of infrastructure, inadequate cargo handling equipment, misuse of handling equipment, downtime associated with maintenance and strikes, and the level of technology employed [8,9,81,82]. There is also a lack of capacity to accommodate a large number of ships at the same time, a scenario that could further lead to port congestion and increased turnaround time if shipping traffic increases [66].

Additionally, ports in the SADC region have some of the highest port charges in the world, and if SSS were to operate, port costs would constitute a high share of transport costs [83]. The reason for high port charges in the SADC region can in part be blamed on port-pricing strategies employed in many of the regional ports. Many ports within the region employ the ad valorem-based wharfage charge method, which assigns a charge based on the value of the cargo, with little consideration for the actual cost incurred or the value of the service provided by the port authority [84]. The United Nations Conference on Trade and Development (UNCTAD) encourages adopting the cost, performance, value method, which relates the port charge to the cost incurred in offering the service, performance efficiency, and value of the service rendered [85]. It is said to be an approach ports can utilise to achieve multiple objectives within the constraints imposed by its financing requirements and the external competitive environment.

Tied to this is the high cost of transport due to inadequate physical infrastructure and delays at borders, which create further challenges for freight transport in the SADC region [86]. According to a 2014 study [87], the estimated effective speed of road transport in some parts of SADC is between 6 and 12 km/hour, with rail transport scoring even worse with an average speed of 4 km/h. Three-quarters of the time spent in a cross-border journey is reportedly attributable to customs delays and not the actual speed once in motion [79]. Even though poor performance by road and rail in the SADC region could signal strength for SSS, it is important to note that SSS requires these services in the start and end legs of the SSS journey, which can be quite long for LLCs. Poor performing land-based modes may, therefore, constitute a further disadvantage to SSS in SADC, but in general, they strengthen the competitiveness of the SSS mode. There are obviously time-consuming border controls in ports, but for longer transport distances, SSS involves fewer border crossings as the vessels can sail around countries that land modes must transit.

Lastly, unlike many regions of the world, the SADC region's population densities are mostly inland, far from coastal areas [88]. This limits the potential of SSS to feeder services and along freight corridors running between port cities (for example, between Cape Town and Walvis Bay) or intermodal transport chains where origin–destination pairing in a transport chain is near the port. This particularity in the SADC region's population densities strengthens the environmental benefits from employing SSS, as it implies a reduced number of trucks in the more densely populated inland areas and increased freight volumes in the less-populated coastal areas. This means that the associated social cost from transport in urban areas will decline, improving the sustainability performance of freight transport, without making huge investments in infrastructure [19]. Typically, countries whose major population lives within 100 km from the sea generally achieve better growth rates than those countries whose major population lives beyond this 100 km zone [89]. Coupled with this, the main cities in the SADC region are distant from each other, creating a spatially challenged economy. These two factors (distance from ports, spatial gap) create a proximity gap in terms of reduced interaction among the economic agents of member states, and thus make transport systems less efficient and more difficult to achieve economies of scale and density [90]. According to Cadestin and Fall [91], distance and language proximity are factors favourable to regional trade.

Most SADC countries also face difficulties in achieving gains from specialisation, which is compounded by low population densities and low urbanisation. Further, weak internal transport links are exacerbated by a strong prevalence of corruption [90]. The World Economic Forum's Global Competitiveness Report 2014–2015 shows that access to finance, the prevalence of corruption and red tape, insufficient human capital and a lack of physical infrastructure remain the top inhibiting factors to doing business in the SADC region [92].

6. Conclusions

The promotion of SSS and its integration in intermodal transport chains has been an issue of significant importance for the last two decades, as it represents an environmentally-friendly, energy-efficient, and safe alternative to road transport that can facilitate the connection of remote and peripheral regions without the need for high infrastructure investments. For SSS to be viable, it needs to appeal to both the shipper who procures the transport service and the maritime carrier who conducts the SSS transport service.

This paper provides provided a theoretical assessment of SSS opportunities in the SADC region. It covered the benefits of developing SSS and the determinants of SSS from both the SSS demand and supply sides, and these determinants were contextualized to freight transport conditions in the SADC region. The following main conclusions were derived from the analysis:

- From a sustainability perspective, SSS could contribute to the abatement of air pollution and increased consumption of fossil fuel in the transport sector of SADC because of its low energy consumption compared with road transport. This fact is verified by recent European transport statistics, where SSS accounts for 1% of the energy consumption and 12.1% of the emissions related to the European transport sector, while transferring 32% of the total freight volumes [93].
- The particularity of the SADC region's population, being concentrated inland, far from coastal areas, restricts development of SSS along intermodal transport chains where the main leg is carried by SSS. However, it provides an additional environmental advantage, as SSS operations will take place in the less-populated coastal areas, and the number of trucks in the more densely populated inland areas would be reduced. This means that the associated social cost from transport in urban areas will decline, improving the sustainability performance of freight transport without the need to make huge investments in infrastructure.
- The comparatively low population in SADC's coastal zones is also a barrier for SSS, as the hinterland is rather deep, which requires long and costly hauls by inland modes.
- Given the large geographic region, projected freight volumes, and customs and trade policies the SADC region is pursuing, SSS has the theoretical potential to work in SADC. However, freight transport in the SADC region has a number of shortfalls that need to be addressed for SSS to work. Of note, port competitiveness, customs provisions, and policies for intra-regional trade require impetus. Additional work is required in terms of policy to support SSS.

Therefore, opportunities for SSS may not be clearly visible, but rather, the situation sets a tone for empirical support to consider SSS development in the SADC region. Furthermore, considering the importance of synergies, the role of policy makers in improving the trust and developing cooperation among the transport chain members needs to be explored. To determine the relative performance of intermodal SSS as an alternative to unimodal road haulage, more route-specific research is needed incorporating the three main dimensions of performance, that is, economic, environmental, and service quality. The way forward may include consideration of SSS under hypothetical settings in the SADC region. Behavioural research methods such as discrete choice modelling is particularly considered to assess the conditions under which SSS may become preferred from both a shipper's and a carrier's perspective.

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