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Connected by oil: A framework to analyze the connected sustainability histories of the Niger and Rhine Deltas, 1950-2015

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ABSTRACT

This article presents a mixed-methods framework for researching how sustainability gains and costs developed in, and became distributed between, distant regions connected by transcontinental resource infrastructure. We apply this framework to the oil-connected Niger and Rhine deltas from the 1950s to 2015. To study the sustainability histories of these regions in a connected and comparable way, we draw on the sustainability monitoring tool recommended by the Conference of European Statisticians and insights from qualitative secondary literature. Our study reveals: (1) Oil has indeed connected the broader sustainability histories of both regions. Consequently, we have developed a future research agenda to incorporate other oil-connected regions in the analysis. (2) Material well-being (e.g. economic growth), personal indicators (e.g. longevity), and investments in human capital (e.g. schooling) improved significantly in both Nigeria and the Netherlands, unlike environmental sustainability indicators. Notwithstanding vast differences (notably inequalities and conflicts in Nigeria), these similarities indicate that transcontinental sustainability trade-offs were no zero-sum game; these cannot be assumed, and must be examined on a case-by-case basis. (3) The framework helps to bring the sustainability histories of distant connected regions into the conversation, but should critically reflect on potential projections of anachronisms and Euro-centricities in its concept of a novel global sustainability history.

1. Introduction

In 2008, Friends of the Earth Netherlands and four Nigerian farmers sued Royal Dutch Shell and its subsidiary, the Shell Petroleum Development Company of Nigeria, at the district court of The Hague in the Netherlands. The petitioners demanded compensation for land and water polluted by oil leaking from the Nigerian subsidiary's transport pipelines. In 2013, the court awarded compensation to one of the claimants, and more importantly, the court as well as a later Court of Appeal confirmed Dutch jurisdiction in the matter with reference to EU law (Enneking, 2014; de Groot, 2016). Together with other lawsuits—with varying outcomes—and out-of-court settlements in the US and UK (Ong, 2017), the Dutch rulings made the Shell Nigeria case a key reference in the literature on foreign direct responsibility, i.e. the moral and legal accountability of multinational companies in their home jurisdictions for alleged damages overseas. That literature calls for a global view on current resource challenges and conflicts in order to make visible, researchable, and governable the social and environmental sustainability issues spanning the global North-South divide (Sachs and Warner, 1995; Ross and Voeten, 2013; Faundez and Tan, 2015; Hennchen, 2015; Tan and Faundez, 2017; Omoteso and Yusuf, 2017). A similar point is made in the emerging literature on sustainability telecouplings, which studies socioeconomic and environmental interactions between distant human and natural systems in today's globalized world (Liu et al., 2013; Hull and Liu, 2018). Both literatures hypothesize that low-income countries often bear the social and environmental sustainability costs for the economic sustainability gains of high-income countries.

We share these aims to develop a global interpretive framework for (un)sustainable development that captures sustainability entanglements across the global South-North divide. In our view, such a framework should also encompass the long-term dynamics of global sustainability entanglements. For example, transcontinental resource infrastructure, and (un)sustainability changes at distant locations linked through such infrastructure, are usually long in the making. In order to study how and why sustainability gains and costs developed and became distributed across different sites along transcontinental resource infrastructure, research needs to consider the cumulative sustainability-related experiences and choices of different generations at multiple locations.

To explore a framework that simultaneously captures the spatial and temporal dynamics of transcontinental sustainability

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entanglements, we revisit the infamous case of the oil connection between the Niger and Rhine deltas. Their (un)sustainability histories became increasingly connected from the 1950s, when Shell Nigeria's forerunner initiated the Niger Delta oil export boom, while the parent company was a key player in the Rhine Delta's emergence as a leading European oil and petrochemicals hub. National economies on both sides of the supply chain embarked on a broader transition to oil, that came with a 'great acceleration' (Steffen et al., 2015) in energy use, traffic motorization, the plastic age, and a host of emissions and other sustainability problems of the fossil fuel-based economy.

Studying this case has enabled us to make several specific contributions. Firstly, we initiate a conversation between sustainability studies and global and transnational history, tentatively coined as global sustainability history. Global and transnational history studies the historical interconnectedness of societies (Iriye, 2013; Saunier, 2013) and can provide sustainability studies with a long-term perspective on global telecouplings and entanglements and their localized implications. Sustainability studies, on the other hand, can help historians raise new and urgent issues. For example, historians should historicize present-day debates on sustainability challenges, and this requires them to transcend the research divides between past and present, and between human and natural history (Costanza et al., 2007; Trischler, 2016; Chakrabarty, 2018; van der Vleuten, 2019b, 2020). Playing on the multiple dimensions of the sustainability concept, the novel academic field of 'sustainability history' aims to systematically investigate the connections between well-established fields such as economic, social, and environmental history (Caradonna, 2015, 2017). So far this emergent historical field has focused on histories of the sustainability idea and socioecological changes in geographically delineated societies (Du Pisani, 2006; Grober, 2012; Caradonna, 2014, 2015, 2017; Lintsen et al., 2018); it has not yet begun to systematically examine global sustainability telecouplings and entanglements. To do so, it could connect with global and transnational history work on the entangled political, economic, social, and environmental histories of distant locations connected through transnational infrastructure and resource supply chains (e.g. Hecht, 2011, 2012; Högselius et al., 2013, 2015; Heymann et al., 2020; Vikström et al., 2017; Anna Åberg and Maja Fjæstad, 2020). We explore the possibility of such a global sustainability history for the oil connection between the Niger and Rhine deltas.

Second, narrowing down our specific research focus, we connect and compare the sustainability histories of Nigeria and the Netherlands, in order to study (un)sustainable developments in both countries in a connected and comparable way. Our approach draws on the quantitative sustainability assessment tool developed and endorsed by the statistical offices of the OECD, EU, UNECE, and World Bank (UNECE et al., 2014; Schoenakers et al., 2015). A recent Dutch sustainability history already adapted this approach to construct an historical time series for economic, social, and environmental sustainability, linking it with qualitative historical studies of key stakeholders' problem definitions and solutions (Lintsen et al., 2018). However, neither the contemporary nor the historical tool has yet been applied in a Global South context. This article explores how the tool works in a Nigerian context; how its findings relate to existing qualitative insights; and how it can inform the connected sustainability histories of the Niger and Rhine deltas.

Finally, based on these findings, we provide an analysis of the long-term sustainability trade-offs between the global North and South for the Nigeria-Netherlands case. The assumption that low-income countries often bear the social and environmental sustainability costs for the economic sustainability gains of high-income countries (see Hull and Liu, 2018), merits further qualification and scrutiny. Sustainability history work has already used the notion of 'trade-offs' to investigate how economic, social, and environmental sustainability gains and losses were historically traded against each other within local or national boundaries. Lintsen et al. (2018) show that substantial improvements in many economic and social sustainability indicators over time came at the expense of environmental sustainability indicators for biodiversity and air pollution. Sustainability trade-offs have also been studied in terms of resources available for successive generations. This article adds the study of how sustainability gains and costs were historically traded across space. For the case of the Nigeria-Netherlands oil connection, we show that transcontinental sustainability trade-offs were not a zero-sum game.

Before describing the case study, we discuss the sustainability monitor, its background, and suggested adaptations for globally and temporally connected sustainability research in Section 2. We look at the oil connection between the Niger and Rhine deltas in Section 3. Using the monitor and secondary literature, in Section 4 we identify associated (un)sustainable developments in the Netherlands, and Section 5 does the same for Nigeria. Section 6 identifies sustainability trade-offs in the connected histories of Nigeria and the Netherlands. In our conclusions we evaluate what kind of global sustainability history emerges, review our findings, discuss the strengths and weaknesses of our approach, and suggest avenues for further research.

2. Sustainability monitoring and research design

2.1. Measuring sustainability

The 1950s and 1960s witnessed increasing concerns that policymakers were over-emphasizing economic growth and ignoring other important dimensions of well-being. Negative environmental externalities, as documented in Rachel Carson's *Silent Spring* (1962), Garret Hardin's *Tragedy of the Commons* (1968), and Paul Ehrlich's *Population Bomb* (1968), inspired a search for new ways to chart societal development. (Rachel Carson, 1962; Garrett Hardin, 1968; Paul Ehrich, 1968). In the 1970s several attempts aimed to correct the leading development indicator, Gross Domestic Product (GDP), for environmental damages. Nordhaus and Tobin's (1972) Measure of Economic Well-being and Hueting's (1980) Sustainable National Income are prominent examples.

From the late 1980s, the concept of sustainability extended beyond intergenerational environmental and resource issues (Grober, 2012; Caradonna, 2014). This broadening was the direct result of the United Nations World Commission on Environment and Development report *Our Common Future*. The report defined sustainable development in conjunction with poverty mitigation. Its precise wording merits quoting at length: "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. Thus the goals of economic and social development must be defined in terms of sustainability in all countries - developed or developing, market-oriented or centrally planned*" (Brundtland, 1987: 41). By highlighting the interrelationships between economic, ecological, and social developments, between generations, and between global North and South developments, the report questioned how high-income country development impacts on the well-being of poorer countries. To accommodate this broad notion of sustainability, its measurement increasingly focused on larger indicator sets instead of composite indicators that capture all the effects in one number (such as GDP, Human Development Index, Footprint Index, etc.). Especially after the mid-1990s, national statistical institutes produced their own sustainability data, leading to over a thousand sustainable development indicator sets (Schoenakers et al., 2015; UNDP, 2018). This variety reflected great societal appreciation of sustainability issues, though the lack of a joint approach frustrated efforts to replace GDP in (inter)national policymaking.

The financial and economic crisis of 2008, seen by some as a climate and societal crisis too, triggered an effort to align existing datasets into

a commonly accepted standard for measuring sustainable development. In 2009, the French president Nicolas Sarkozy commissioned the Stiglitz-Sen-Fitoussi Report, co-authored by two Nobel laureates (Stiglitz et al., 2009). In the wake of this initiative, the UNECE, the OECD, and Eurostat formed the Taskforce for Measuring Sustainable Development (TFSD). Its remit was to come up with a measuring system for sustainable development that would be acceptable to member state statistical offices.

Initial TFSD discussions focused on three important options. The first revisited the debate on a broad versus narrow concept of sustainability. Environmentalists argued that sustainability should refer solely to ecological issues; they feared a broader concept might reproduce the dominance of economic issues. The TFSD nevertheless opted for a broad perspective in order to explicitly identify and analyze fundamental trade-offs between economic, societal, and environmental issues. This decision built on the literature about trade-offs between investments in economic, human, social, and natural capitals in economic growth theory (Friedman, 1957; Romer, 1986; Romer, 1994; Mankiw et al., 1992; Grootaert, 1997; United Nations et al., 2012). To satisfy the environmentalists' concerns, the TFSD decided that the measurement system must clearly emphasize the natural resources that could be depleted to the point that all life on earth would be jeopardized.

The second option was somewhere between a future-oriented and a so-called 'integrated' perspective. Originally the sustainability debate focused on meeting the resource needs of future generations. However, in order to inform contemporary policy debates and choices, the measurement system should integrate the analysis of *present-day* as well as future needs. Measuring both present-day well-being and the resources needed for future well-being helps to evaluate the implications and trade-offs of political choices for current and future generations.

A similar argument applies to the third TFSD option, of either a composite indicator or indicator sets. The TFSD highlighted several problems with composite indicators: there was no consensus whatsoever on how to weigh different sustainability indicators when combining them in one single measurement. Attributing relative weights to different sustainability indicators involves political choices, which a composite indicator obscures. Equally, a composite indicator obscures the sustainability trade-offs implied by policy choices. By contrast, a large sustainability indicator set invites explicit discussion on weighing different sustainability aspects, and facilitates a fine-grained evaluation of the sustainability pros, cons, and trade-offs.

Based on these considerations, the TFSD final report *Conference of European Statisticians (CES) Recommendations on Measuring Sustainable Development* (UNECE et al., 2014) presented an extensive and flexible indicator framework. Its measurement system distinguishes human well-being indicators in three conceptual categories or dashboards for "here and now", "later", and "elsewhere". The "here and now" dashboard identifies and analyzes economic, social, and environmental dimensions of the current generation's well-being on a country level. The "later" dashboard analyzes the distribution of economic, human, social, and natural capital across generations, still on a country level. The "elsewhere" dashboard describes the external impacts of generating domestic sustainability and well-being in a specific country. Indicators range from footprint indicators, showing how imported non-renewable natural resources deplete resources abroad, to indicators for human capital migration, knowledge capital exports, and international aid.

The CES monitoring system was endorsed by statistical offices in 65 countries. Of course, data for the suggested indicators is not always available—especially when doing historical research, or studying low-income countries that lack a strong statistical tradition. The CES Recommendations thus presented not only larger indicators sets (two sets of 60 and 90 indicators), but also a smaller set of 24 indicators describing key aspects of the measurement framework for which data is widely available. In this small set, broader themes such as "education", "health", and "nutrition" in the "here and now" dashboard were identified by extensive literature and dataset research in the global North as well as the South; and thus from a statistician's perspective, were considered universal. Conversely, specific proxy indicators can be seen as temporally and spatially specific, pending on data availability and relevance. For instance, "nutrition" can be measured in terms of under- and malnutrition in low-income countries and obesity prevalence in high-income countries.

For our analysis, we build upon such a smaller indicator set (see Appendix 1). Particularly relevant is a recent historical sustainability study for the Netherlands (Lintsen et al., 2018), which used the CES small indicator set to produce (un)sustainable development time series. These proxy indicator time series were qualified, explained, challenged, and corrected through qualitative historical research on historical actor perceptions of, and responses to, the 'societal challenges' of their times. The study describes the decisions by 19th century governments and industries to exploit natural resources in order to tackle extreme poverty and improve living conditions, health, education, and other human and social capitals, thus greatly bettering most economic and social development indicators at the expense of environmental ones. This pattern in domestic sustainability trade-offs became increasingly disjointed since the 'great acceleration' after World War II (Steffen et al., 2015). Another important insight is that in recent decades, environmental protection policies have helped to improve or at least stabilize some domestic environmental indicators. But these policies have also inspired substituting domestic resource exploitation with imports, in effect exporting once-indigenous environmental pressures abroad (Lintsen et al., 2018; Veraart, 2019). Notably, the setup of this particular historical study did not allow for investigating the connected sustainability histories of diverse localities in the global North and South; it studied developments within one well-delineated country, black-boxing limited "elsewhere" implications by using a footprint approach.

2.2. Adaptations and research design

Our task is therefore to explore whether the CES measurement system can open up the historical research of transcontinental sustainability telecouplings and associated sustainability trade-offs between distant regions. For this purpose we propose a sequential explorative research design. This places the "elsewhere" or "connections" dimension up front, and combines the incommensurable methodologies of transnational analysis (following connections and rejecting *a priori* geographical delineation) with comparisons that isolate national units of analysis, to facilitate meaningful comparison (Haupt and Kocka, 2009). Thus section 3 discusses transnational oil connections within and between the Niger and Rhine deltas, for which purpose it supplements the CES country-level "elsewhere" indicators with the quantitative and qualitative exploration of transcontinental oil flows and their implications in a broader transition to an oil-based economy at both ends of the supply chain. Sections 4, 5 and 6 offer a national comparison of sustainability changes in the Nigerian and Dutch oil chain economies, using the country level indicators of the CES "here and now" and "later" dashboards to explore sustainability trade-offs within and between the two economies. In order to further mitigate the methodological nationalism of the comparison, we also compare country-level results with the oil hotspots in southeastern Nigeria and the Rotterdam harbor region.

These choices come with several caveats regarding data poverty and unreliability, the risk of reproducing methodological nationalism by using country-level data sets, and potential anachronisms and Eurocentricities stemming from taking present-day, North-born sustainability debates as our interpretive framework. All these concerns are known to be particularly problematic for the Gulf of Guinea region (e.g. Bourne, 2015; Mangarella, 2019). We try to anticipate and correct for interpretation errors with qualitative insights on historical processes and actor experiences. For the time being, these insights are based on limited engagement with secondary literature. In accordance with these

caveats, our investigation takes the form of a sketchy yet structured narrative exploring whether the CES approach can uncover sustainability trade-offs in time and space.

3. Connecting the Niger and Rhine deltas

To explore the oil *connections* between and within the Niger and Rhine deltas, we start by tracking Royal Dutch Shell to highlight the creation of connective oil infrastructure. We then present trade data specifying the dynamics and importance of transcontinental oil flows. Our examination discusses how oil flows across each region's political and sector boundaries further contributed to broader transition to an oil-based economies, indicating the pivotal role of oil in connecting the Dutch and Nigerian sustainability histories compared in subsequent sections.

3.1. Building connective infrastructure

The histories of the Niger and Rhine deltas became increasingly connected from the 1950s onward. Perhaps the best way to explain this connective take-off, is by considering, among many actors, Royal Dutch Shell's role in building connective oil infrastructure. This oil company initiated the construction of the Nigerian-Dutch oil supply chain and associated flows of oil, capital, knowledge, labor and much more. It became a key player in the Nigerian as well as the Dutch transition to an oil-based economy, and remains central to Foreign Direct Responsibility debates today.

The Dutch East Indies had been the birthplace of Royal Dutch Petroleum, which after an alliance with the Shell Transport and Trading Company, formed Royal Dutch Shell in 1907 (Jonker and van Zanden, 2007). Together they pioneered an integrated oil company: The Dutch partner was responsible for exploration and oil production activities, the British partners provided transport and storage. The Dutch-British Shell group established subsidiaries, including one in the British colony of Nigeria, which in 1936 gained exclusive rights to explore Nigerian oil reserves (Steyn, 2009). The Dutch Indies remained Shell's key production site until World War II and the Indonesian War of Independence, which forced the company to intensify oil production elsewhere and ultimately sell its Indonesian assets to the Indonesian government.

Following a postwar policy of 'decentralized expansion', Royal Dutch Shell parented a host of national operating companies able to adapt to distinct political environments. In Nigeria, Shell resumed oil explorations together with Anglo-Iranian (forerunner to British Petrol) in 1946. The British authorities viewed these oil explorations in the light of post-war economic recovery and colonial development programs (Steyn, 2009). Onshore oil was found in 1953 at Ataka in central Nigeria; subsequently large oil deposits near Oloibiri and Afam in the Niger delta after 1956. Shell built extraction and pipeline infrastructure to transport crude oil to Port Harcourt harbor. By 1958, Shell had discovered oil in twelve areas of the Niger delta, and that year the first crude oil was shipped out of Port Harcourt to Rotterdam.

The discovery of Niger delta oil, combined with the aftermath of the 1956 Suez Crisis, drove other Western oil companies to the region in a veritable Gulf of Guinea oil rush, which would transform the region into Africa's largest oil extraction area. Nigeria became its largest exporter. Here, Shell Nigeria continued to play a pivotal (and much criticized) role in Nigerian natural, financial, and human capital development, as well as in politics—even though its share in Nigerian crude oil production declined from a monopoly in the 1950s, to 73% in 1970, and about 50% in the early 1980s (Okorobia and Oladi, 2018). At the same time, Shell and other oil companies expanded into several countries in the Gulf of Guinea; for example, Shell also became a key producer in Cameroon, the Democratic Republic of Congo, and Gabon. Also Chevron, Elf and Eni were active in four or five Gulf of Guinea countries (Yates 2004: 47).

Tracing Royal Dutch Shell also sheds light on oil infrastructure expansions on the Rhine delta side of the oil supply chain. Shell's oil was considered a major asset in Dutch post-war recovery planning. The traditional economic pillars of agriculture and trade were considered insufficient sources of future employment and welfare for a growing population. In response, the Dutch government, the Rotterdam harbor authority, Royal Dutch Shell, and other stakeholders teamed up to develop oil as the 'engine' of an ambitious postwar industrialization program. The package included massive investments in the oil handling capacity of Rotterdam harbor where the Rhine and Meuse rivers enter the North Sea. The new Botlek (1954–1960) and Europoort (1958–1964) oil terminals facilitated a steep increase in oil import capacity. With Shell as a so-called 'first mover' (Boon, 2014: 13), oil became the largest incoming commodity and earned Rotterdam the title of the world's largest port by 1962. The share of oil in the harbor's total commodity throughput increased from 25% in 1950 to about 70% on the eve of the 1973 Oil Crisis; in 2018, crude and mineral oil still accounted for about 43% of incoming tonnage (Boon, 2014: 12; Havenbedrijf Rotterdam, 2019).

In addition, the Shell group greatly expanded its refinery capacity in Rotterdam as well as further upstream the Rhine in Dusseldorf, Germany (Wever, 1974). The same expansion happened at Shell's petrochemical complex near Rotterdam, which by the late 1950s produced over a thousand products for the plastic age. The oil supply chain from Rotterdam continued; Shell's tanker trucks and pipelines supplied petrol to its roadside tank station network (Shell is still a market leader in the Netherlands, with some 600 filling stations), kerosene to Schiphol Amsterdam airport, and marine fuel oils for inland and international shipping (Homburg et al., 2000; Howarth and Jonker, 2007; Leenaers, 2012; Notten et al., 2016).

3.2. Trade data

Trade data further specifies the oil connection between the Niger and Rhine deltas. It shows that West African rentier states restructured their national economies around oil exports. In the case of Nigeria, oil replaced agriculture as the main pillar of exports in the decade after independence in 1960: oil's share in total Nigerian export value increased from 3% in 1960, to 32% in 1966, 60% in 1970, and over 90% in the 1980s and 1990s (Akindele, 1986; Okorobia and Oladi, 2018). The share then fell to about 80% in 2010 following attempts to diversify the economy.

We can trace the oil flow from Nigeria to the Netherlands mainly through Shell. Fig. 1 shows that periods of rapid growth alternated with low trade volumes. Shell initially exported most oil from Nigeria to refineries in the UK and elswehere in Europe, while expanding its Dutch

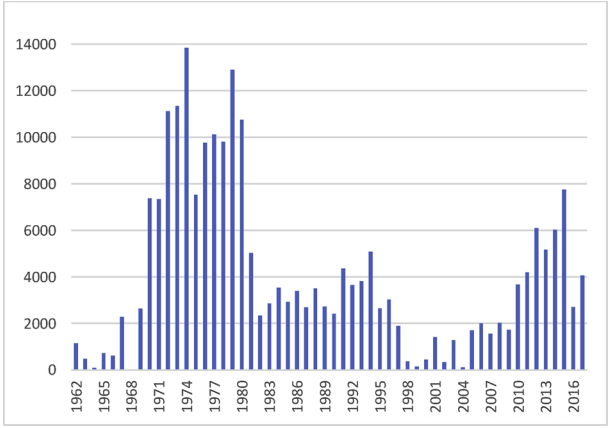

Fig. 1. Volume of Nigerian crude and partly refined oil imports to the Netherlands, 1962–2017 *(in million kg)*. Source: UN Comtrade (Petroleum, crude and partly refined – 331).

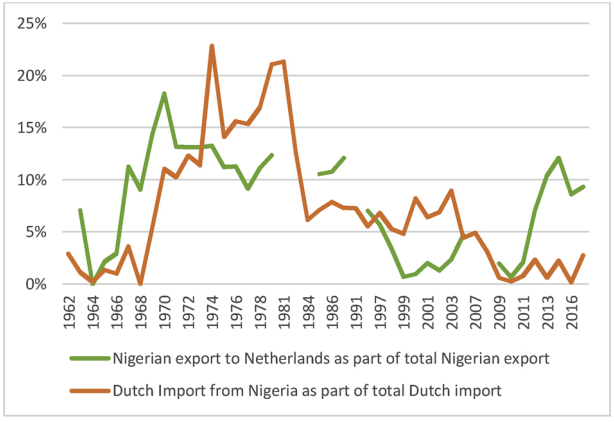

Fig. 2. Nigerian exports to the Netherlands as percentage of total Nigerian crude and partly refined oil exports, and Dutch imports from Nigeria as percentage of total Dutch imports of crude and partly refined oil, 1962–2017 (percentage of mass flows). Source: Processed data base, UN Comtrade (Petroleum, crude and partly refined – 331).

refining capacities near Rotterdam. Especially the 1970s witnessed a strong growth of Nigerian oil imports to the Netherlands. Having accounted for around 3% of total registered Nigerian oil exports in the early 1960s, that share increased to 13% a decade later, dropping to 10% in the 1980s. By the late 1990s, exports to the Netherlands plummeted; only in recent years have these recovered to around 10%, as shown in Fig. 2.

The declining importance of exports to the Netherlands mirrors the growing importance of Nigerian oil exports to the United States. The US share of Nigerian oil exports increased from 2% in the mid-1960s to 40% by the late 1970s. This rapid increase was for many geopolitical reasons, but in the context of sustainability trade-offs, American environmental legislation to lower SO_2 emissions played its role in favoring lower-sulfur Nigerian oil over South and North American oil.

Trade data also shows that crude oil played a considerable role in Dutch imports. The average annual growth of the Nigerian oil imports to the Netherland amounted to circa 20% in the 1970s. Nigerian crude was only one of several sources of Dutch oil imports: In 1965–1985 it accounted for 8% of the total. This share dropped to 4% from 1985 to 2000. Recently this has further declined, currently comprising 2% of Dutch oil imports (see Fig. 2).

We conclude that the Niger and Rhine deltas were certainly connected through oil. This was not a 1:1 relationship: Nigerian oil exports had other destinations, and Dutch oil imports had other sources. Although both regions were important nodes in a global web of oil infrastructure and flows, their oil histories should clearly not be studied in geographical isolation. We argue that the same applies to both regions' sustainability histories.

3.3. Sociotechnical transitions and connected histories

To substantiate these sustainability histories, we consider the transition to an oil-based economy and society in both deltas. Through these transitions, the oil connections between both regions also came to connect their broader economic and sustainability histories, which we compare in the next sections.

In sociotechnical transition studies, economy-wide or society-wide transitions have recently been conceptualized as 'connected' or 'deep' transitions across a broad range of sociotechnical function systems —including energy, mobility, production, consumption, military, and many other systems (Högselius et al., 2015; Schot and Kanger, 2018; van der Vleuten, 2019a). Significantly, oil connected various system transitions across sector boundaries in the 1950s and 1960s. Cheap and abundant imported oil was key to the energy-intensive society that took off in the Netherlands: this was a veritable energy system transition, when energy use increased by a factor of 4–5 before the S-curve flattened considerably after 1973. Oil's role in this transition is indicated by its share in the energy balance, which increased from 20% in 1950 to over 60% in 1965. After that, domestic natural gas joined imported oil as the chief energy carrier (Hölsgens, 2016; CBS Statline, 2017).

Simultaneously, oil facilitated a connected transition of the transport system towards motorization: in the mobility explosion of the 1950s and 60 s, car traffic came to dominate the transport of people and cargo (Mom and Filarski, 2008). Yet another connected transition concerned industrial production, where oil fuel and feedstock were part of the vast growth in energy-intensive and capital-intensive industries. The petrochemical industry was iconic for this development: besides the Royal Dutch Shell factories, the Rotterdam harbor authority and the Dutch state managed to lure a host of foreign oil and petrochemical companies to the area, offering cheap land, low taxes, and access to the European Economic Community market. The region between Rotterdam and Antwerp emerged as Europe's petrochemicals hotspot, from where products were distributed across the subcontinent (Wever, 1974; Homburg et al., 2000; Högselius et al., 2015: 144–159; de Goey et. al, 2003). Plastics, automobiles and numerous other products of this industrial transition led to Dutch consumer society accelerating in the post-war decades. Regarding the Rhine delta end of the oil supply chain, multiple oil-connected transitions interacted to create the oil-based economy and its environmental problems (Lintsen et al., 2018: 346–349; CBS, 2016)

Similarly connected transitions in oil, energy systems, car society, omnipresent plastics, and more took place in the Niger delta, though we are not aware of any historical transition analysis. However, this is amply compensated by a vast amount of literature on the entanglement of the region's oil sector and its political systems. Governing elites in West African rentier states teamed up with foreign oil companies to make oil exports their main source of revenue, accounting as we have seen for 80–90% of total exports and 97% of government revenues (see section 5) in Nigeria. The oil sector's contribution to GDP was lower but nevertheless increased impressively, from under 10% by 1970 to over 20% only three years later, and later fluctuating to 30–40% (Okotie, 2018). The formal economy as well as the state system thus became intimately tied to oil, and the literature amply exposes the uneven distribution of gains and costs among social groups, and all the ensuing social and ecological conflicts typical of resource struggles (Omeje, 2006, Omeje, 2008; Obi, 2012). While oil companies and state actors have been abundantly studied, scholars call for more research on the implications for, and the agency of local communities (Mangarella, 2019).

These observations confirm that in both the Niger and Rhine deltas' oil was crucially implicated in broader economic, societal, and environmental changes. Not only the oil histories, but also the broader sustainability histories of either regions should thus be studied as connected and mutually shaped. That said, such as transcontinental sustainability history can profit from a comparative approach (which methodologically isolates and compares both regions) in order to identify sustainbility trade-offs within and between both regions. The next sections illustrate this approach and offers a national comparison of the sustainability histories of the Netherlands and Nigeria. This national comparison leads us to one final comment: in line with global and transnational history insights, sociotechnical transition studies alert us not only to deep transitions across sector boundaries, but also across the political boundaries of nation-states. This applies to the Niger delta region and the Rhine delta region. Indeed, studies have amply discussed the transnational 'Rhine economy' from the Dutch delta via the German Ruhr area to the upper Rhine area in Switzerland, and the role of oil and petrochemicals there (notably de Goey et al., 2003; Boon, 2014, 2018; Högselius et al., 2015). The same is true of the Gulf of Guinea, where the economies of different countries were connected by legal and illegal flows of oil, migrant workers, motorized vehicles, pollution, the

corporate structures of oil companies active in multiple countries, and governance structures for transborder oil fields and pollution such as the Gulf of Guinea Commission (Traub-Merz and Yates, 2004; Onuoha, 2012). By narrowing our focus to a national comparison of Dutch and Nigerian sustainability histories, we are using these categories as proxies to explore the dynamics of sustainability trade-offs within and between global North and South locations in a geographically open system.

4. (Un)sustainability trends in the Netherlands and Rotterdam 1950–2015

Our discussion of Dutch sustainability trends and trade-offs draws on a more elaborate study of Dutch sustainability history (Lintsen et al., 2018). This highlights oil-related developments, adding an analysis for the Rotterdam region. Appendix 2 presents the data for the Dutch ´here and now´ and ´later´ monitors.

4.1. Here and Now – Dutch demand from 1950 to 2010

We start the analysis with demographics. Between 1950 and 2010, the Dutch population increased from 10 million to over 16.5 million. The city of Rotterdam's population increased after the war to 731,000 in 1965, then dropped to 686,000 in 1970 and 593,000 by 2010. The number of inhabitants in the greater Rotterdam region increased from 1.2 million in 1970 to 1.4 million in 2010. These demographics reflect the urban sprawl in the Rotterdam area, facilitated by increasing personal wealth, low fuel prices, and the motorization of private mobility.

Indicators for material well-being show vastly expanding per capita consumptive expenditures, fewer income and gender inequalities, and high life satisfaction scores. The post-war transition to an oil economy thus came with powerful economic growth broadly shared among the population (Salverda et al., 2013, 2014, Borbély, 2016). In the 1970s, dampened technological innovativeness and economic crisis may have harmed labor-intensive industries, reduced exports and caused economic stagnation, reinforced by increasing oil prices (Smits, 2003). However, the increasing consumption fostered economic growth. Economic stagnation in the 1980s was followed by a new upsurge in economic prosperity in the 1990s that lasted until the financial and economic crisis of 2008. Increased consumptive expenditures were reflected in households' continually improving material well-being.

Personal characteristics also indicate generally favorable developments between 1950 and 2010. The average Netherlander lived longer, healthier, in better housing, and with better utilities. Water, natural gas, and electricity networks penetrated every corner of the country. In the 1980s, the last slums fell prey to urban renewal projects. Investments in education manifested themselves in an expansion of compulsory schooling and a growing number of students in vocational and academic educational programs. Netherlanders continued to be educated longer and better.

On the downside, the economic slowdown of the 1980s and the recession after 2008 had a negative effect on employment. After periods of 10% unemployment in the 1980s, this percentage declined gradually to about 5% around 2010. The risk of becoming a murder victim also increased, especially in large cities like Rotterdam. The number of crimes registered nationally grew from 103,000 in 1950 to 833,000 in 2017, meaning an increase from 10 to about 50 crimes per 1000 inhabitants. Rotterdam counted 90 crimes per 1000 inhabitants in 2017 (CBS Statline, 2019; Nieuwbeerta and Deerenberg, 2005).

Country-level indicators for the natural environment show an improvement in local water and air quality, yet an increase in 'global' greenhouse gas emissions. Concerning emissions, the Rotterdam region was a hotspot of concern and action. The industrialization of the Rotterdam Harbor region had put increasing pressure on the natural environment and the local quality of life. In 1948, the city established a Soil, Water and Air Commission to investigate excessive quantities of fluoride and sulfur dioxide in the region's atmosphere, emitted by artificial fertilizer factories, electrical power plants, and oil refineries (Buijsman, 2010a,b, 2011). In the 1960s Rotterdam suffered regular 'smog' conditions due to the polluted air. This added fuel to the fire of the scientific, political, and public debate. Protest groups like the *Society against Air Pollution in and around the New Waterway* (1963) and the *Committee for the Habitability of the Waterway Region* (1968) became the protagonists of dissatisfaction. Municipal politicians, scientists, and local experts followed up with measures. Local groups continued to demand solutions for livability and environmental issues. The government appointed nation-wide Air Pollution Councils and developed a law on air pollution in 1963 that came into force in 1971.

Creating the new regulative structure was impossible without knowledge of air quality and spurred the development of a national air quality monitoring network. The first fully automated measurement network, using 'sniffing poles' to monitor air quality, was set up in 1969 in Rotterdam's harbor region. This system was gradually expanded and in 1975 a national air-quality monitoring network was completed (Buijsman, 2003, 2015). Systematic measurements in Rotterdam and Amsterdam dating back to the 1960s revealed high but declining concentrations of sulfur dioxide and 'black smoke' (see Fig. 3). The transition from coal to oil and especially natural gas showed beneficial knock-on effects. The heyday of choking air pollution seemed definitely over by the end of the 1960s (Buijsman, 2010a). This, however, did not shift the spotlight from air quality; nitrogen oxides and dust particles became the new points of concern (Buijsman, 2010b).

The need for more data on the composition of the air and its consequences for health shaped a new agenda for research institutes and policymakers. Local interest groups developed into environmental organizations. Water and air pollution were no longer accepted as the inevitable outcome of improved well-being; around 1970 some concluded that the price of this kind of well-being was far too high. New demands on the quality of air, water, and soil became the overture to the sustainability problems of the following decades. Air and water pollution started to show signs of recovery in the course of the 1980s and thereafter (CBS et al., 2016a, 2016b).

The pre-war decline in biodiversity was halted in the period under consideration. After the 1990s there was even talk of improvement, but generally the natural environment in the Netherlands continued to be under serious duress (CBS et al., 2015; PBL, 2014). Per capita emissions of greenhouse gases continued to increase. Measures to combat climate change did little more than stabilize emissions at 1980s levels. The consumption of fossil fuel energy and the per capita contribution to the global climate problem remained as high as ever. Dutch per capita emissions were higher than in the surrounding countries of Belgium, Germany, France, the UK, Norway and Denmark (EDGAR, Emission Database for Global Atmospheric Research, 2016).

Comparing indicators of the well-being 'here and now' dashboard for 1950 with those of 2010 reveals a mixed picture. Poverty, the major issue of well-being and sustainability in the early twentieth century, had become totally irrelevant. Improvements to quality of life focused on income security and material wealth. The last remnants of poverty,

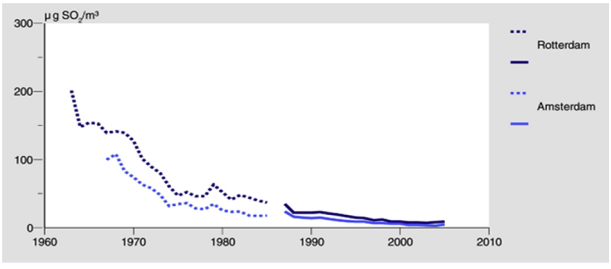

Fig. 3. Yearly average sulfur dioxide concentrations in Amsterdam and Rotterdam, 1965-2005. Source: Buijsman, 2010a.

the housing shortage and particularly the slums, were resolved in this period. Other issues came to the fore: criminality, work, nature, environment, and climate change.

4.2. Dutch savings for ´later´

The 'later' dashboard investigates whether contemporary generations increased or reduced the natural, economic, social and human capital available to later generations. Regarding economic capital indicators, the Dutch economy experienced rapid and stable growth in the 1950s and 1960s. Businesses and government invested in knowledge development, education, innovations, and infrastructures. The economic structure of the Netherlands changed radically after the mid-1970s. New investments were called for, enabled by the exploitation of national reserves of natural gas. Economic capital continued to develop favorably thanks to the strong growth in investments, though at the cost of rising national debt—a problem for subsequent generations. The growing stockpile of knowledge had a positive effect on economic capital. Research expenditures by private firms and the government came close to the European average. By 2011 the Netherlands found itself in the European middle-tier, spending just over 2% of its GDP on research (Davids et al., 2013; Manshanden et al., 2013).

These investments also had an impact on human capital. Expenditures for higher education increased. By 2010, 28% of the Dutch population had an academic degree. Thanks to investments and new constraints on compulsory schooling, the number of students in secondary and tertiary (higher vocational and university) education increased–despite the demographic decrease. The Netherlands now boasted a better educated and (insofar as this can be deduced from life-expectancy) a healthier workforce. Insecurity about employment, however, had risen since the 1980s. More flexible work situations via employment bureaus, temporary contracts, and part-time work increasingly became the norm.

Indicators for social capital shifted in this period. Stable ´pillarized´ society, organized along the lines of confessional and political institutions disappeared. The 1970s saw a new social climate, influenced by 'left-wing, anti-authoritarian' youth groups and environmental groups dedicated to preserving nature and the environment. By 2010, the political climate had shifted to so-called 'right populism', a movement that was deeply skeptical about environmental problems and climate change, championing new issues like Dutch identity, the migrant problem, and integration.

Natural capital declined. Since the 1950s, industrialization had been causing many environmental problems due to unlimited emissions deteriorating the quality of the air, water, and soil. Mounting general and political concerns for the environment and the natural surroundings led to environmental policies in the 1960s, which gradually improved the situation. The decline in biodiversity was turned around. On the other hand, incessantly growing consumption and production put undiminished demands on energy, land-use, and raw materials. Despite increasing social and political concerns about inter-regional, international and global environmental problems like acid rain and climate change, energy consumption in the 1980s was still based largely on the combustion of fossil fuels. In 2010, only 4% of energy consumption was derived from renewable sources (Meurink and Segers, 2015). Energy transition was still very much in its initial stages. Yet this period saw an unmitigated negative development of greenhouse gas emissions. Past generations shifted the burden of these environmental problems to future generations.

5. (Un)sustainability trends in Nigeria 1970–2015

Studying Nigeria´s past is challenging. According to historian Richard Bourne, "anyone who claims to understand Nigeria is either deluded or a liar. It comprises so many ethnicities and perspectives, with a contested past and statistics to be taken with pinches of salt" (Bourne, 2015). Forewarned, but trying to avoid throwing out the baby with the bathwater, we based our overview on limited use of secondary literature. It can therefore only be sketchy, and the data should be seen as an estimate of major developments. Our analysis is more an initial assessment of sustainability trade-offs, rather than an explanation of complex multi-cultural societal developments.

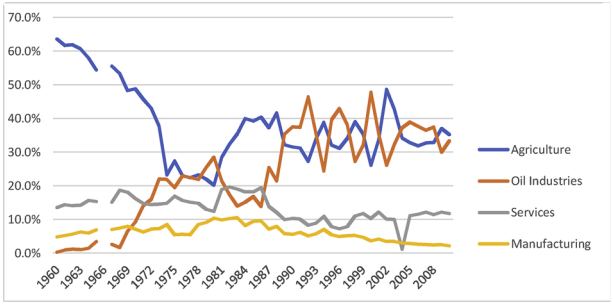

Fig. 4. Various sectors' contributions to Nigerian GDP. Source: Central Bank of Nigeria Statistical Bulletin 2010 (Okotie, 2018).

Because of limited statistics, the monitor overviews are restricted to the developments around 1970 when Nigeria's shift to oil was becoming a broader socio-economic transition: in 1970 oil only contributed to 7% of GDP (see below). After Nigeria joined the Organization of Petroleum Exporting Countries (OPEC) in 1971, this changed the business model: Exporting countries demanded a bigger share of the profits. In 1977, when Nigeria established the Nigerian National Petroleum Corporation (NNPC), Shell and other foreign oil companies were forced into joint venture partnerships, with the NNPC as majority partner. Governments focused on oil export profits and neglected investments in other economic activities, especially agriculture. Nigeria transitioned from a food exporting country in the 1960s to a food importing country in the 1970s (see Figs. 4 and 5) (Okorobia and Oladi, 2018). Oil profits furthermore became a source of inter-regional and cultural conflicts. Oil played a major role in the Nigerian Civil Biafran War (1967–1968) and has fueled ongoing violent political, ethnical, and cultural conflicts since the 1990s (Uche, 2008; Amenaghawon, 2016). Since independence, the promise of oil has united Nigerian regions, but 'destroyed the social, economic and political fabric from within', as Nigerian governance scholar Chibuike Uche concluded: "Nigeria in the 1990s is in more dire straits, economically and perhaps even politically, than the Nigeria of the years when oil was not the mainstay of the economy" (Uche, 2008: 135).

5.1. ´Here and Now´ – Contemporary demand in Nigeria and the Niger Delta 1970–2015

Our overview of the ´Here and Now´ dashboard shows the changes in Nigeria´s immediate needs in selected years: 1970, 1981, 1990, 2010 and 2015 (Appendix 3). In this period Nigeria´s population tripled rapidly from 55 million to almost 180 million, bringing tremendous challenges to material well-being. Yet the dashboard suggests that

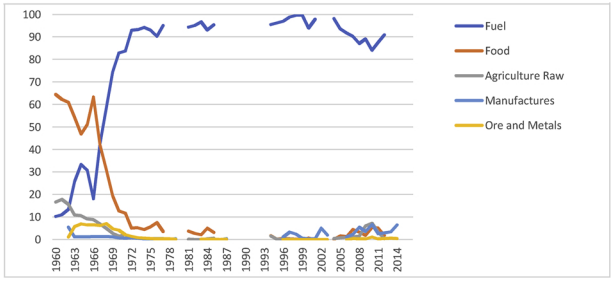

Fig. 5. Nigerian merchandise exports' share of total exports (1960–2015).

material well-being in Nigeria generally increased after the 1970s. Since the 1960s, the Nigerian economy had shifted from a self-sustaining producer and exporter of agricultural goods (cocoa, groundnuts, rubber, and palm oil) to an economy almost exclusively aimed at the production and export of crude oil. By 1970, once Nigeria had recovered from the devastations of the civil war (1967–1969), agriculture accounted for 49% of the national economy, and oil production was still under 10%; since the late 1970s, both sectors account for 25% of the national economy. In 2010 agriculture contributed 35% and the oil industries 33%. Oil became the key element in government revenues. From 7% of the national revenue in 1970, oil revenues shot up to 97% in 1990 (8). Material well-being, however, is unevenly divided. Since 1980, income inequality and absolute poverty levels have increased. Despite seeming to improve after 1990, the levels have remained higher than in 1981 (currently the first known data point).

On a country-level, the oil economy seemed to have a long-term trickle-down effect. The monitor reveals that health and living conditions started to improve in the 1960s already, despite the rapidly growing population. Average life expectancy at birth in 1960 was 37 years, which gradually improved to 53 years in 2010. Better housing and water supply followed the same upward trend. Also schooling seems to have improved dramatically.

The natural environment, however, deteriorated vastly from 1970 to 2010. The World Rain Forest Movement calculated in 1999 that 70–80% of Nigeria´s original forests had disappeared. More recent FAO investigations show Nigeria's continual deforestation. Population growth, poverty, and poor land use are seen as the major threats to Nigeria's biodiversity. About 70% of Nigerian households depend on fuelwood, and illegal logging is a major concern (Convention on Biological Diversity, 2015).

Generalized trust can only be estimated qualitatively in Nigeria. From 1970 to 1999, the country was led by military regimes, characterized by corruption and regular military coups. Since 1999, Nigeria has gradually (re)gained more democratic governments, with decreasing violence since 2010. However, corruption and a lack of trust in institutions still haunt Nigerians. Nigeria is one of the many sub Saharan countries in the lower ranks (144 out of 180) of the corruption perception index (Transparency International, 2019). Since the return of more democratic regimes, corruption perceptions seem to be diminishing slowly, but remain far more problematic than the world average. This lack of institutional trust is a major sustainability issue as it hampers the prospect of good governance.

Nigerian sustainability developments for immediate 'here and now' needs show distinct upward trends in personal well-being, economic, and human development. Income inequality remains an issue, along with the loss of natural capital and pollution of air and water. This trade-off in sustainability echoes Dutch experiences since the industrial revolution, though Nigerian shifts are much more rapid and disruptive.

5.2. Subnational conflicts, inequalities, and environmental problems

Zooming in on the oil extracting activities in the Niger delta, we find major issues that risk unwarranted underexposure in the country-level analysis. We mention three of these.

First, we point out the major discrepancies in interpretation between regional development studies and oil industry histories of southeastern Nigeria. Oil companies' accounts emphasize their gradual assimilation in the region and the nation. Initially, participation agreements governed Nigerian federal government co-ownership of oil companies: The federal government participated in Shell Nigeria for 35% (1973) and later 55% (1974). When the NNPC was set up in 1977, incorporating nationalized British Petrol and merging with Shell meant that 80% of Shell Nigeria equity moved into government hands. In 1989, this was reduced to 60% in order to attract capital. Additional agreements allocated 55% of the revenues from oil extraction to the federal government, against 30% to Shell Nigeria, 10% to Elf, and 5% to Agip (Boele et al., 2001a, 2001b; Sluyterman, 2007: 345; Okorobia and Olali, 2018). In these joint ventures, Shell controlled about half of the excavation operations (Onuoha and Elegbede, 2018). Regarding regional assimilation, Shell policy allocated greater responsibilities to Nigerian nationals and developed scholarships, management schools, and training programs at universities (Howarth and Jonker, 2007). The Nigerian teaching facilities established by Shell in the 1970s had a cumbersome existence, however, and in practice became a training ground for Shell expat managers (Hendriks, 1987). Since the late 1990s, the company has professionalized its educational programs in light of its corporate social responsibility strategy. Today, these investments feature proudly in Shell's sustainability reports. Joint venture contracts in the 1970s gradually shifted Shell management into Nigerian hands, and so 20% of the Shell Nigeria managers and 60% of the employees were Nigerian nationals; a decade later, Nigerians held 90% of Shell management positions, though the top management was European. By 2017, 95% of the employees were Nigerian nationals (Hendriks 1987; Royal Dutch Shell, 2017). These histories portray Shell and other oil companies as important regional and national development companies largely controlled by Nigerians.

By contrast, regional development studies present a much grimmer picture, highlighting all kinds of socioecological conflicts. Conflicts about land ownership, revenues, and compensation arose already during the oil explorations of the late 1940s. Colonial authorities framed these as nationalist opposition and responded with violent oppression. Seeking to regain authority, the colonial government introduced better communication with local communities and damage reclaim regulations in 1949 (Steyn, 2009). In the late 1950s, the debate about distribution of revenues and damage reclamation intensified, but now between local and national Nigerian authorities. In 1958, in the final years of British colonial rule, the revenue scheme for resource exploitation was restructured: rents and royalties should benefit not only the oil producing region (50%), but also the federal government (20%) and other regions (30%). After independence, the distribution of oil revenues became an important tool for federal control, and the oil-producing region's share was reduced to a mere 10%. It was no coincidence that the reformation of Nigerian states and subsequent reallocations of oil revenues in 1966 spurred the proclamation of the Biafran Republic by Eastern Region rulers. Oil was thus a key factor in the Nigerian Biafran Civil War (1967–1970). With British support, the federal government regained control. Successive regimes reduced Nigerian oil producing regions' revenues and increased federal control (Table 1). Revenue allocation structures continued to change and remained a powerful mechanism in forging at times extorted national unity in a culturally and ethnically divided country (Uche and Uche, 2004, Uche, 2008, Casertano, 2011).

A second crucial observation at risk of underexposure concerns local community conflicts and developments in the Niger delta. As Nigeria's major oil extraction region, the Niger delta contributed to the majority of government revenues. Yet rural communities do not seem to have benefited from the improvements in personal well-being and economic development indicated in the country-level monitor for the average population. Indeed, this region is reportedly below "every measure or

Table 1
Percentage of revenue reallocated to Nigeria's oil producing states.
Source: World Bank/Uche, 2008/Casertano, 2011.

1958	50%
1968	10%
1977	10%
1982	10%
1989	10%
1995	13%
2001	13%

indicator of development" (Ibaba, 2016). Oil industry pollution has destroyed the livelihood of farming communities and undermined social structures, and the inequalities of the Nigerian economic and political system hit especially hard on Niger Delta region inhabitants (Obi, 2010a,b, 2012, 2014). As one observer puts it, "Oil exploration has generated billions of dollars into the coffers of Nigeria, the inhabitants of the Niger Delta have misery, pollution, failed aquatic (marine) environment, poverty, sickness and death to show for it. Some have been forced out of their livelihood like fishing and farming as a result of oil spillage, pollution, gas flaring and acid rain" (Dode, 2012).

These inequalities and the insufficient compensation measures by the government and the oil industries sparked protests, sabotage, and armed conflicts in the Niger delta. Deteriorating living conditions gave rise to the launch of the Ogoni Bill of Rights in 1990, which underlined loyalty to Nigeria, but also asserted the Ogoni People's rights to self-determination and to environmental, social, and economic justice. The Movement for Survival of the Ogoni People (MOSOP) led by Ken Saro-Wiwa, successfully teamed up with the United Nations Working Group on Indigenous People. In 1992, MOSOP issued a ´demand notice´ to Shell and the other oil companies, listing their demands for compensation for past damages and impacts of oil production. The companies did not react and were declared ´persona non grata´ by MOSOP; violent clashes followed between Ogoni, other communities, and the Nigerian military. Despite several peace brokering attempts by the government and Shell's acknowledgment of the problems, the turmoil continued—and eventually led to the arrest and shameful execution of Saro-Wiwa in 1995. Amid world-wide public outrage, the collaboration between Shell and the military regime was seriously compromised, and traumatized Shell boards initiated social corporate responsibility (Sluyterman, 2007; Boele et al., 2001a, 2001b).

The conflicts and ensuing development problems also triggered mass migration to the cities. Port Harcourt, once known as a garden city, turned into a mega shopping town cramped with traffic and vast urban slums. About one third of its dwellings are illegal and lack sanitation and clean water supply. Wood fired stoves are a huge health threat (Jaja, 2010). Mass urbanization further undermines existing social structures, leading to increased prostitution, high school-pupil pregnancies, abortions, child abuse, matrimonial savagery, murder, theft and other crimes (Opukri and Ibaba, 2008, Jaja, 2010). Small wonder that the community's perception of the region is overwhelmingly negative and speaks of an oil curse (Odera et al., 2018).

A third observation concerns particularly grave negative effects on air and water quality as well as global warming in the delta region. Acid rain is widespread because of high SO_2 and NO_3 emissions. In 2017, 94% of the Nigerian population lived in areas with air pollution that exceeded WHO norms; the cities of Aba, Umuahia and Onitsha in southeastern Nigeria are among the ten most air-polluted cities worldwide (in PM_{10}, WHO, 2016). In addition, acid rainwater is widely used as drinking water (Ite and Ibok, 2013). Oil excavation activities jeopardize natural capital: The delta mangrove and swamp area form the largest wetland in Africa. It is Nigeria´s richest biodiversity area, harboring a very rich variety of wildlife (many endemic) and aquatic life. According to the World Bank "The full significance of the delta´s biodiversity remains unknown because new ecological zones and species continue to be uncovered, and major groups such as higher plants and birds remain unstudied in large areas" (Ebeku, 2004). Meanwhile oil and gas extraction, pipeline leakages, gas flaring, and oil spill fires contaminate water, soil, and air, thereby threatening biodiversity (Abii and Nwosu, 2009; Convention on Biological Diversity, 2015).

Unlike Nigerian national developments, Delta region sustainability indicators for 1970–2010 all indicate negative trends. Quality of life, social, human and natural capitals all decreased. The fruits of the oil trade were harvested elsewhere in Nigeria, and the resulting inequality was fertile ground for conflict.

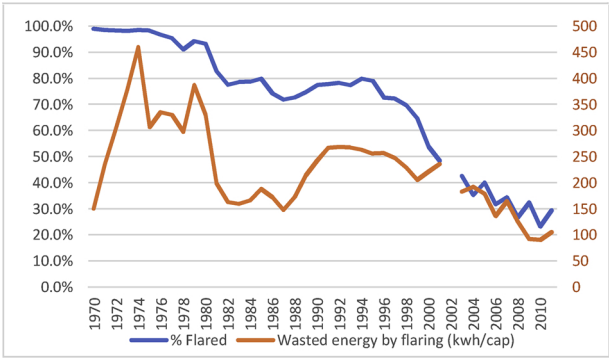

Fig. 6. Natural gas, percentage flared and wasted energy (in kwh/cap).

5.3. Nigeria's savings for ´later´

The 'later' dashboard maps the rise and fall in natural, economic, social, and human capital available to later generations. The (general) increase in well-being in Nigeria since the 1970s translated into investments in education and health. These are the positive signs on the 'later' dashboard. Indications of social capital development are too limited to draw conclusions. The main and immense challenges for the future concern Nigeria's natural capital.

Well-being has increased energy consumption from 29 to 144 kW h per capita. At the same time, energy was wasted in the oil industries, where most natural gas was flared due to the lack of viable markets. The early 1970s saw the flaring of ca. 20 billion cubic meters of gas, at that time representing over 450 kW h/capita; in the 1980s, natural gas was partly used for local consumption. In 2000, half of the natural gas was still flared; in 2010 23% (Fig. 6). Moreover, energy consumption did not include spilled oil. Between 1970 and 2010, Nigerian officials counted hundreds of spill incidents involving thousands of barrels (Fig. 7). Nor was the energy consumption of woodstoves accounted for in the official data.

These unaccounted sources and energy wastes may have had a far bigger impact on the development of natural resources than the official accounts. The earlier mentioned negative impacts of air, water, and soil pollution on biodiversity and living conditions have drawn more and more attention to these issues since the 1990s. Protection areas have been installed by law. The results, however, are very limited.

The dashboards ´here and now´ and ´later´ clearly show the trade-off at the country level: Economic and human capitals increased at the expense of natural capital, and some might argue social capital improved, especially institutional trust. The analysis also shows underexposure of vast socioecological inequalities and conflicts at a subnational level. Finally, the dashboards show Nigeria´s current and future sustainability challenges. The limitations of this article do not allow for deeper analysis of the fluctuations.

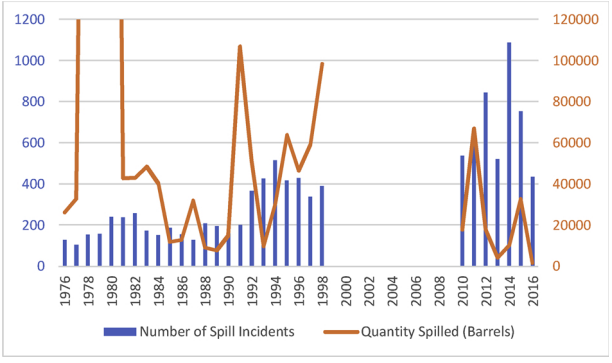

Fig. 7. Oil spill incidents and oil spilled (in barrels).

6. Comparison

The extraction, production, processing, and use of oil have greatly transformed the sustainability histories of both Nigeria and the Netherlands. The dashboards enabled us to chart the stylized facts of (un)sustainability developments in the Netherlands and Nigeria from the 1960s-70 s to the present, and to compare country levels. Such a comparison, surprisingly, exposes similar types of sustainability trade-offs within each region. Material well-being such as economic growth, personal characteristics such as increased life expectancies, and investments in human capital significantly increased in both countries. And in both countries, the oil producing and processing regions suffered environmental damage and decline in natural capitals. In the Netherlands this was halted and to a certain extent reverted after environmental and indigenous pressure groups lobbied politicians, triggering prevention and mitigations measures. In Nigeria, ecological damage continues to be a breeding ground for brutal conflict. This finding nuances the simplistic assumption that the global North held the economic sustainability gains while the global South suffered the social and environmental sustainability costs. It also shows that transcontinental sustainability trade-offs were not a zero sum game: economic growth and environmental damage occurred at both ends of the supply chain.

The comparison also exposes vast differences, notably regarding inequalities, conflicts, and the domestic distribution of sustainability gains and costs across regions and social groups. Dutch policymakers, companies and others teamed up in a nation-wide industrialization program driven by oil in order to secure future employment and welfare for current and future generations in an inclusive fashion; their efforts seemed to reflect a further reduction in inequality. By contrast, Nigerian elites battled over the distribution of revenues between oil producing regions and the state, but local communities were not part of the equation. The number of people living in absolute poverty increased by millions. And in the oil producing regions, urban slums increased and urban pollution expanded to world-record levels. These regions also suffered the most from rebellions and even full-scale civil war. The sustainability monitor tool in its present state is poorly equipped to adequately represent the misery of conflict regions.

The monitor-based comparison does speak directly to economic growth theory. Let us evaluate our findings accordingly. The economic growth literature suggests slow growth in the global South compared to the North; the same goes for improvements in well-being. It is often assumed that despite slow economic growth, the global South displays a relatively rapid depletion of capital, especially natural capital (Heuting 1980; Nordhaus and Tobin, 1972; Mankiw et al., 1992; Sachs and Warner, 1995, 1997a, 1997b; Panfold, 2017).

Indeed, per capita consumption in Nigeria expanded at a slower rate than in the Netherlands. However, in view of Nigeria's very rapid population growth, the increase in consumptive expenditure from 1980 to 2010 per head of population (31%) is remarkably high even compared to the 70% increase in the Netherlands (1970–2010).

Examining whether economic growth led to improved well-being, provides a mixed picture. In a purely economic sense, material well-being is poor in Nigeria compared to the Netherlands. Income inequality is increasing in Nigeria, whereas it shows a downward trend in the Netherlands. Besides, in some time-periods unemployment rates were astoundingly high in Nigeria (over 20%) compared to the Netherlands (1.5–5 %). This data unequivocally shows that economic growth was much more unevenly distributed in Nigeria, corroborating the standard notion that economic growth in the global South is not for the "common good" but rather benefits small segments of society. However, a broader set of indicators helps us achieve a much more balanced view. Next to conventional economic indicators such as the Gini coefficient and unemployment rate, our comparison included non-material aspects of well-being such as health and education. For Nigeria, the indicators on health and education, which are both important determinants of overall well-being, increased rapidly. So, despite the uneven distribution of economic growth, there seems to be a "trickle down" and a large part of the population sees its personal well-being in terms of improved health, housing, water supply, and educational attainment. Some of these indicators remain at unenviable levels. Nevertheless, investments in personal well-being outnumbered population growth, which is no mean feat. Dutch change rates in this area seem miniscule in comparison.

Our comparison confirms that levels of social capital remain relatively low in the global South (e.g. corruption scores) and that natural capital is rapidly depleting. As this affects the relationship between natural capital, social capital and inequality, it raises important questions for future research.

7. Conclusions

Understanding global sustainability challenges in the Anthropocene requires research that transcends conventional academic divides by space (global North-South), time (past-present-future), domain (economy-society-environment), and methodology (quantitative-qualitative), (van der Vleuten, 2020). We developed a tentative interpretative framework that does just that and tested it on the case of oil-connected (un)sustainability developments in the Niger and Rhine deltas. This explorative exercise yielded important insights.

First, our article responds to calls by scholars of sustainability telecouplings and Foreign Direct Responsibility to develop a global interpretive framework for analyzing (un)sustainable developments that capture sustainability entanglements across the global South-North divide (Liu et al., 2013; Hull and Liu, 2018; Faundez and Tan, 2015; Tan and Faundez, 2017). We added a temporal dimension: studying how sustainability gains and costs became distributed across different sites along transcontinental resource chains, involves considering the cumulative sustainability-related choices and experiences of different generations at multiple locations. Our transnational historical analysis of oil connections between the Niger and Rhine deltas showed that oil indeed linked the economic and sustainability histories of both regions, since the connecting oil infrastructure and associated actors and flows were crucially involved in a broader transition to an oil-based economy and society (also due to environmental implications) in both regions. The strongest connection between their histories was the take-off phase through Royal Dutch Shell and the Port Harcourt-Rotterdam oil flow; though that connection remained important, Nigerian oil exports later diversified, and Dutch oil imports had other sources. Both oil economies transcended national borders into neighboring countries. The connections analysis thus highlighted that the Niger and Rhine deltas are hubs in a global oil network that do not map neatly on the political division of the world into nation-states. Accordingly, our national comparison of two major global oil economies, Nigeria and the Netherlands, can serve only as a proxy for identifying and exploring possible sustainability trade-offs between oil-connected global North and South regions. Further research needs to bring the sustainability histories of many other oil-connected sites into that conversation.

Second, the relevant literature highlights a particular transcontinental sustainability trade-off, positing that global North actors and countries reaped the economic benefits while global South actors and countries bore the social and environmental costs. Comparing the connected Nigerian and Dutch experiences helped nuance that rather basic assertion. By mapping sustainability developments through a set of country-level indicators recommended by the Conference of European Statisticians (UNECE et al., 2014), we found similar sustainability trade-offs within Nigeria and the Netherlands. Welfare indicators such as longevity, housing, and education increased significantly in both countries despite vast population growth. Both places—the oil sector hotspots of southeastern Nigeria and the Rotterdam region in particular—suffered environmental damage (though this was partly mitigated in the Netherlands). The same applies to

trade-offs between successive generations: in both countries, past generations increasingly invested in economic and human capital for the benefit of later generations, while consuming natural and financial capital passed considerable challenges on to later generations. The comparison also exposed vast differences, notably in socioecological inequality and conflict trends. And even though oil companies and their historians tend to interpret struggles in Nigeria as domestic conflicts between Nigerian social groups and regions, oil companies' complicity and legal accountability are amply highlighted in the literature. Either way, the similarities between Nigerian and Dutch trends demonstrate that sustainability trade-offs between regions on different continents were not a zero sum game; their shape and distribution should not be assumed, and require detailed examination on a case by case basis. Global sustainability historians have work to do.

Third, our mapping of sustainability trends built on the CES sustainability monitoring tool, in particular its 'small indicator set' of two dozen indicators developed in view of the scarce historical and global south data. Our mixed methods approach complemented monitor insights with qualitative research in order to check, interpret, nuance or challenge findings. A key advantage of the monitor is that its common language can bring the sustainability challenges of successive generations all over the world into a joint conversation. It helps identify trade-offs between different sustainability indicators and the lock-in effects and path dependencies of past generations' choices. The risks of using the monitor to structure research include projecting explicit, but also unknown and implicit Eurocentricities and anachronisms built into this North-born tool onto past and global South experiences. Future research should therefore bring to the table the bottom-up experiences and concerns articulated by multiple generations and communities on different sides of the North-South divide in terms used by those communities; this would facilitate a critical and open debate about the selected themes and indicators that statisticians regard as 'universal' for human well-being and sustainability (de Hoop, 2018; Mangarella, 2019; van der Vleuten, 2019b).

We coined the notion of global sustainability history to bring together a number of academic debates: on sustainability in the global North and global South; on sustainability choices and experiences of different generations; and on quantitative and qualitative sustainability research. There is certainly much work to do. We hope this article shows that such work can be both rewarding and compelling.

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Appendix 1 Monitor (small set) Dashboards ´Here and Now´ and ´Later´

Dashboard well-being 'Here and Now'

THEME		INDICATOR
Well-being		
	Consumption, Income	Consumer expenditure
		General income inequality
		Gender income inequality
	Subjective well-being	Life satisfaction
Personal characteristics		
	Health	Life expectancy
	Nutrition	Height
	Housing	Housing quality
		Public water supply
	Physical safety	Murder victims
	Work	Unemployment
	Education	Level of education
	Leisure time	Leisure time
Natural environment		
	Biodiversity	MSA
	Air quality	SO_2 in air
		Greenhouse gasses
	Water quality	Public water supply
Institutional environment		
	Trust	Generalised trust
	Political institutions	Democracy

Dashboard well-being 'Later'

THEME		INDICATOR
Natural capital		
	Energy	Energy consumption
	Non-energetic resources	Gross domestic consumption
	Biodiversity	MSA
	Air quality	SO_2 emissions
		Greenhouse gas emissions
	Water quality	Public water supply

Economic capital		
	Physical capital	Economic capital stock
	Financial capital	Gross national debt
	Knowledge	Stock knowledge capital
Human capital		
	Health	Life expectancy
	Work	Unemployment
	Level of education	Schooling
Social capital		
	Trust	Generalised trust
	Institutions	Democracy

Appendix 2

Dashboard well-being 'here and now,' The Netherlands and Rotterdam 1950–2010
Source: Lintsen et al. (2018), p.30 and CBS-Statline (https://opendata.cbs.nl/statline/#/CBS/en/)

THEME	INDICATOR	UNIT	1950		1970		2010		
			NL	R´dam	NL	R´dam	NL	R´dam	EVAL
Population		million inhabitants[1]	10	-	13.0	1.2[G]	16.5	1.4[G]	
Material well-being									
Consumption, income	Consumptive Expenditures per capita/ constant prices	index (1850=100)	132		340		581		⇧
	Income inequality, general	Gini coefficient 0-1	0.40	0.39[R]	0.37	0.38[R]	(0.31)	(0.29)[R]	⇧
	Gender income inequality	% difference hourly wage M/F	28%		29%		19%		⇧
Subjective well-being	Satisfaction with life	Score 0-10	-		7.4		7.8		⇔

Dashboard well-being 'here and now' (continued)			1950		1970		2010		
Personal Characteristics			NL	R'dam	NL	R'dam	NL	R'dam	
Health	Life expectancy	years	72		74		81		⇧
Nutrition	Height (military conscripts)	cm	174		178		(183)		⇔
Housing	Housing quality	% slums			6		<1		⇧
	Public water supply	m^3/capita	44		109		120		
Physical Safety	Murder victims	per 100,000 inhabitants	0.4	0.5	0.7	1.0	(1.1)	(4.1)	⇩
Labor	Unemployment	% workforce	2.1		1.6		5.0		⇩
Education	Level of Education	years	7		9		(11)		⇧
Free time	Free time	hours / week	-		47.9		47.8		⇔
Natural Environment									
Biodiversity	MSA	% original biodiversity	55		66		(63)		⇔
Air quality	SO_2	µg SO_2 / m^3	14	>200	21	100	1.3	6.3	⇧
	Greenhouse gas emissions	ton CO_2 / capita	5.2		10.1		10.6		⇔
Water Quality	Public water supply	m^3/capita	44		109		120		⇧

Dashboard well-being 'here and now' (continued)			1950		1970		2010		
Institutional environment			NL	R'dam	NL	R'dam	NL	R'dam	
Trust	Generalized trust	% population with adequate trust			?		67		?
Political Institutions	Democracy	Democracy-index 0-100			39		(39)		⟺

⇧	Positive development
⇩	Negative development
⟺	Not positive/not negative
?	Unknown or irrelevant

Dashboard well-being 'later', NL 1950–2010

THEME	INDICATOR	UNIT	1950		1970		±2010 (2000)		EVAL
			NL	R'dam	NL	R'dam	NL	R'dam	
Natural Capital									
Energy	Energy consumption	TJ /capita			0.16		0.17		⟺
Non-fossil fuels	Domestic consumption	ton /capita			9.4		9.8		⟺
Biodiversity	MSA	% original biodiversity	55		66		63		⟺
Air quality	SO_2 emissions	kg SO_2/capita	14		21		4		⇧
	Greenhouse gas emissions	ton CO_2/capita	5.2		10.1		10.,6		⇩
Water	Public water supply	m^3/capita	44		109		120		⇧
Economic Capital									
Physical capital	Economic capital stock/capita	index (1850=100)			518		1046		⇧
Financial capital	Gross national debt	% GDP			48		59		⇩
Knowledge	Stock knowledge capital	index (2010=100)			30		100		⇧
Human Capital									
Health	Life expectancy	years			75		81		⇧
Labor	Unemployment	% workforce			1.6		5.0		⇩
Educational level	Schooling	years			9.0		(11)		⇧
Social Capital									
Trust	Generalized trust	% population with adequate trust			?		67		⇧ ⇧
Political institutions	Democracy	democracy index 0-100			39		(39)		⟺

⇧	Positive development
⇩	Negative development
⇔	Not positive/not negative
?	Unknown or irrelevant

Source: Lintsen et al. (2018).

Appendix 3

Sustainability Monitors for Nigeria 1970, 1980, 1990, 2010 and 2015.

Dashboard Nigeria ´Here and Now´			**1970**	**1981**	**1990**	**2010**	**2015**	
Theme	**Indicator**	**Unit**						
Population	Inhabitants		55,981,400	75,482,552	95,269,988	158,578,261	181,181,744	
Material Well-being								
Consumption	Consumptive expenditures	Constant billion US$ (2010)		100	72	280	320	⇧
		Constant billion US$ (2010) per capita		1333	759	1741	1746	⇧
	Household final consumption expenditure,	Constant 2011 international billion US$			203	541	647	⇧
Income	Income inequality	Gini coeff.		0.39	0.45	0.43		⇩
	Gender income inequality							
	Poverty gap at national poverty lines	% of population				17		
	Poverty headcount	(% of population) ratio at $1.90 a day (2011)		45.3	57.1	53.5		⇩
Subjective well-being	Satisfaction with life	Score 0-10						

Dashboard Nigeria ´Here and Now´ (continued) ***Personal Characteristics***			**1970**	**1981**	**1990**	**2010**	**2015**	
Health	Life expectancy	year	41.0	45.6	45.9	50.8	53.0	⇧
Nutrition	Height (military conscripts)	cm						
Housing	Housing quality	% slums						
	Population living in slums	*(% of urban population)*			77.3	62.7	50.2	⇧
	Improved water source,	*(% of population with access)*			76.4	63.4	68.5	⇩
	Improved water source, urban	*(% of urban population with access)*			76.4	79.9	80.8	⇧
	People using safely managed drinking water services	*(% of population)*				19.3	19.4	⇔
	People using at least basic drinking water services	*(% of population)*				59.3	67.3	⇧
Physical Safety	Murder victims	per 100,000 inhabitants			n.a.	10.7	9.8	⇔
Labor	Unemployment, total (% of total labor force) (modeled ILO estimate)	% workforce			5.9	7.3	4.3	⇧
	Unemployment, total	(% of total labor force) (national estimate)		3.9		21.4	4.3	?
Education	Level of Education	years						

	Secondary education, pupils		356,565	1,864,713	3,125,192	9,056,768	12,532,753	⇧
	Secondary education	Pupils / 1000 cap.	6.4	24.7	32.8	57.1	69.2	⇧
Free time	Free time	hours per week						
Natural Environment								
Biodiversity	MSA	% original biodiversity		Qualitative	Qualitative	Qualitative	Qualitative	↓
Air quality	SO2	kg SO_2 / capita						↓
	Greenhouse Gas emissions	ton CO_2 /capita	0.38	0.87	0.41	0.58	0.55	↓
Water quality	Renewable internal freshwater resources	m^3 / capita	3767	2853	2205	1509	1252	↓
Institutional environment								
Trust	Generalized trust		Low	Medium	Low			
		Corruption Perception Index			18 (1997)	24	26	↓
Political Institutions	Democracy	Democracy Index 0-100						

Dashboard Nigeria ´Later´								
Theme	**Indicator**	**Unit**	**1970**	**1981**	**1990**	**2010**	**2015**	
Natural Capital								
Energy	Energy consumption	TJ /capita						
	Electric power consumption	kWh/capita	29	51	87	136	144	↓
Non-fossil fuels	Gross domestic consumption	ton/capita						
Biodiversity	MSA	% original biodiversity						
	Marine protected areas	*% of territorial waters*			0,2		0,2	↔
	Terrestrial protected areas	*% of total land area*			11.57		14.18	⇧
Air quality	SO2 emissions	kg SO_2 / capita						
	Greenhouse gas emissions	ton CO_2 /capita	0.38	0.87	0.41	0.58	0.55	↓
Water	Public water supply	m3 /capita						
	Renewable internal freshwater resources	*m3 /capita*	3767	2853	2205	1509	1252	↓
Economic Capital								
Physical capital	Economic capital stock/capita	index (1981=100)		100	20	43	52	⇧
Financial capital	Gross capital formation	% GDP		89	53	17	15	↓
Knowledge	Stock knowledge capital	index (2010=100)						

Dashboard Nigeria ´Later´ (continued) Human Capital			1970	1981	1990	2010	2015	
Health	Life expectancy	years	41.0	45.6	45.9	50.8	53.0	⇧
Labor	Unemployment	% workforce						
	Unemployment, total	% workforce(modeled ILO estimate)			3.5	3.8	5.3	⇔
	Unemployment, total	% total labor force (national estimate)		3.9		21.4	4.3	?
Educational level	Schooling	years						
	Secondary education	*No. of pupils*	356,565	1,864,713	3,125,192	9,056,768	12532753	⇧
	Secondary education	*Pupils / 1000 cap.*	6.4	24.7	32.8	57.1	69.2	⇧
Social Capital								
Trust	Generalized trust	Corruption Perception Index			18 (1997)	24	26	⇧
Political institutions	Democracy	democracy index 0-100				3.47	4.44	⇧

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