



Global Emerald & Ruby Supply:
Analysing Market Data

Market Research

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GEMFIELDS

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I. Scope of this paper

The aim of this paper is to compile data relating to international coloured gemstone supply.

Due to the challenges outlined in section 2, most of the data presented is for all coloured gemstones taken together, including cut and polished gemstones. However, where possible, the focus is on rough rubies and emeralds (and sapphires to a lesser extent).

Production data is presented in both quantity, which can be stated in kilograms or carats (1 gram = 0.2 carats), and value, stated in US dollars (USD).

II. Challenges

Before drawing conclusions from the data presented herein, readers are alerted to the significant challenges related to obtaining data and information about coloured gemstone supply and the downstream market.

The major challenge when trying to assess worldwide coloured gemstone production is the lack of available data. The vast majority of coloured gemstones are extracted by artisanal mining, both formal and informal, for which no reporting standards – and scant data – exist. Private large-scale miners do not have to make their production numbers public. Formal mining operations must typically report their activity to their national authorities. However, the less economically developed countries (in which a large portion of coloured gemstones are extracted) do not always have strong reporting systems in place, and nor do they make available what little data they have.

If reported, the production figures are usually declared as total quantities or values of gemstones produced, but they rarely break down the varieties of gemstones.

Production information is typically declared either in terms of quantity or of value, but very rarely with both sets of data together. This is a major obstacle when trying to see the full picture of supply, because providing quantity with value represents an improved overall assessment of gemstone quality and pricing. Unlike with many commodities, gemstone pricing is enormously sensitive to subtle changes in colour and quality. For example, it is difficult to talk about the ruby market as a whole when it covers quality and price ranges from red corundum to fine exceptional rubies reserved for high jewellery and where the price per carat can vary 30 million times! This feature of coloured gemstones also has profound implications for deposit-hosting nations: allowing the price to be set at the point of export from the host country inevitably leads to acute under-pricing as the value is so subjective. This, in turn, highlights the fact that official export data is likely to seriously understate the true value of the gemstones.

Because production information is very rare, data for coloured gemstone exports from producing countries is presented and considered to reflect their domestic production (but note that export numbers could include re-exports and exports of gemstones produced much earlier in time). A further complication arises in that export data is often published for ‘worked’ gemstones (those that have been cut and polished), instead of for rough gemstones.

The Natural Resources Governance Institute (NRGI), who published a report about the coloured gemstone sector in 2017, summarises these issues as follows: *“Uncertainty regarding countries’ respective market share remains, particularly in the coloured gemstone market, given sparse and contradictory information concerning available sources, the relatively rapid pace of development and exhaustion of critical deposits, a high degree of smuggling and under-reporting, conflation between the volume and value of resources produced, and the tendency of operators to misreport a stone’s country of origin for their own commercial gain.”*

Considering all of the above challenges, it should be kept in mind that the data collected and used in this report is unfortunately often inconsistent and far from robust. Yet, these are the only data sources readily available for analysis and interpretation, and they allow a useful, if somewhat fuzzy, picture to be formed.

III. Ruby

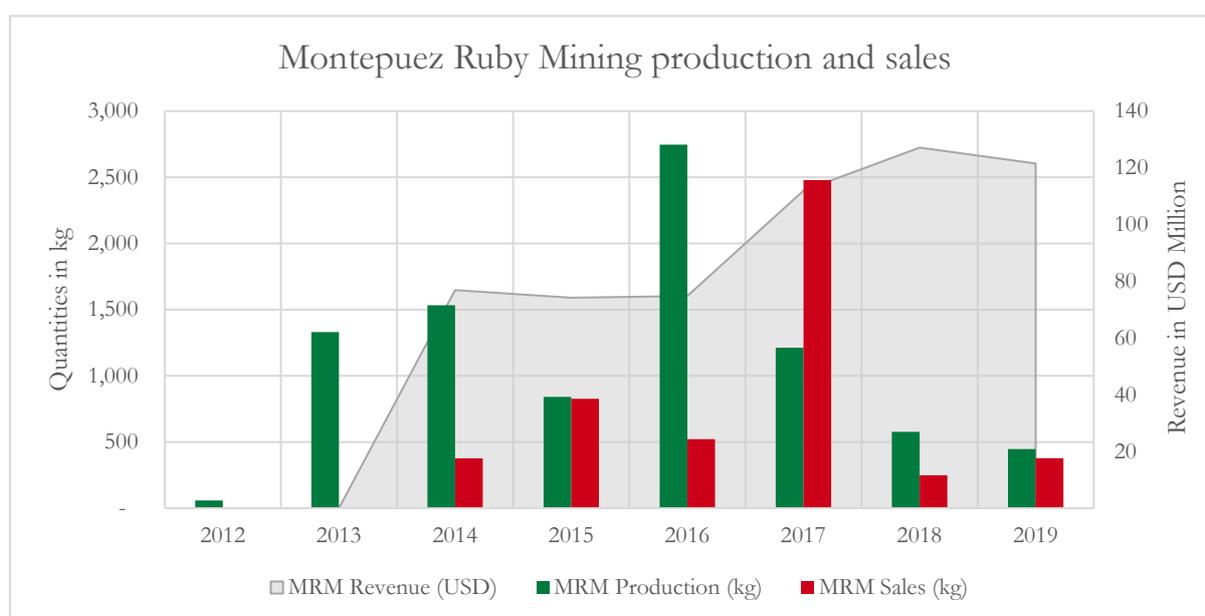
The data sources used and presented below are:

1. Production and sales (export) data from large-scale mining companies;
2. Insights from the 2017 report “Governing the gemstone sector” by the Natural Resources Governance Institute (NRGI);
3. Production data from the United States Geological Survey (USGS) mineral reports per country;
4. Export data from the UNComtrade database;
5. Export data from the Bank of Mozambique’s balance of payments data set;
6. Export data from the ResourceTrade.Earth database of Chatham House.

A. Insights from each data source

A.1. Mining Data

Gemfields is the only coloured gemstone mining company in the world publicly reporting its production and sales volumes, as well as its revenues. Graph 1 presents production, sales and revenue data for Gemfields’ Mozambican ruby mine, Montepuez Ruby Mining (MRM). As a result of the Covid-19 pandemic, MRM had no revenue in 2020 and also suspended mining operations from April 2020 for a year.



Graph 1

A.2. NRGI

The NRGI report published in 2017 provided some global statistics on the production and manufacturing of coloured gemstones. Figure 1 below is taken from this report, and percentages were extrapolated from the charts. The values are modelled on estimated market value. The coloured gemstone industry is highly dependent on discoveries (“gemstone rushes”) and is very dynamic: therefore, not knowing the period of time used for this modelled data makes it difficult to interpret, but it is assumed to represent the market as of the date of the report, in 2017.

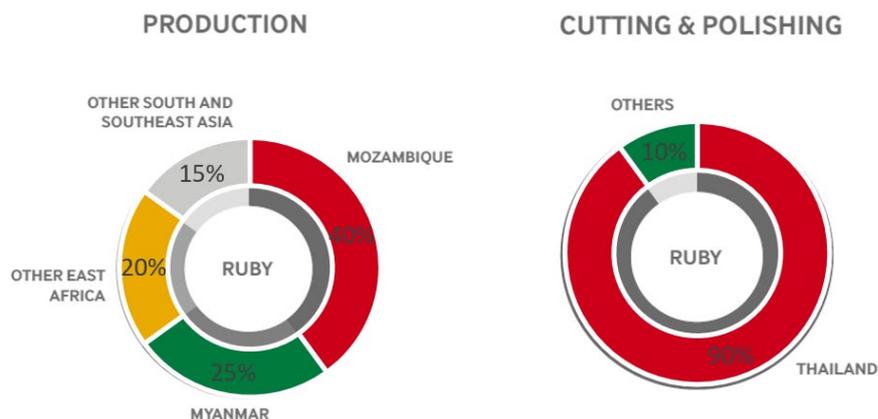
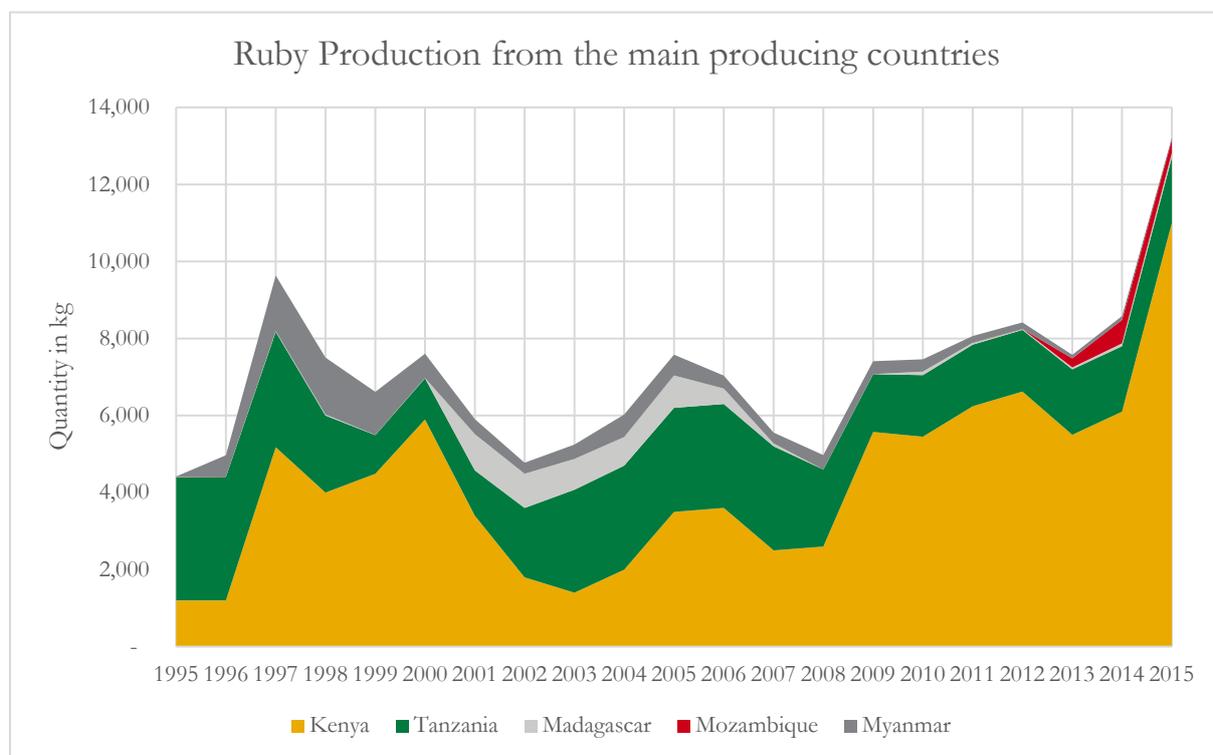


Figure 1

A.3. USGS

The USGS mineral reports are the only source of gemstone production data in volumes (kg) for most of the producing countries.

For ruby production, production data for five of the main producing countries, namely Kenya, Madagascar, Mozambique, Myanmar and Tanzania, have been compiled and presented in Graph 2 below. Production from other East Asian countries like Cambodia, India, Thailand and Vietnam must have occurred within the time period presented, but no data for ruby production was available for these countries. The highlight of this graph (which runs only to 2015) is the importance of production from Kenya and Tanzania, which represent about 90% of global production. Montepuez Ruby Mining (MRM) held its first ruby auction in June 2014.

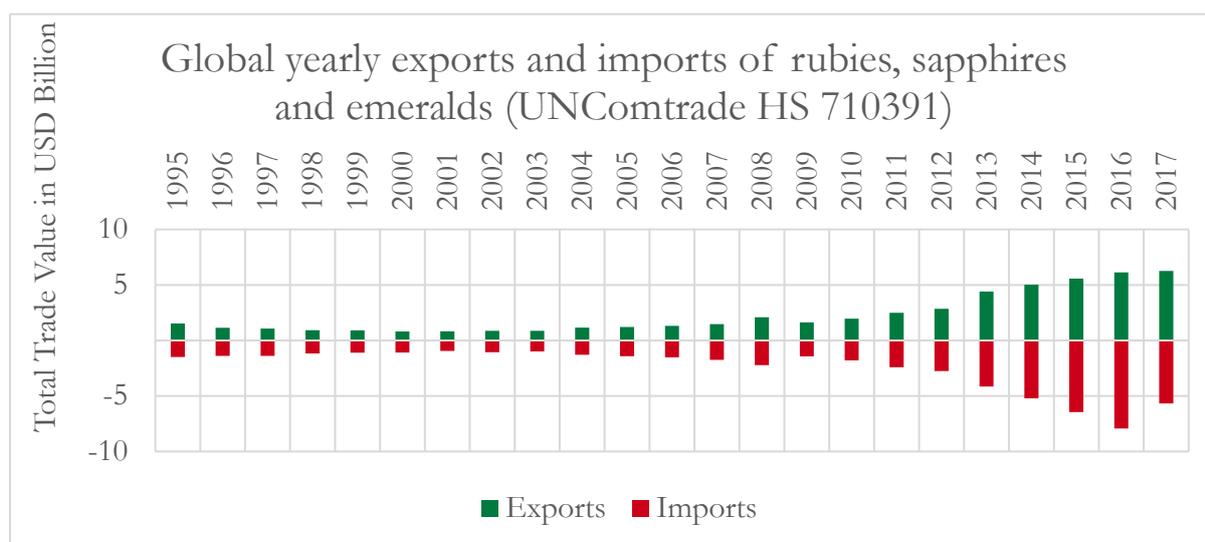


Graph 2

A.4. UNComtrade

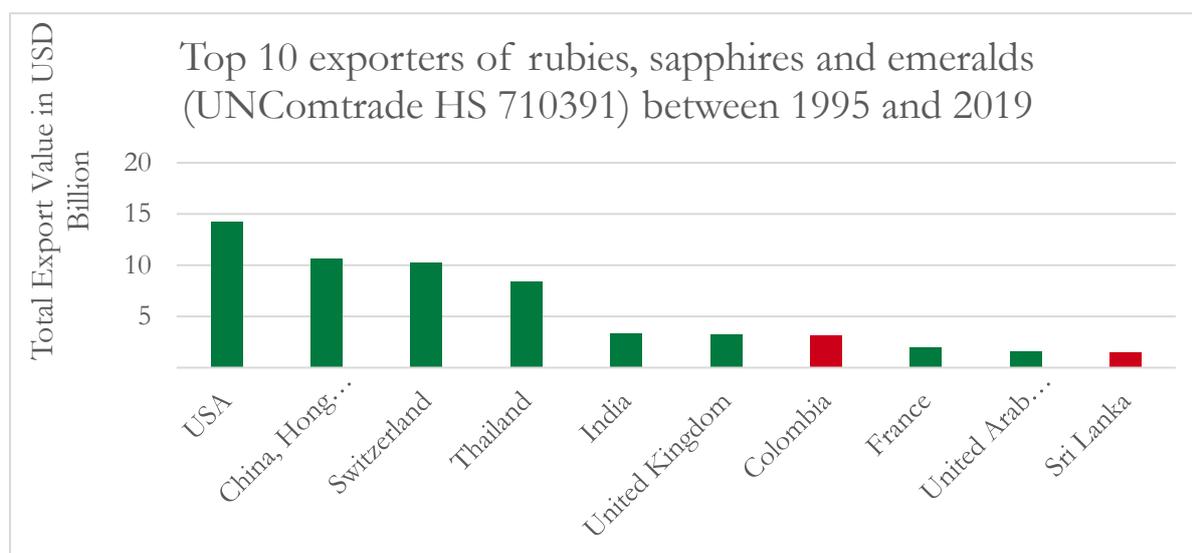
UNComtrade is a free online database providing all reported data of exports and imports by country. The values are provided in USD and the commodities are classified as per the Harmonised System (HS). For this report, data for HS 710391, defined as “rubies, sapphires and emeralds worked but not set”, is presented.

Graph 3 below presents the worldwide exports and imports for HS 710391 between 1995 and 2017. The import values tend to be higher than the exports because the imports are generally reported based on Cost, Insurance and Freight (CIF), while exports are reported on a Free on Board (FOB) basis. It is worth noting that Gemfields announced the acquisition of the Kagem emerald mine in 2007, and the financial crisis of 2008/2009 clearly had a detrimental impact on operations.



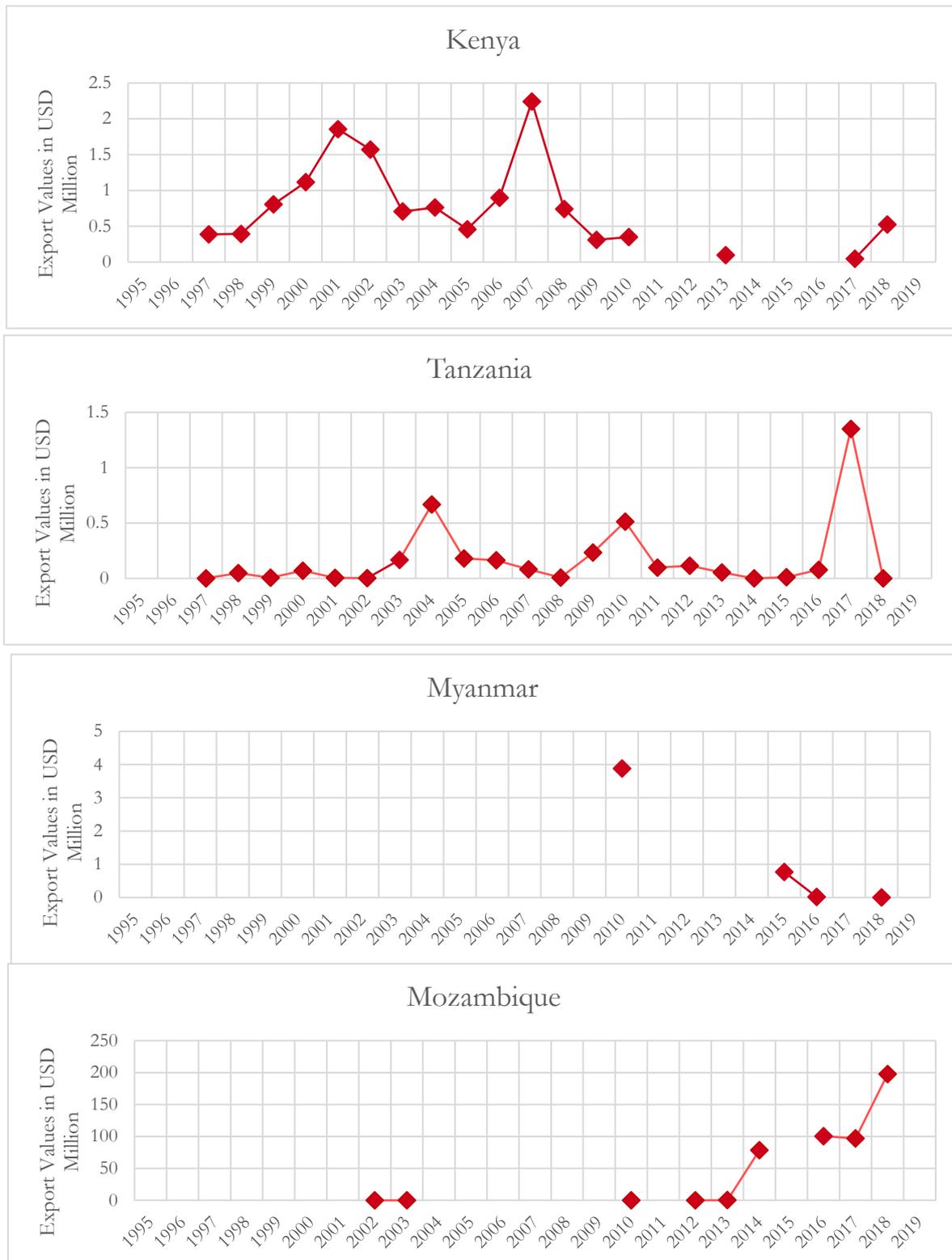
Graph 3

Interestingly, when looking at the top ten exporters for this period of time (1995-2017), only two countries, Colombia and Sri Lanka, were producers of rubies, emeralds and/or sapphires. This seemingly suggests that most of the coloured gemstone exports were actually re-exports (Graph 4).



Graph 4

Graph 5 below presents the export value for HS 710391 for the four main producing countries of rubies. Considering that rubies are the principal gemstones produced in these countries by value, the graphs are assumed to reasonably reflect their production of rubies. There are clear reporting issues, as many gaps are

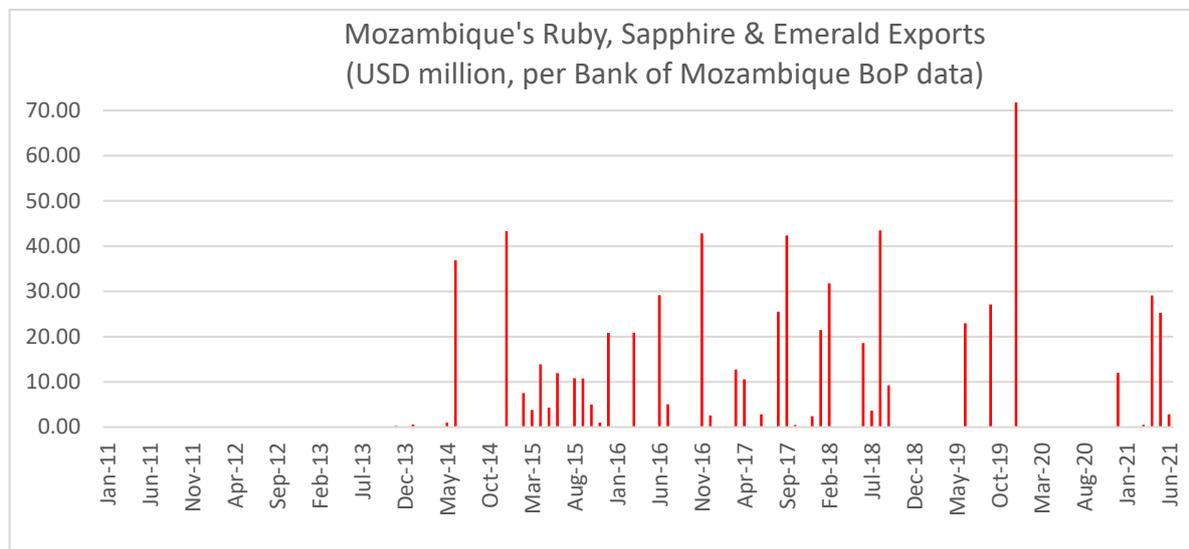


Graph 5

present. It is also difficult to assess if the major jumps and drops in yearly exports are representative of reality, or are just data anomalies.

A.5. Bank of Mozambique balance of payments data

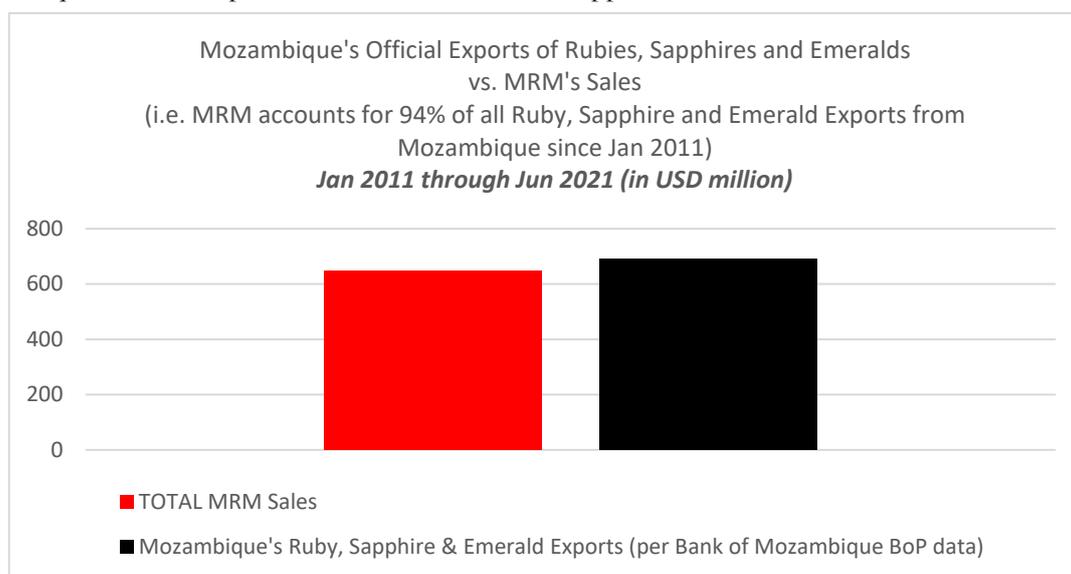
In its balance-of-payments data set, the Bank of Mozambique provides a useful “Rubies, Sapphire and Emerald” category reflecting Mozambique’s combined export value for these three gems since 2011 (Graph 6).



Graph 6

Notwithstanding the commencement in 2009 of a well-documented “ruby rush” in the Montepuez area, involving thousands of artisanal and illegal miners, no official exports of rubies, sapphires or emeralds were reported across Mozambique until August 2012. MRM commenced mining in mid-2012 and held its first auction in June 2014, garnering USD 33.5 million. Prior to May 2014, and since January 2011, when the data commences, the cumulative exports of rubies, sapphires and emeralds across all Mozambican producers totalled less than USD 1 million.

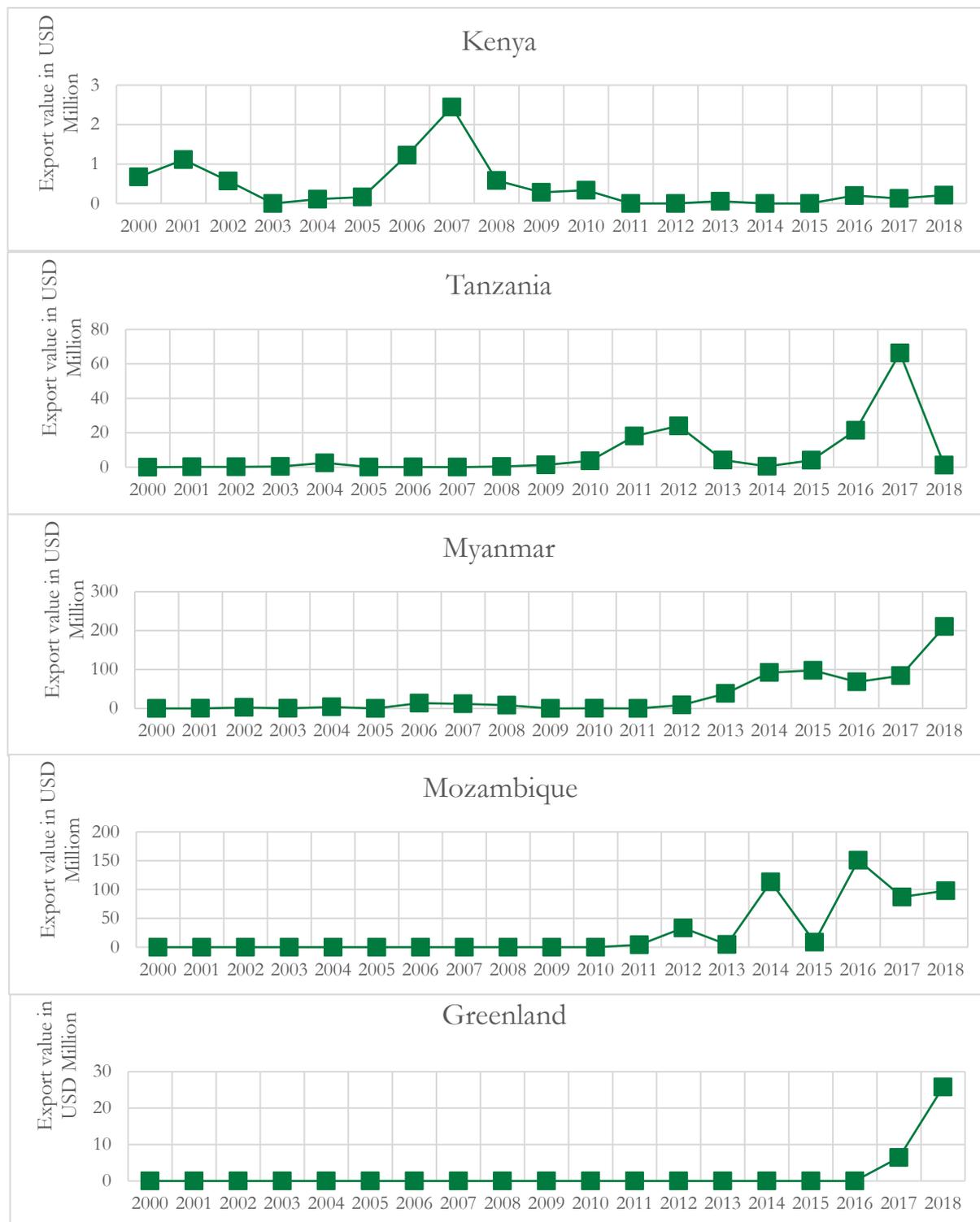
During the last decade (from January 2011 until June 2021), MRM’s ruby exports accounted for 94% of Mozambique’s official exports of rubies, emeralds and sapphires:



Graph 7

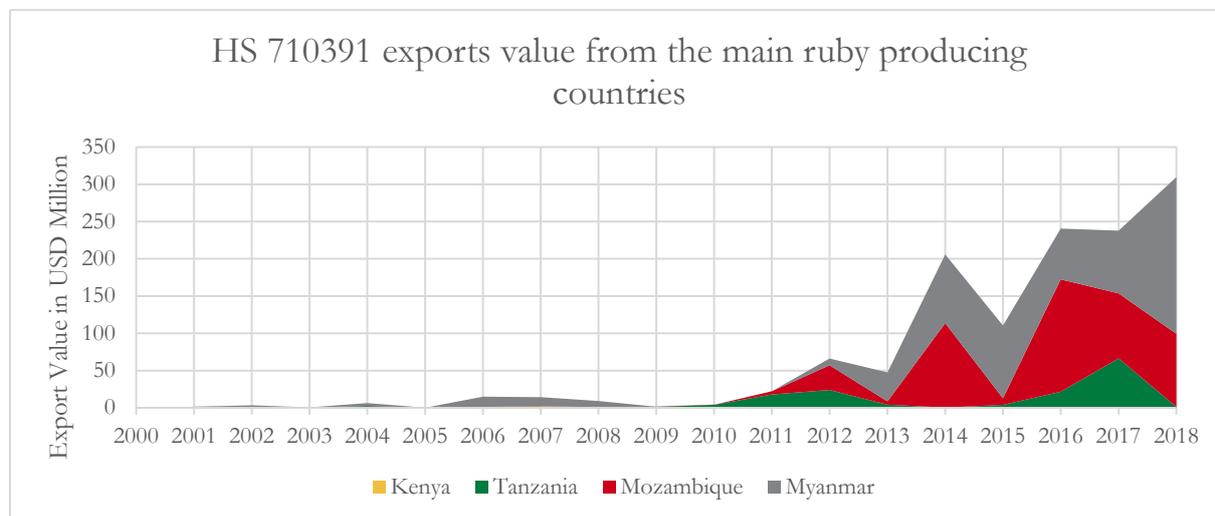
A.6. ResourceTrade.Earth

ResourceTrade.Earth has been developed by Chatham House using their proprietary database, the Chatham House Resource Trade Database (CHRTD). The values are in USD and the commodities are classified as per the Harmonised System (HS). For this report, data for HS 710391, defined as “rubies, sapphires and emeralds worked but not set”, is presented. Although some information gaps remain (e.g. in Mozambique), they are fewer and the data seems smoother than that provided by UNComtrade. The Chatham House database is likely to be cross-referencing data from different sources.

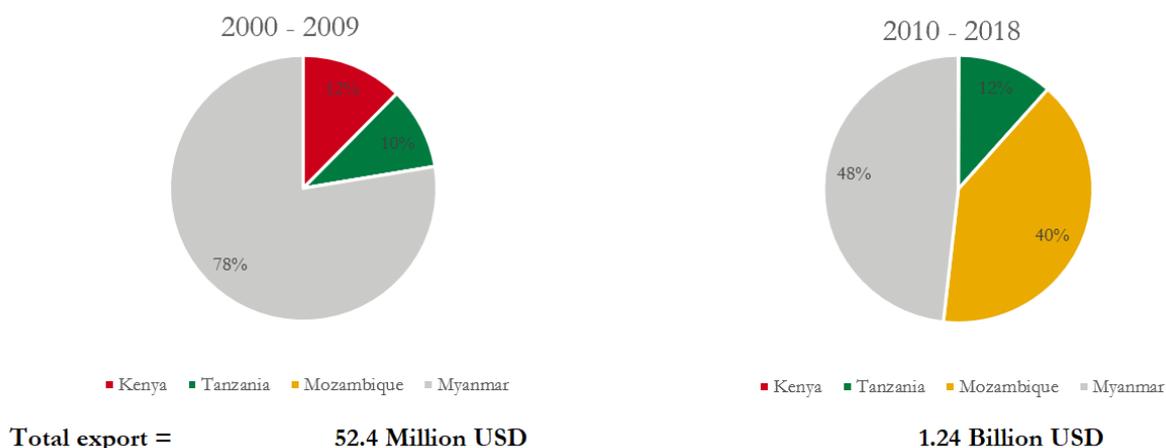


Graph 8

Graph 9 below presents the export value for the four main ruby-producing countries. This is the export value for HS 710391, but considering that these countries produce mainly rubies, we can again interpret the graph as a reasonable proxy for the export value for rubies. Graph 10 compares two periods of time, showing the impact of the ruby discovery in Mozambique in 2009.



Graph 9



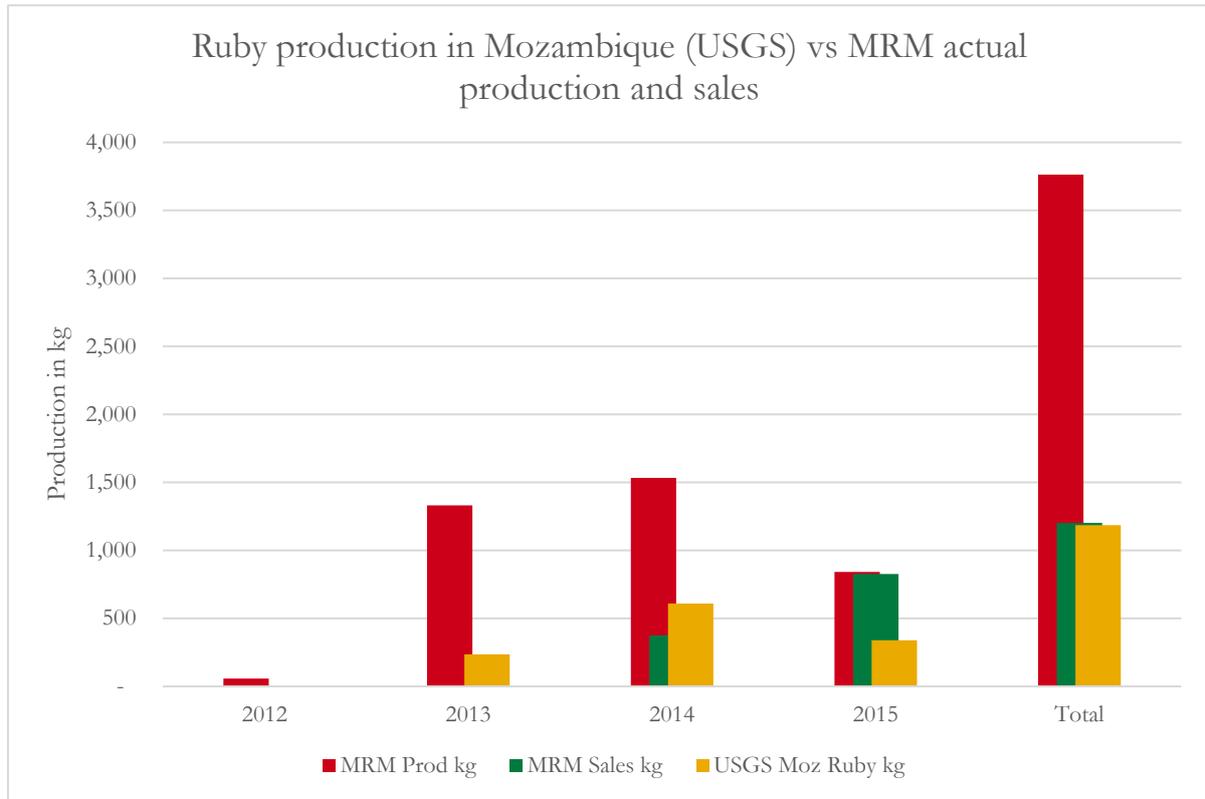
Graph 10: Share of exports value of HS 710391 for four ruby-producing countries

B. Insights from comparison of data sources

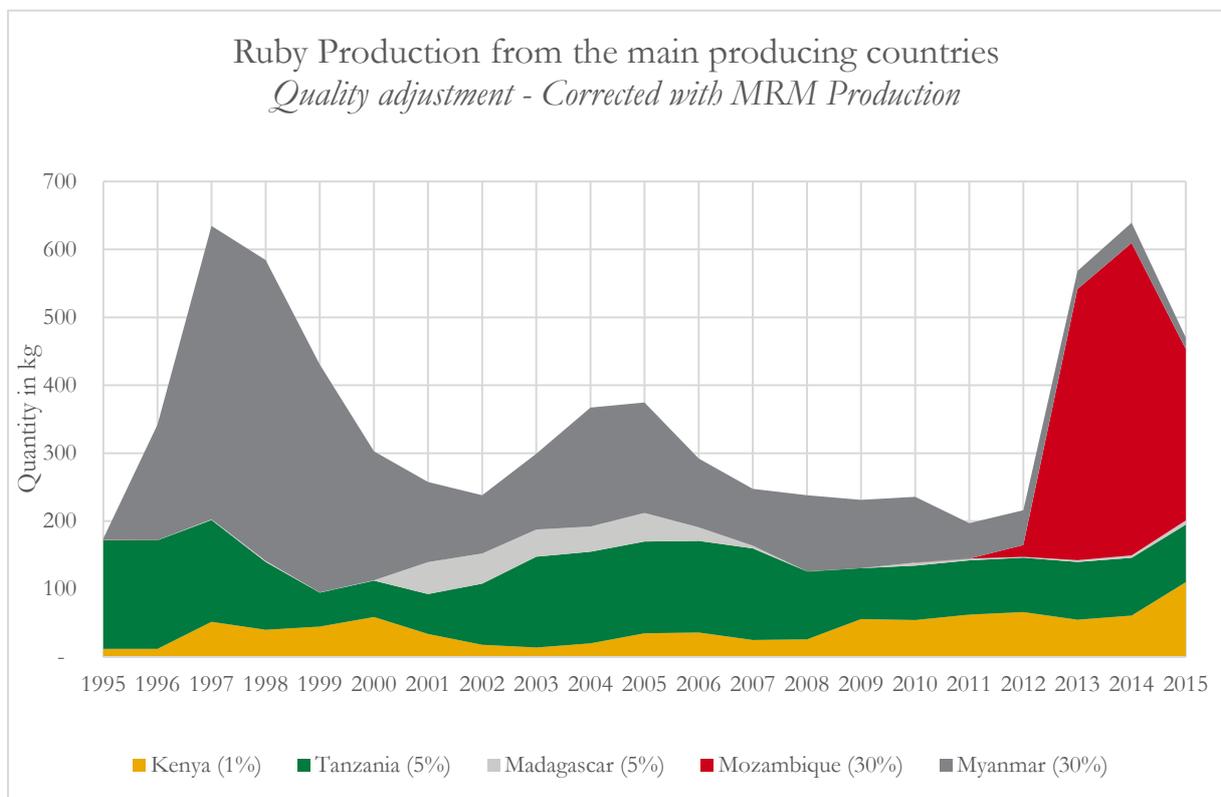
B.1. Production volumes

Two sources of production (by quantity) can be compared: the value reported by MRM and the values declared by USGS (Graph 11). In total for the period from 2012 to 2015, it is clear that MRM produced a much higher volume than what is reported by USGS. However, the sales volume from MRM more closely matches the USGS total. This suggests that USGS data of production in volume is, in reality, representative

of the exports, and not of the production. Another key observation from this comparison is that MRM is nearly the only source of (declared) exported rubies from Mozambique.



Graph 11



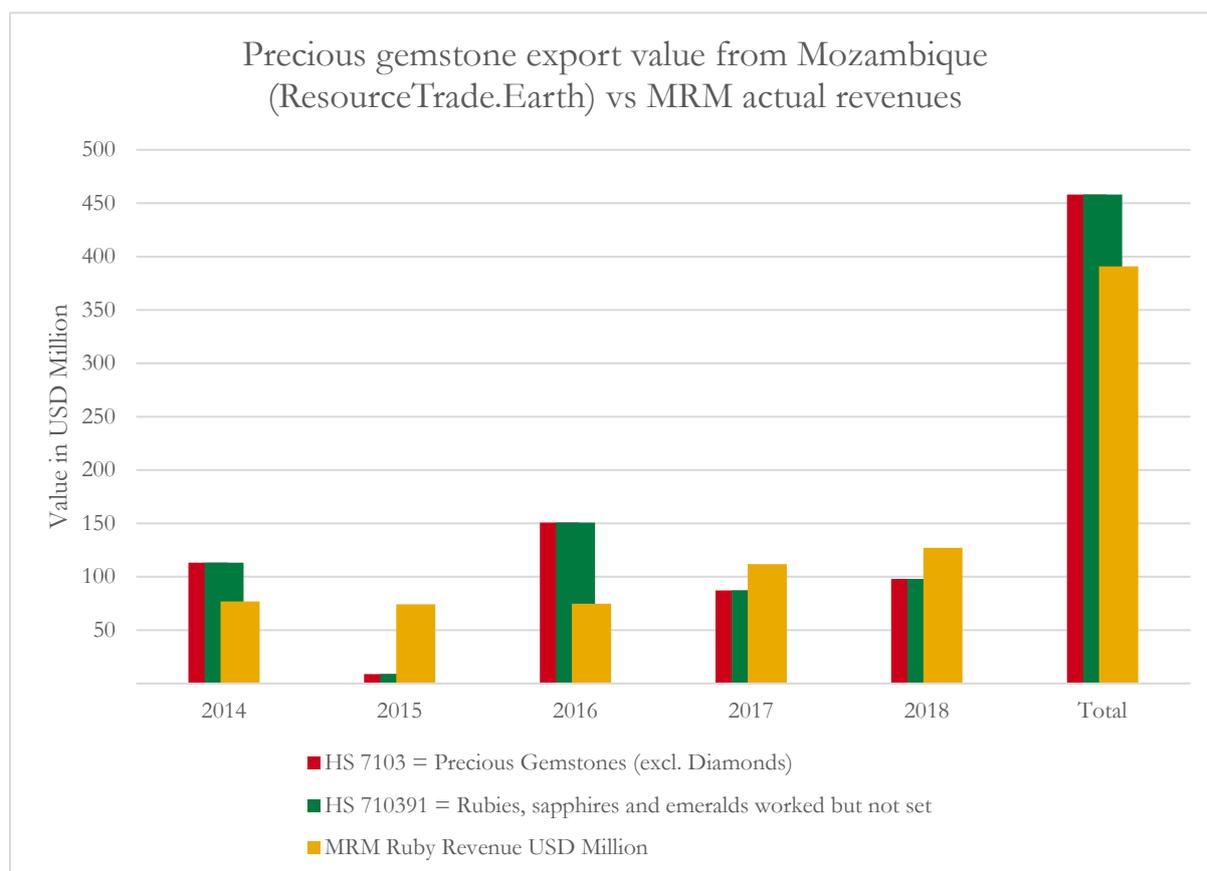
Graph 12

To know that USGS production volumes are most likely export volumes changes the interpretation of Graph 2 (global ruby production by main producing countries). Moreover, when comparing the volume of rubies produced per country, the quality of the rubies produced should be considered: as per USGS data, Kenya appears to be the leading producer of rubies, strongly dominating the market. So why are Kenyan rubies so rarely seen at trade shows and in jewellers’ shopfronts? Kenya does produce a lot of red corundum, but the overall quality, and therefore value, is very low. Indeed, USGS notes that Kenyan rubies are mainly produced from the Rockland mine (the former John Saul mine), and this mine is described by Gemdat as producing a “large quantity of ruby rough, but only around 1% is fine quality and suitable for faceting”. In comparison, about 30% of MRM production is suitable for faceting.

Following the above observation, Graph 2 has been corrected using the actual production of MRM for Mozambique’s production, and adjusted with percentages applied to each source and based on the assumed share of faceted quality ruby. The new Graph 12 shows that since Mozambique began producing rubies, it has accounted for between 50% and 70% of the yearly supply of faceted quality rubies.

B.2. Production value

UNComtrade coloured gemstone exports from Mozambique (HS 7103 and HS 710391) are considered to represent the export value of rubies. ResourceTrade.Earth data was used to complete the UNComtrade data gaps. These export values are compared with MRM’s revenues in Graph 13. This graph suggests that between 2014 and 2018, MRM’s revenue represented 85% of the total export value of non-diamond gemstones from Mozambique.



Graph 13

The export values from ResourceTrade.Earth have been compared with the production volumes from USGS (Figure 2), to calculate an average value in USD per gram. Mozambique’s average value is identified

as being the highest of the five main producing countries, with Myanmar coming second and the other East African countries showing much lower values.

When looking at the share of production value from the NRGI report compared to the ResourceTrade.Earth export values, Mozambique remains at around 40%.

Ruby statistics between 2000 and 2015			
Producing country	Production in Kg ¹	Export Value in thousand USD ²	Average USD/g
Mozambique	1,186	164,376	138.60
Myanmar	5,045	278,437	55.19
Madagascar	5,107	23,757	4.65
Tanzania	30,919	59,653	1.93
Kenya	73,186	7,558	0.10

¹ Production from USGS Mineral Yearbook per country
² Export value from Chatham House (ResourceTrade.Earth)

Figure 2

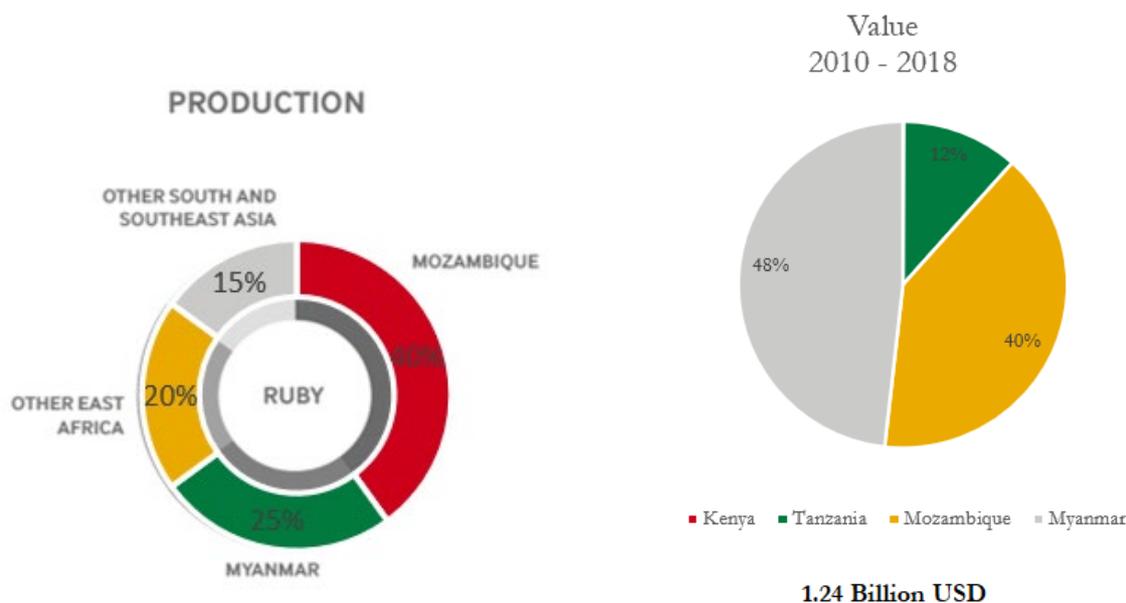


Figure 3 Left, NRGI report (production as per market value estimate) vs Right, ResourceTrade.Earth data

IV. Emerald

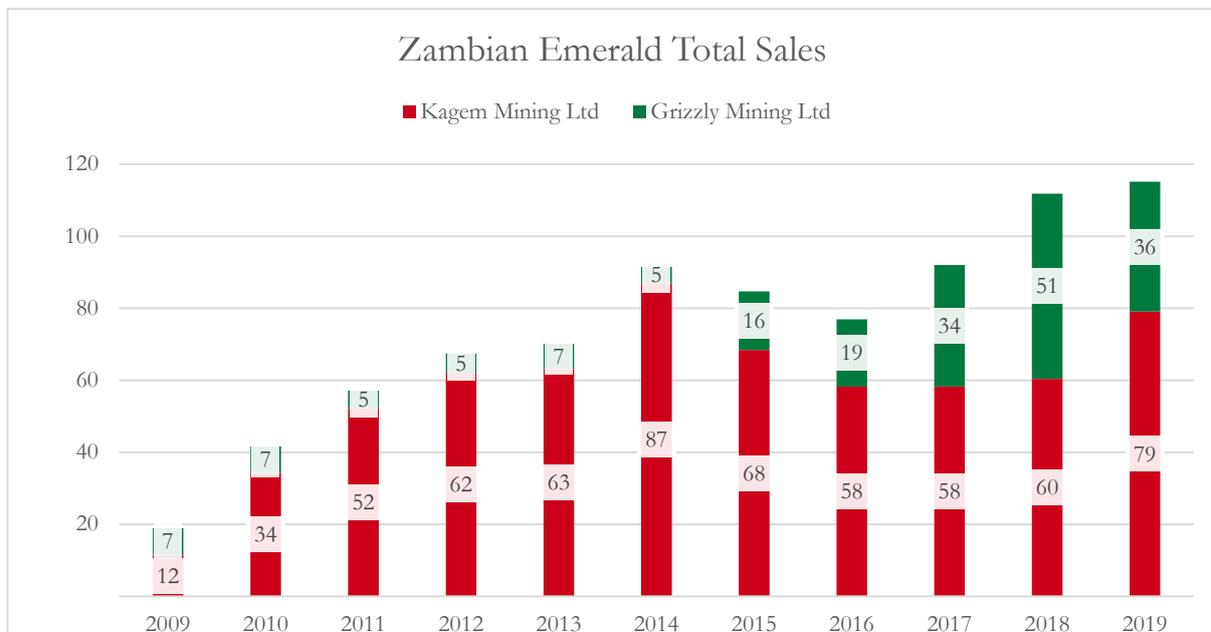
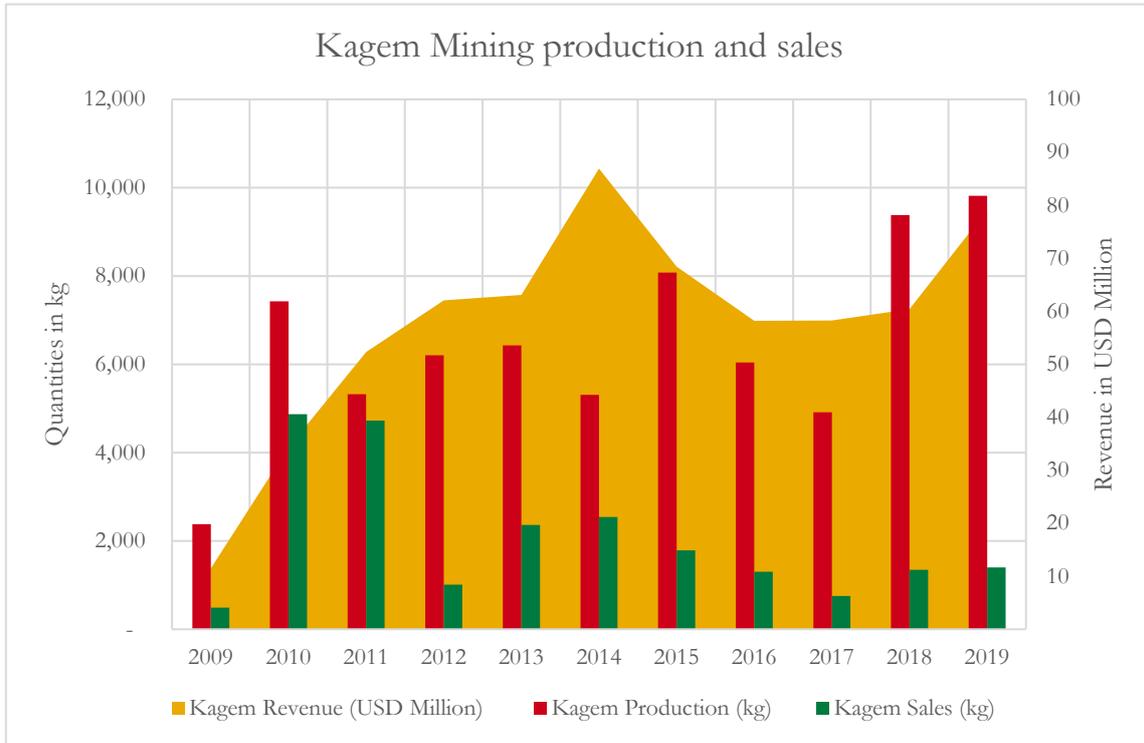
The data sources used and presented below are:

1. Production and sales (export) data from large-scale mining companies;
2. Insights from the 2017 report “Governing the gemstone sector” by the Natural Resources Governance Institute (NRGI);
3. Production data from the United States Geological Survey (USGS) mineral reports per country;
4. Export data from the UNComtrade database;
5. Export data from the ResourceTrade.Earth database of Chatham House.
6. Export data from Fedesmeraldas vs. ResourceTrade.Earth

A. Insights from each data source

A.1. Mining Data

Gemfields is the only coloured gemstone mining company in the world publicly reporting its production and sales volumes, as well as its revenues. Grizzly Mining (Grizzly), also operating in Zambia, has shared its revenues. Graph 15 below presents production, sales and revenue data for Gemfields’ Zambian emerald mine, Kagem Mining Limited (Kagem). Graph 14 below presents Kagem and Grizzly revenues.



Graph 14

A.2. NRG I

The 2017 NRG I report provides some global statistics on production and manufacturing of coloured gemstones. Figure 4 is taken from this report and percentages were extrapolated from the charts. The values are modelled on estimated market value. The coloured gemstone industry is highly dependent on discoveries (“gemstone rushes”) and is very dynamic: therefore, not having the period of time used for this modelled data makes the interpretation difficult, but it is assumed to represent the market as of the date of the report, in 2017.

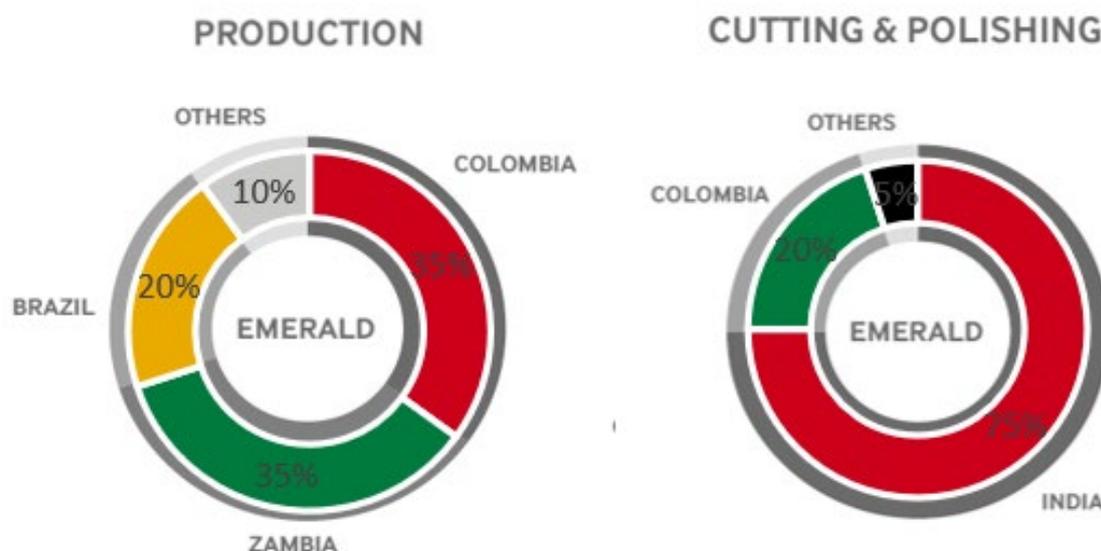


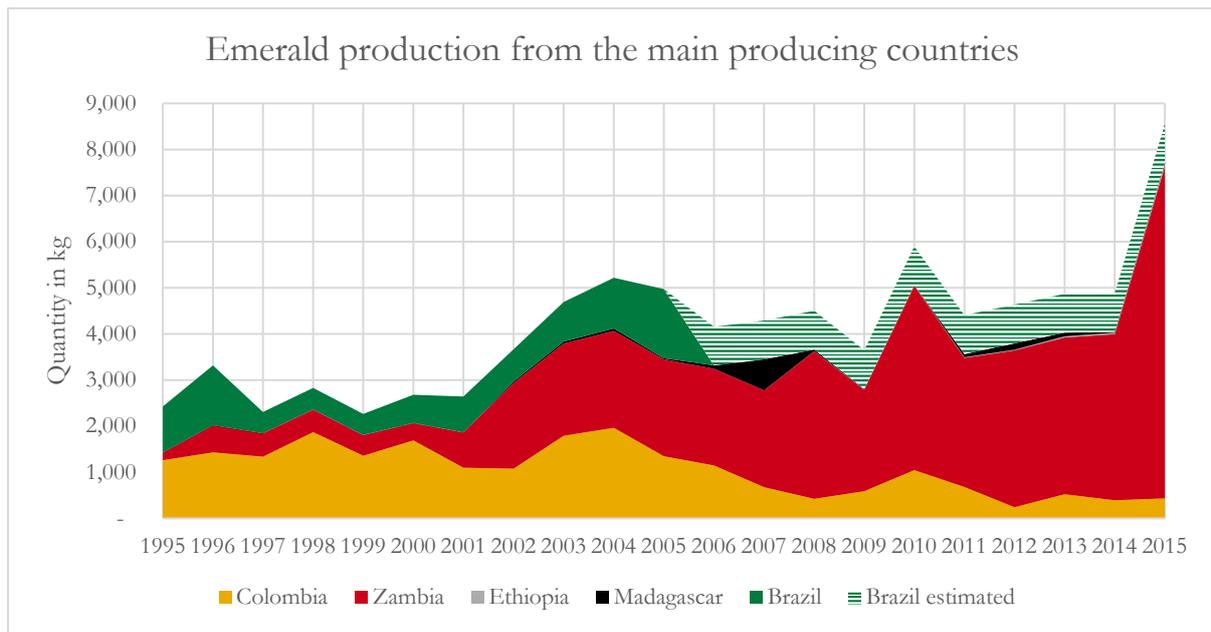
Figure 4

A.3. USGS

The USGS mineral reports are the only source of gemstone production data by volume (kg) for most of the producing countries.

For emerald production, production data for five of the main producing countries, namely Brazil, Colombia, Ethiopia, Madagascar and Zambia, have been compiled and presented in Graph 16. Production from other countries, like Afghanistan, Pakistan and Russia, must have occurred within the time period presented, but no data was available for these countries. Data for Brazil was available until 2005, and the last ten years for Brazil have been extrapolated, assuming a consistent supply from that country (and no new discovery or depletion).

The graph highlights the importance of production from Zambia, which represents about 50% of the global production for the period 1995 to 2015, and more than 70% of the global production for the period 2010 to 2015.

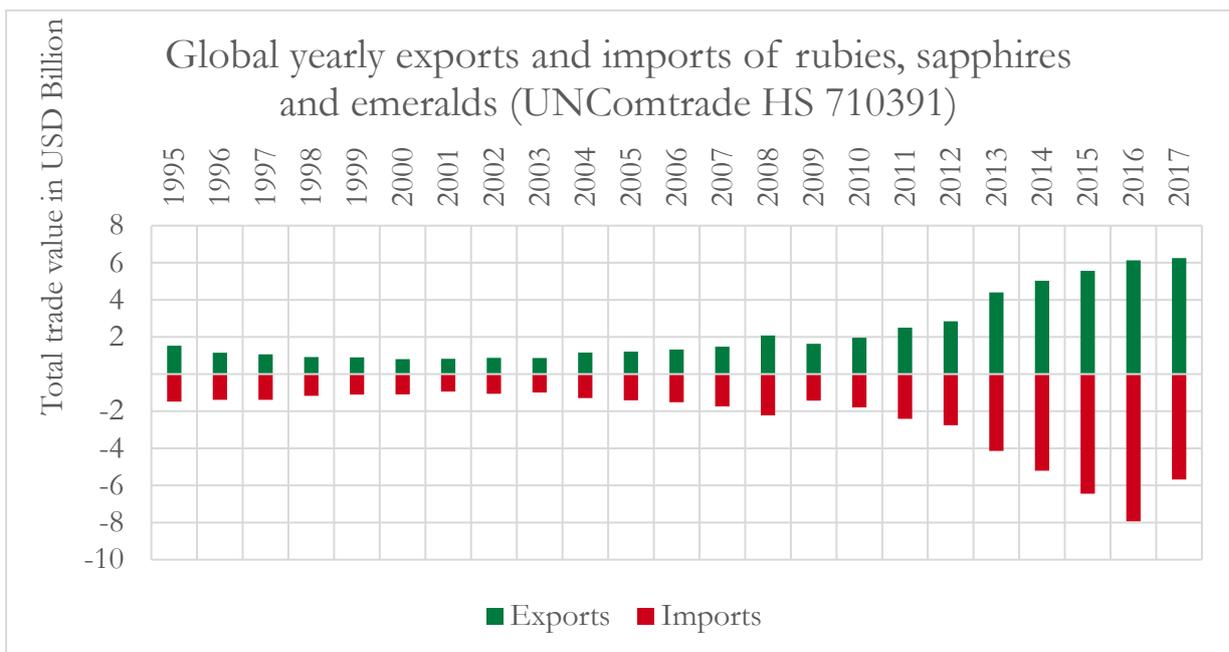


Graph 16

A.4. UNComtrade

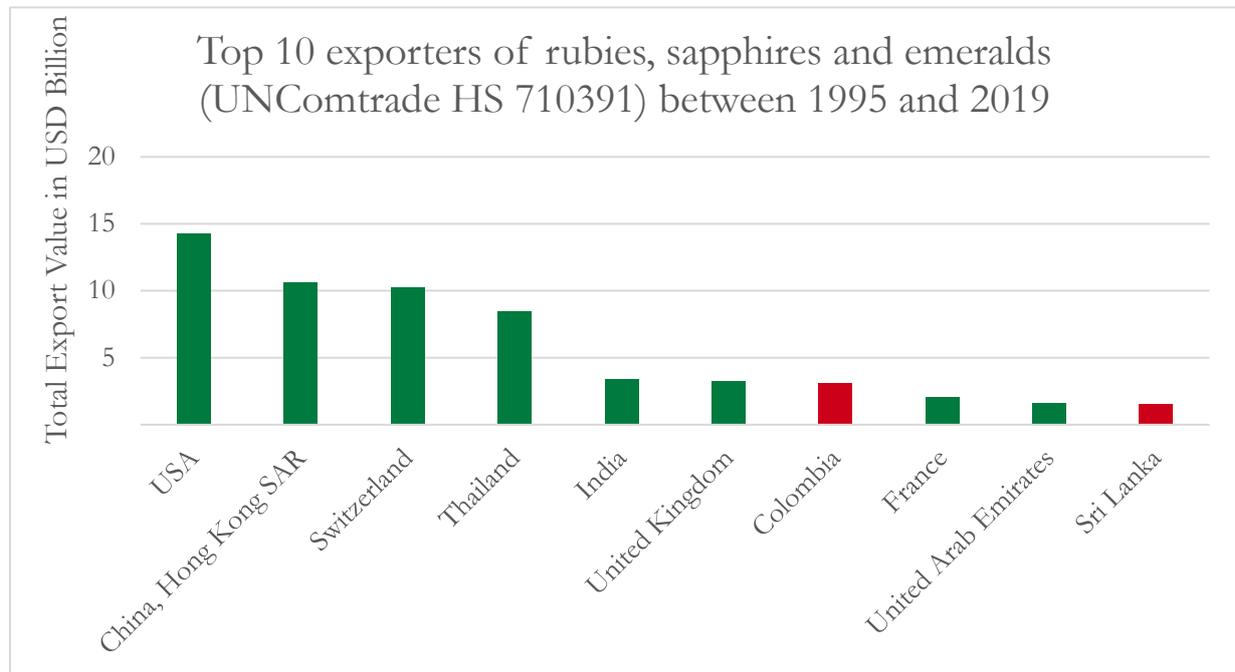
UNComtrade is a free online database providing all reported data of exports and imports by country. The values are in USD and the commodities are classified as per the Harmonised System (HS). For this report, data for HS 710391, defined as “rubies, sapphires and emeralds worked but not set”, is presented.

Graph 17 presents the worldwide exports and imports for HS 710391, between 1995 and 2017. The import values tend to be higher than the exports because the imports are generally reported on the basis of Cost, Insurance and Freight (CIF), while exports are reported on a Free on Board (FOB) basis.



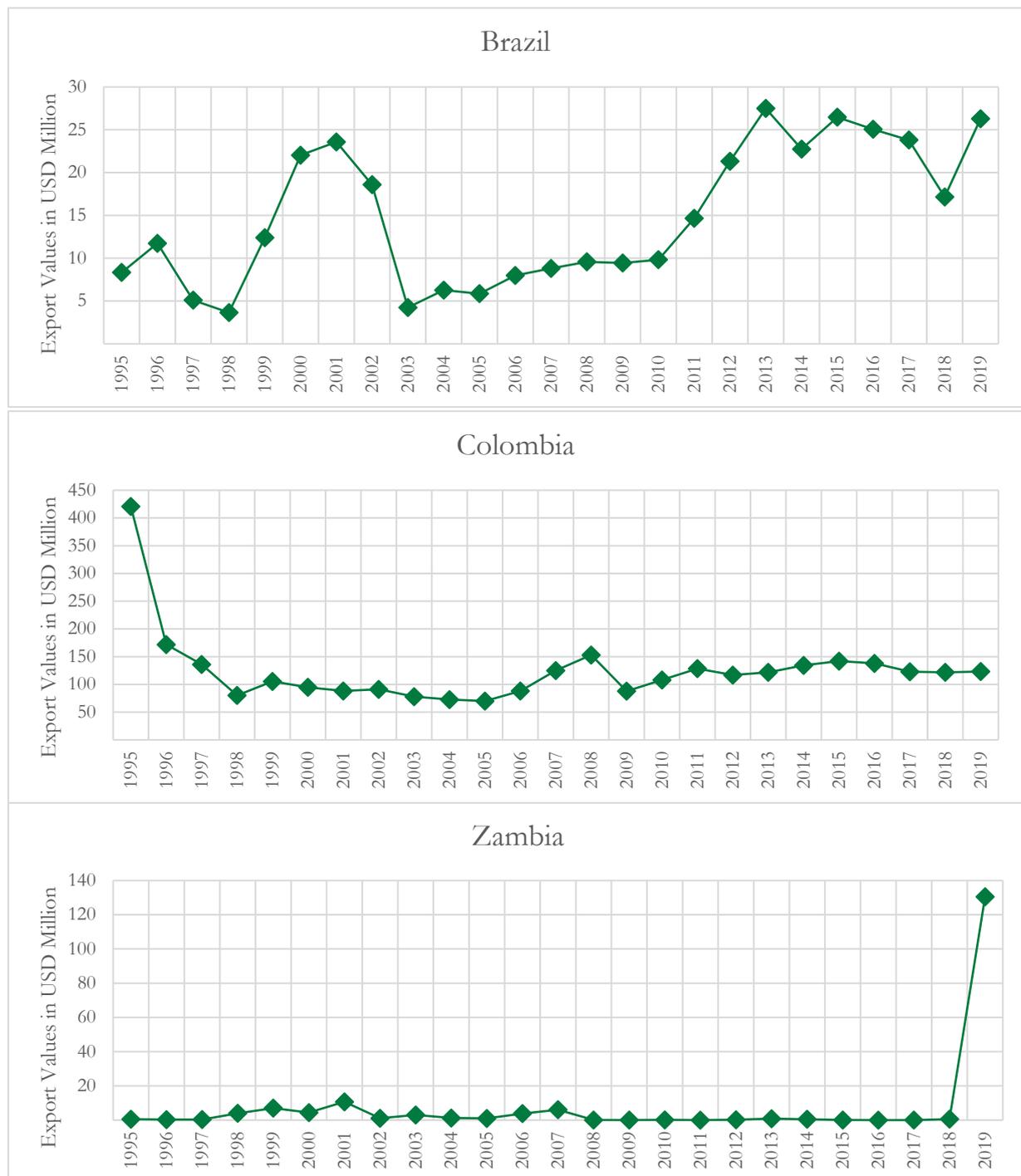
Graph 17

Interestingly, when looking at the top ten exporters for this period of time (1995-2017), only two countries, Colombia and Sri Lanka, were producing rubies, emeralds and/or sapphires. This suggests that most of the coloured gemstone exports were actually re-exports (Graph 18).



Graph 18

Graph 19 presents the export value for HS 710391 for the three main producing countries of emeralds. Considering that emeralds are the principal gemstones produced by these countries (by value), the graphs are assumed to reflect their production of emeralds. The export value for Zambia was near to zero until 2018, with a sudden jump to USD 130 million in 2019. Kagem and Grizzly mining together have sold on average USD 75 million per year over the past ten years, so the data provided by UNComtrade seems very inaccurate.

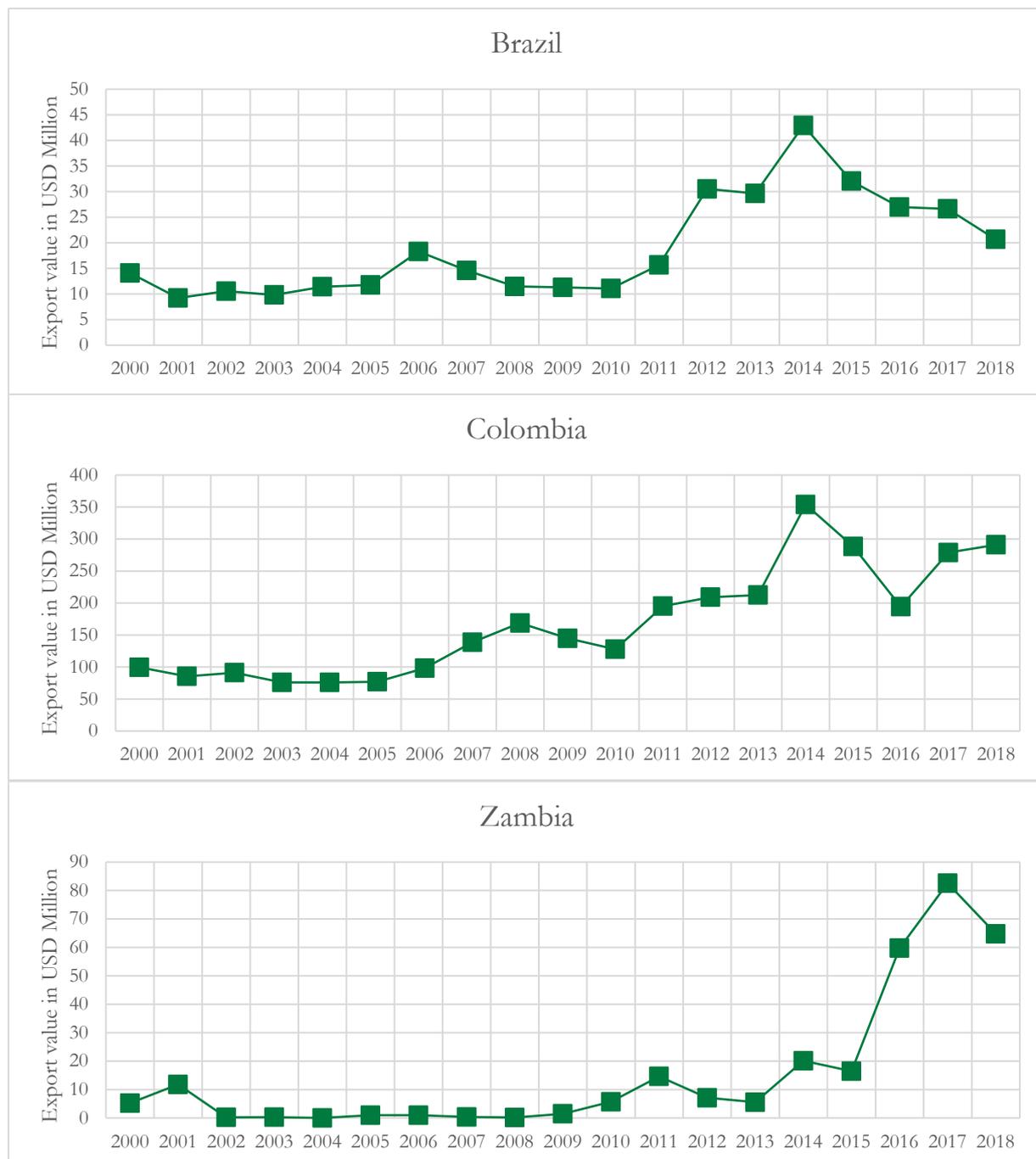


Graph 19

A.5. ResourceTrade.Earth

ResourceTrade.Earth has been developed by Chatham House using their proprietary database, the Chatham House Resource Trade Database (CHRTD). The values are in USD and the commodities are classified as per the Harmonised System (HS). For this report, data for HS 710391, defined as “rubies, sapphires and emeralds worked but not set”, is presented.

The data seems less irregular than that presented by UNComtrade. Zambia’s value looks closer to reality, and Colombia’s value also seems more accurate with a steady overall increase in the value exported. The Chatham House database is likely to be cross-referencing data from different sources.



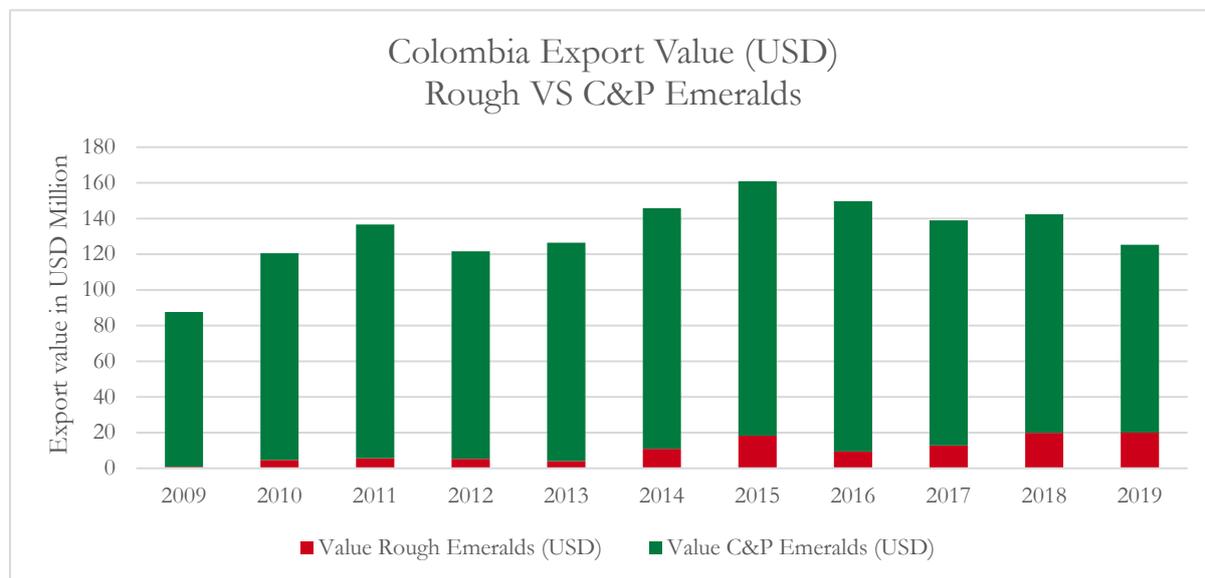
Graph 20

A.6. Fedesmeraldas vs. ResourceTrade.Earth

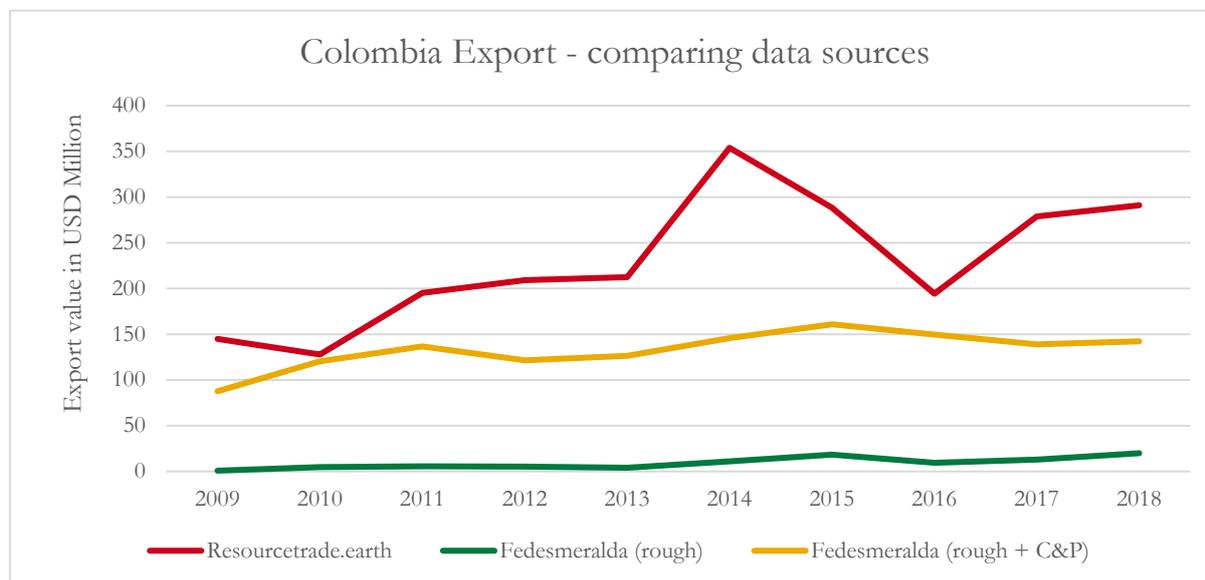
The National Federation of Emeralds of Colombia (FEDESMERALDAS) is a trade union entity founded in 1988 with the aim of developing, representing and guiding the Colombian emerald industry. Fedesmeraldas links a large number of formal actors in the Colombian emerald production chain and

administers the National Emerald Fund, which collects by law a parafiscal tax of the order of 1% of the value of all exports of emeralds.

The data set provided by Fedesmeraldas indicates that the vast majority of Colombian emerald production is exported to the rest of the world to fulfil demand for medium to fine quality emeralds. Colombia has a well-established emerald cutting industry, and most of the exported emeralds are beneficiated in country. With very little formal mining taking place, accurate production data is not available.



Graph 21



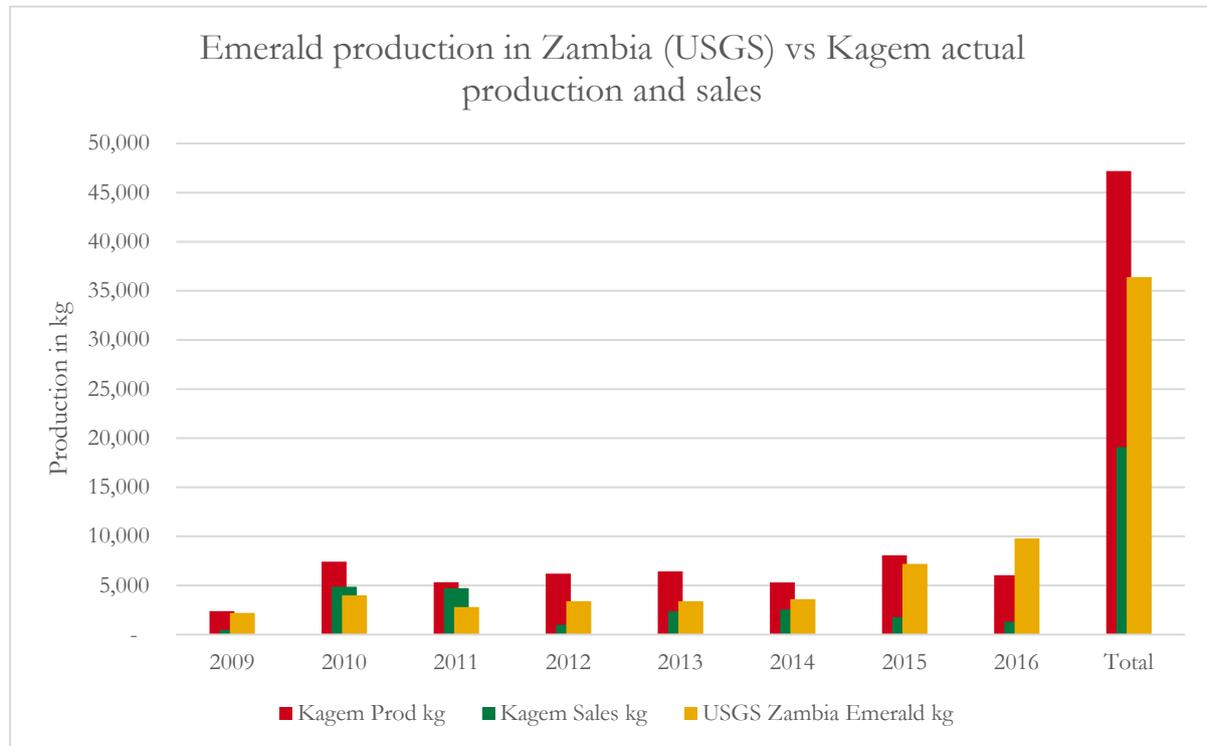
Graph 22

B. Insights from each data source

B.1. Production volumes

Two sources of production by quantity can be compared: the value reported by Kagem and the values declared by USGS (Graph 23). In total for the period from 2009 to 2016, it is clear that Kagem produced

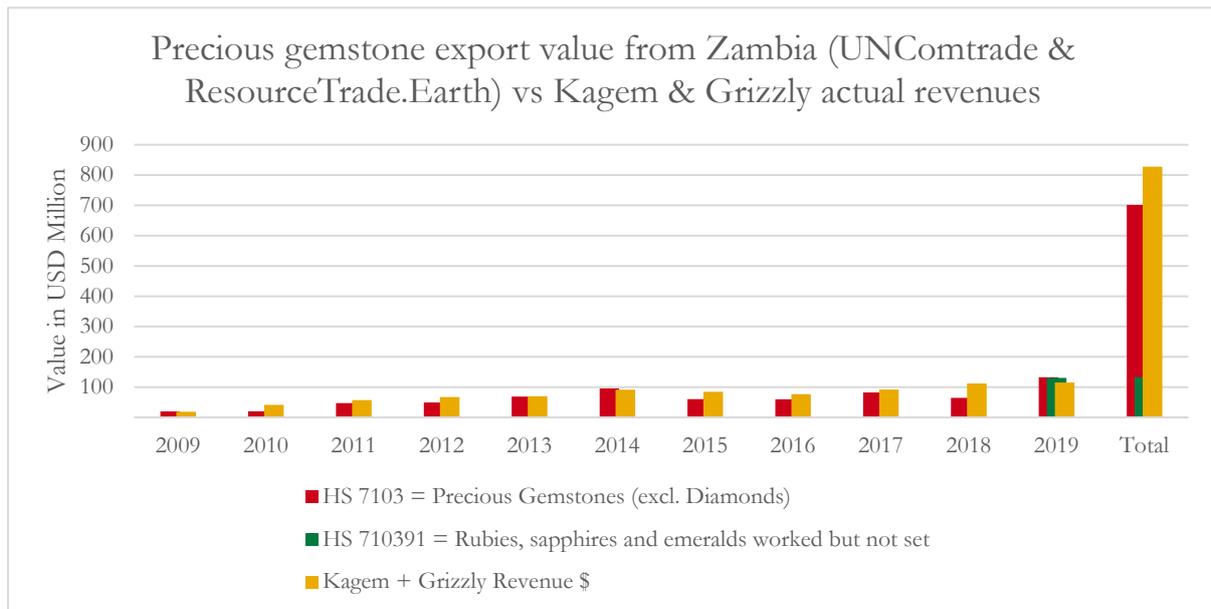
a much higher volume than that reported by USGS. However, the sales volume from Kagem is about 50% of the USGS total. This suggests that USGS production data by volume is, in reality, representative of the exports, and not of the production, and that the Kagem mine accounts for about half of the emerald exports in Zambia.



Graph 23

B.2. Production value

UNComtrade coloured gemstone exports from Zambia (HS 7103 and HS 710391) are considered to represent the export value of emeralds. ResourceTrade.Earth data was used to complete UNComtrade data gaps. These export values are compared with the revenues of Kagem and Grizzly in Graph 24. The total declared revenues from both mines between 2009 and 2019 exceeds the reported export values. This suggests that both mines together account for most of the declared exports.



Graph 24

The export values from ResourceTrade.Earth have been compared with the production volumes from USGS (Figure 5) to calculate an average value in USD per gram. Zambia’s average value comes in as the lowest of the three main producing countries.

Emerald statistics between 2000 and 2015			
Producing country	Production in Kg ¹	Export Value in thousand US\$ ²	Average USD/g
Colombia	15,134	2,443,168	161.43
Brazil	5,550	284,348	51.23
Zambia	43,193	91,184	2.11

¹ Production from USGS Mineral Yearbook per country
² Export value from Chatham House (ResourceTrade.Earth)

Figure 5

However, Kagem itself has achieved an average selling price of USD 4.26 per carat based on its auction sales between 2009 and 2015 and USD 10.28 per carat from 2016-2020.

When looking at the share of production values from the NRGi report, compared with the ResourceTrade.Earth export values, Zambia’s share of market value is between 10% and 35%.

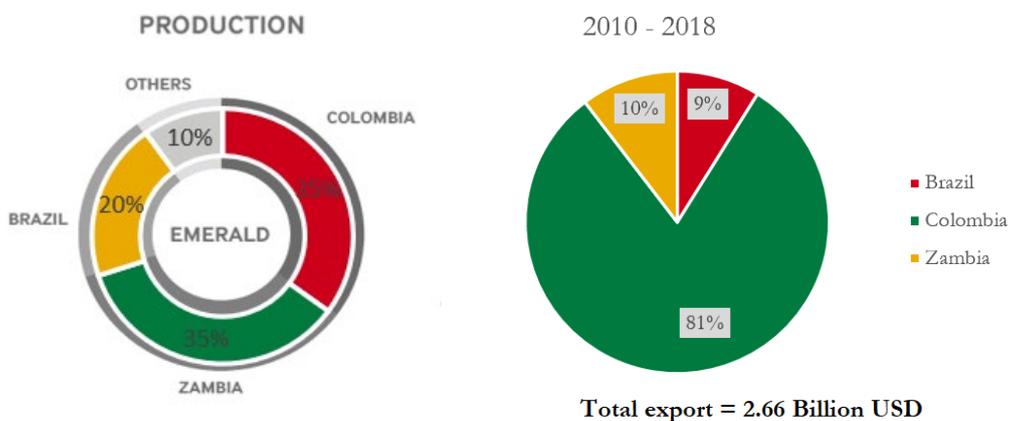


Figure 6: Left, NRGi report (production as per market value estimate) vs ResourceTrade.Earth data

V. Closing statements

It is clear from this research that data relating to coloured gemstone supply, demand and movement is both hard to come by and unreliable. Differing values per carat due to the variation in gemstone quality, reliability of declared export value, and the values attributed to gemstone smuggling all provide complexity that challenges the validity of any closing statements. We observe that the data analysed within this report is often differing, conflicting and necessitates assumption in order to develop a narrative.

We can draw assumptive conclusions that Kagem is believed to be the world's single largest producing emerald mine from the USGS data, which indicates that Zambia has accounted for more than 70% of global emerald production since 2010, and Kagem accounts for at least 50% of the total emerald production from Zambia. This suggests that Kagem produces about some 35% of the world's emeralds. However, greater verification of the data originating from Colombia would be needed to substantiate this.

Similarly, the data indicates that Mozambique provides around 40% of the world's production volume of rubies (in all qualities) and has supplied between 50% and 70% of the yearly stock of faceted quality rubies, and that MRM revenue represents 85% of the total declared export value from Mozambique. Gemfields' direct experience of the market leads us to question the value that should be attributed to ruby smuggling and what this would reveal about the deposit. Mozambique is undoubtedly one of the most significant ruby deposits in the world, but the true extent of the export value of rubies from there remains unknown.

It is therefore necessary to see this paper as a first step and undertake further research before reliable statements regarding global emerald and ruby supply can be drawn.

VI. Request for participation in further research

Gemfields wishes to co-author, together with other interested parties, additional research papers in order to better understand global emerald, ruby and sapphire supply. Please contact helena.choudhury@gemfields.com should you wish to join the initiative to produce an updated and more in-depth study during 2022.

VII. References

[ResourceTrade.Earth \(Chatham House\)](#)

[United States Geological Survey \(USGS\)](#)

[UNComtrade](#)

NRGI Report: Shortell, Paul, and Irwin, Emma. "Governing the gemstone sector: Lessons from global Experience." Natural Resource Governance Institute. UK Department of International Development and Australian Department of Foreign Affairs and Trade (2017)

[Quality statement on the Rockland mine](#)