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Using Link Analysis to Understand Persons of Concern in Zimbabwe

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Abstract. This study uses link analysis to examine United Nations High Commissioner for Refugees (UNHCR) data from 1975 to 2020, to identify patterns in the migration of persons of concern in Zimbabwe. Supplementary charts and tables are created to further investigate the acquired data and trends. Upon examining the data over time, a notable trend is observed. There is a clear upward trend in out degree with each successive year studied in Zimbabwe. The number of Zimbabweans who left as asylum seekers increased in the 1990s and has risen ten times in size at the end of 2020. Between 1975 and 2005, there were no internally displaced persons (IDPs). The high number of IDPs from 2006 to 2020 occurred as a result of different government policies and actions. This study provides a measurable visual to connect with an audience, enables humanitarian specialists to rerun assessments, and analyse concerns of persons of concern.

Keywords: *Persons of concern; GIS; Refugee; Link analysis; Zimbabwe*

Introduction

Following the major land reform in Zimbabwe in 2000, the migration flows have been changing (Takaindisa, 2021). Zimbabwe's migration history deviates from the norm within the Southern African region. Throughout history, nations have been categorised as either recipient or sending countries in relation to migratory populations. Zimbabwe has consistently found itself in a unique dual nature position (Chikanda & Crush, 2016; Dore et al., 2008). Throughout the years, a significant number of Zimbabwean individuals migrated to South Africa for employment purposes. According to Charlson (2020), a significant proportion of the adult population in Zimbabwe, specifically around 25%, may trace their familial connections to individuals who have engaged in employment within South Africa throughout certain periods of their lives. In contrast, Zimbabwe had an influx of labour migrants originating from neighbouring nations such as Zambia, Malawi, and Mozambique. According to Tevara and Zinyama (2002), during the 1951 census, the population of foreign Africans in Zimbabwe amounted to 246,000 individuals, with around 40% of them originating from Mozambique. Zimbabwe served as both an origin, a destination, and a transit point. When examining contemporary patterns of

emigration, it is possible to identify significant stages. The phenomenon of emigration flows and cross-border migrations has exhibited a gradual increase, particularly after the year 2000, coinciding with a significant decline in the national economic conditions (Kiwanuka & Monson, 2009). Furthermore, it is worth noting that a significant proportion of migration and cross-border movements predominantly take place inside the Southern African region (Tevara & Zinyama, 2002). In addition, it is worth highlighting the prominent types of migration and cross-border movements that have experienced significant growth since the 1990s. These include irregular migration, informal cross-border trade, migration of highly skilled individuals, and survival migration of individuals facing poverty and destitution (Crush & Tevera, 2003). Accurate data on migration in Zimbabwe is challenging to obtain due to its predominantly informal and undocumented nature. The existing data, which lack complete quantification, trends and circularity, present an overly distorted and understated portrayal of Zimbabwean emigration patterns. Hence, it is imperative to do a comprehensive investigation in this context in order to gain a deeper comprehension of the dynamics associated with their migratory patterns.

In today's rapidly evolving world, where over 100 million people were displaced worldwide in May 2022 alone (Jagtap et al., 2022), accessible, trustworthy, and timely geospatial data are essential. It is crucial to harness the potential of geospatial data to help make informed decisions and take effective action on the ground during a humanitarian disaster. Migration and internal displacement are location-based fields that rely heavily on geospatial data. The migration and dynamic growth of refugees in the European Union (EU) countries were visualised by Calka and Cahan (2016) using GIS to create interactive maps. This mapping method facilitated strategic decisions and provided a resource for the people of refugee-accepting nations. The necessity to visualise the routes of refugees and their final destinations is the basis of this study. Zhang (2015) employed GIS to visualise the distribution of overseas Chinese in Japan and other parts of the world and their provinces of origin in China to analyse the migration process. The findings revealed a higher number of Chinese migrants originating from cities and provinces in the eastern coastal area, such as Beijing, Shanghai and Northeast China. In contrast, fewer migrants came from inland provinces. This study underscored the significance of GIS in conducting spatial-temporal analyses of migration patterns. In a similar vein, Çetinkaya et al. (2016) utilised a GIS-based fuzzy analytic hierarchy process

(FAHP) and technique for order preference by similarity to ideal solution (TOPSIS) to identify suitable locations for refugee camps catering to Syrian refugees in Turkey. The research demonstrated that geospatial methods enable a deeper understanding of alternative suitability patterns and can lead to the adoption of strategies for establishing refugee camps that would not be considered using traditional land suitability analysis methods by planning authorities.

Link analysis is a method in GIS that uses a network of interconnected links and nodes to discover and investigate links that are not readily apparent in the raw data. The following are some common kinds of network: conflict networks that illustrate alliances of connected players (Konig et al., 2017), airline networks that illustrate which airports have connecting flights (Verma et al., 2014), and semantic networks that illustrate topics that are related to each other (Bales & Johnson, 2006). The findings of a link analysis can be visually represented through a link chart or a link map. Centrality metrics can be calculated with the use of link analysis. Some examples of centrality measurements that can be derived by link analysis include degree, betweenness, closeness, and eigenvector. This study aims to employ link analysis to chart the migration of persons of concern from their countries of origin to the countries where they settle. Additionally, supplemental charts and tables will be created to investigate the data and trends that materialise over time in Zimbabwe, a nation in Southern Africa. Using relationships between objects, link analysis can help identify patterns and trends (Tresidder, 2005). The goal is to collect and link information from multiple sources and accurately depict and estimate its relevance to reveal hidden linkages. Many organizations have published maps of persons of concern migration, however, these maps scratch the surface of the problem (Calka & Cahan, 2016). To understand how networks function, it is necessary to perform link analysis and visualise them using link charts. This knowledge makes it possible to take steps to improve, manipulate or disrupt the network. Using a Geographic Information System (GIS), it is possible to add the dimensions of location and time to the depiction of entities and relationships in a link chart.

The study area and methods

2.1 Study area

Zimbabwe, located in the southern region of Africa, is a landlocked country (Figure 1). The country has territorial adjacency with Botswana, Zambia, Mozambique, and South Africa. According to ZIMSTAT (2022), Zimbabwe has a population of 15,178,979 individuals, with males comprising 7,289,558 (48%) and

females comprising 7,889,421 (52%). Consequently, the sex ratio in Zimbabwe is 92 males for every 100 females. The total population consisted of 3,818,992 households, with an average of 4 individuals per household. According to ZIMSTAT (2022), the population density in the specified land area of 390757 square kilometres is 39 individuals per square kilometre. Based on a recent evaluation, it can be observed that agricultural expansion is, nevertheless, playing a role in the revival of the economy (Ndlela et al., 2018).

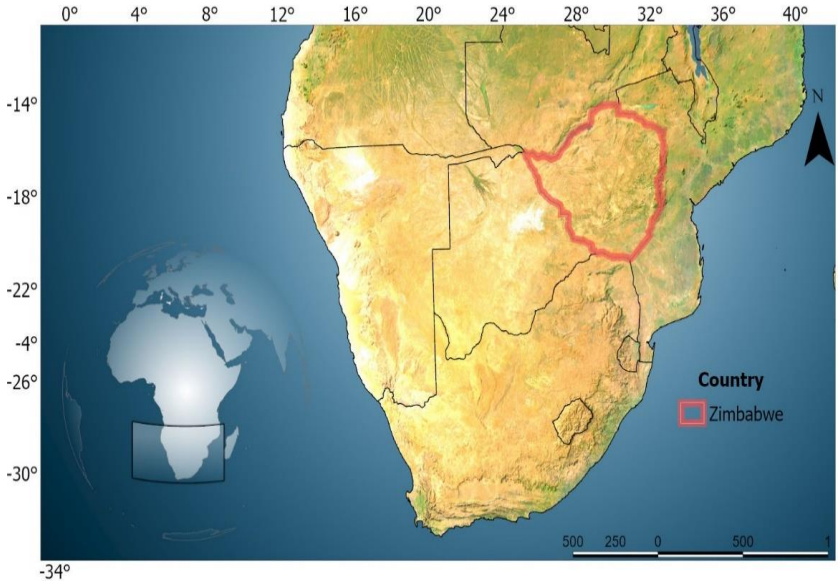

Figure 1: Map of Zimbabwe

2.2 Data

The United Nations High Commissioner for Refugees (UNHCR) database served as the source of the information used in this study. Population estimates of persons of concern are provided quarterly and data are broken down by country of origin. According to UNHCR, affected people and affected populations who have been forcibly removed from their homes are called 'persons of concern' (Idemudia et al., 2020). They include refugees, asylum-seekers, refugee returnees, stateless people, and the internally displaced. The database compiles information from various sources, such as governmental agencies, UNHCR field offices, and non-governmental organisations (NGOs), through surveys, censuses, and registrations (AbouZahr et al., 2015). The UNHCR database offers the most significant information available, but it has several drawbacks. The lack of earlier data for some countries is the biggest obstacle to studying persons of concern migration trends, along with

different definitions and administrative processes between states. The study will account for these limitations by performing analyses using complete and more restricted data selections, such as those available for the entire period of interest.

2.3 Methods

According to Environmental Systems Research Institute (ESRI, 2023), ArcGIS Insights has fundamentally altered spatial analysis. According to Sultan and Hilton (2019), the ArcGIS program is a web-based tool that performs data analytics and can simultaneously work with interactive maps and charts. ArcGIS Insights workbooks were built to investigate, analyse and uncover patterns and specifics within a dataset. Having the data in ArcGIS Insights provides robust analysis that can be shared. The next part provides an overview of a link analysis-based Insights worksheet developed to better understand the persons of concern crisis.

2.3.1 Enabling location

The UNHCR accumulates population statistics in the form of spreadsheets that include refugees, returnees, stateless persons, and Internally Displaced Persons (IDPs), collectively known as "persons of concern" or "total population of concern." The ArcGIS Insights Workbook uses the countries' shapefile layer boundaries from ArcGIS Living Atlas to geolocate the persons of concern table from UNHCR. To enable the location of the persons of concern table, two fields from the UNHCR table are matched to the countries layer: the field indicating the country of asylum and the field indicating the country of origin.

2.3.2 Creating a link map

The relationships and interconnections within a dataset are the primary focus of a link map. They show how different locations are connected using nodes, lines, or arrows. A new field, Total Population, is added to the persons of concern table. The following equation sums all of the number fields in the spreadsheet to calculate the Total Population of concern:

asylum_seekers+idps_of_concern_to_unhcr+others_of_concern+refugees_under_unhcr_s_mandate+returned_idpss+returned_refugees+stateless_persons

The created link map shows the total number of people of concern who travelled between the different nations, with the nodes denoting the countries of origin and residence. In this case, the directional arrows depict the migratory patterns on the map. Directional relationships between nodes define flow maps. The nodes, which represent the nations of origin and residency, are sized using graduated symbols based on centrality. The degree of centrality of a node reflects its importance within a network. When determining which nodes in a network have the

most direct influence on other nodes, a notion known as degree centrality, which is based on the number of direct connections a node has, can be used. The following equation (ESRI, 2023) is used to compute the degree centrality of node x:

$$degCentrality(x)=deg(x)/(Nodes_{Total}-1)$$

Where:

$Nodes_{Total}$ = Total number of network nodes

$deg(x)$ = The number of nodes connected to node *x*

If the linkages in a network are directed, meaning that information can only flow from one node to another in a specific direction, then the degree centrality can be computed as either the indegree or the outdegree. The in-degree option quantifies the number of nations from which a nation has accommodated asylum seekers and refugees. A country that accommodates individuals from several nations will have a more extensive network. Asylum seekers come from all over the world, and the degree shows which countries are receiving the most of them. The Indegree centrality is computed using the following formula (ESRI, 2023):

$$indegCentrality(x)=indeg(x)/(Nodes_{Total}-1)$$

Where:

$Nodes_{Total}$ = Total number of network nodes

$indeg(x)$ = The number of nodes connected to node *x* with flow directed toward node *x*

The term 'outdegree' describes the total number of connections a nation has with other nations. A country with refugees who leave the country and settle in only one or two other countries would have a smaller symbol than a country with refugees who leave the country and settle in many different countries. The outdegree does not indicate the number of individuals departing a country; rather, it just indicates the number of outgoing linkages the country has. Outdegree centrality is computed with the following formula (ESRI, 2023):

$$outdegCentrality(x)=outdeg(x)/(Nodes_{Total}-1)$$

Where:

$Nodes_{Total}$ = Total number of network nodes

$outdeg(x)$ = The number of nodes connected to node *x* with flow directed away from node *x*

2.3.3 Managing the data

The UNHCR data are displayed in the link map created in the previous phase, making it impossible to identify trends or relationships. Data filtering helps to

organise information for better analysis. Instead of reporting on the number of new persons of concern each year, the UNHCR reports on the total number of individuals of concern for the year. For instance, if a person's status as a persons of concern is first recorded in 2018, they may be recorded as such again in 2019 and 2020 if no changes have occurred. Therefore, avoiding any analysis that combines data from different years is crucial, as doing so will provide inflated figures. In this study, charts are used to supplement the flow map and make your analysis more effective.

Results

3.1 Analysing recent refugee situations

In 2020, Zimbabwe had 23637 total persons of concern, as seen in Table 1. Based on the calculations shown at the bottom of the table, it can be observed that the number of refugees originating from Zimbabwe amounted to more than 8614 individuals. Additionally, the data indicates that there were 14611 individuals classified as asylum-seekers, while no internally displaced persons were reported. The UNHCR data include additional categories of individuals of concern that are not represented in the table. These categories include returned refugees, returned internally displaced persons, stateless persons, and others who are deemed to be of concern. Consequently, the total population figure slightly exceeds the combined count of refugees, asylum-seekers, and internally displaced persons. The majority of available data pertains to those classified as refugees, asylum-seekers, and internally displaced persons, so the data displays those fields.

Table 1: 2020 summary table of total persons of concern

Origin	Residence	Refugees (SUM)	Asylum-seekers (SUM)	IDPs (SUM)	Population (SUM)
Zimbabwe	South Africa	3,954	10,995	0	14,949
	United Kingdom	1,594	467	0	2,061
	United States	756	1,041	0	1,797
	Ireland	597	688	0	1,285
	Canada	629	334	0	963
	Australia	417	213	0	630
	Botswana	20	292	0	592
	Germany	282	254	0	536
	Zimbabwe	0	0	0	132
	Namibia	57	52	0	109
	China	5	90	0	95
	Egypt	43	21	0	64
		Total 8,614	**Total** 14,611	**Total** 0	**Total** 23,637

Both the bubble chart and the flow link map were used to filter and display the countries in which individuals of concern from Zimbabwe were residing during the year 2020. The cartographic representation displays the varying widths of the

connections between Zimbabwe and the respective countries of residence, which serves as an indicator of the volume of individuals of concern who are engaged in migration between these nations. Based on the bubble chart, it can be observed that South Africa had the largest population of individuals of concern, as shown by the highest number of residents. This was followed by the United Kingdom, represented by a green bubble, and the United States, represented by a purple bubble. The flow map uses data extracted from the population field in Table 1, representing it through varying line widths, and establishes connections between the origin and residence locations for different countries. The presentation of the data geographically (Figure 2) provides additional context and information that improves the comprehension of the data.

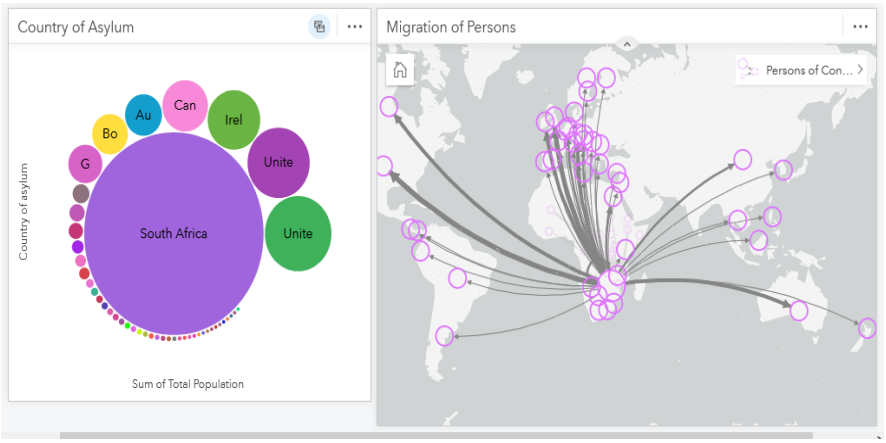

Figure 2: Bubble chart and the flow map for Zimbabwe in 2020

In addition to providing data on the volume of migrants between nations, the flow map also includes information pertaining to the number of countries from which refugees are entering Zimbabwe, as shown by the centrality of nodes. Figure 3 shows the indegree centraliy of Zimbabwe. The indegree centrality for Zimbabwe in 2020 is 20 (Figure 3). In 2020, South Africa had the highest indegree centrality of any African country, with 59. The indegree centrality measures how many countries a country has accepted persons of concern from.

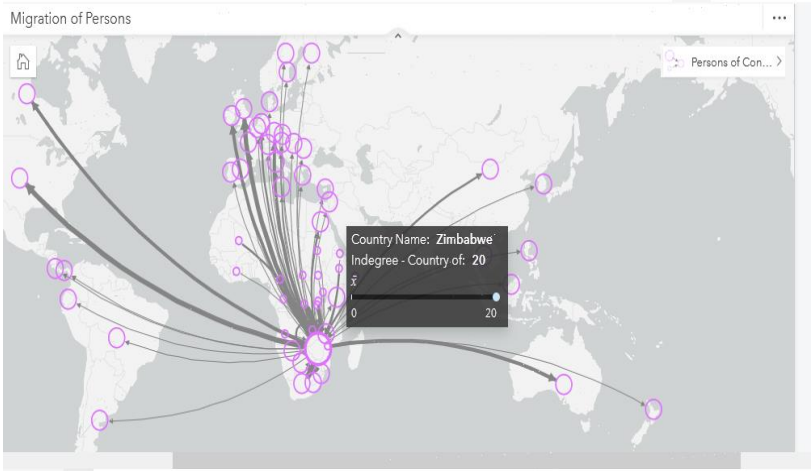

Figure 3: Indegree centrality for Zimbabwe in 2020

The columns in Figure 4 indicate the countries that have persons of concern residing in Zimbabwe in 2020. The most persons of concern are from Congo DRC (11675) and Mozambique (8172). Figure 4 also shows that Zimbabwe had 23637 persons of concern, as also indicated in Table 1. The blank columns have a very low to no population. Figure 5 shows the number of persons of concern travelling between Zimbabwe and the country of residence in 2020 as the thickness of the links between the two nations. The line to South Africa is the thickest, followed by those to the UK, the USA, and Ireland (as seen in the bubble chart in Figure 2). Around 46% of Zimbabwean refugees had made their way to South Africa.

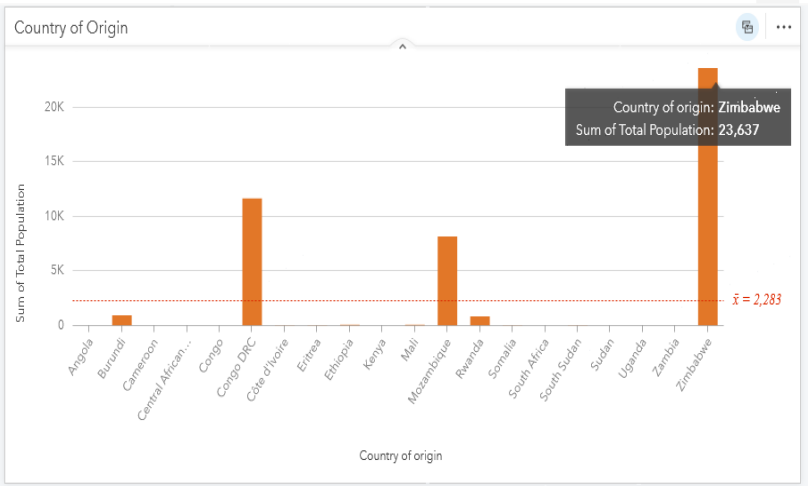

Figure 4: Column chart of countries that have persons of concern residing in Zimbabwe

Figure 5: Flow map showing outdegree centrality for Zimbabwe in 2020

The occurrence of emigration from Zimbabwe is not a recent development. As an illustration, the process of Zimbabweans relocating to South Africa for employment in the mining sector began in the early 1900s (Zinyama, 1990). Most persons of concern migrated to Mozambique, Zambia, Botswana and the United Kingdom from 1975 to 1990 (Figure 6).

3.2 Comparing changes in movement from 1975 to 2020

3.2.1 Movement from 1975 to 1990

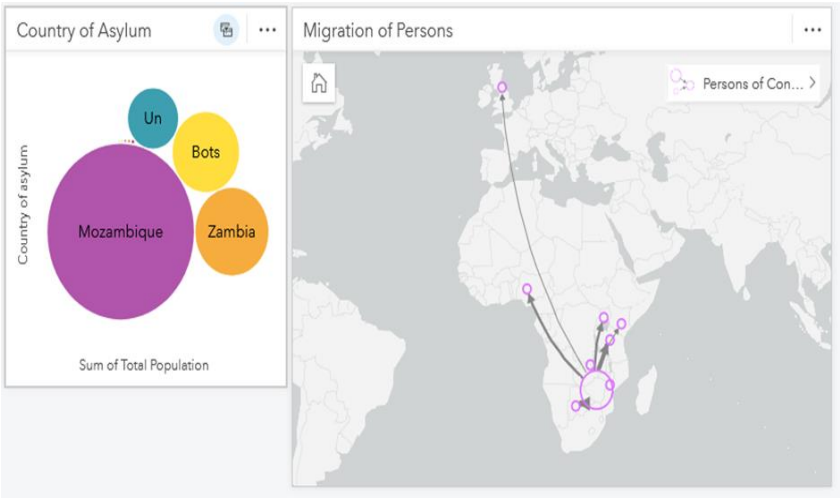

Figure 6: Bubble chart and the flow map for Zimbabwe between 1975 to 1990

During the period 1975 to 1990, 65.6% of the persons of concern were refugees, while no one sought asylum. 486900 individuals out of the total population

under consideration migrated to Mozambique, constituting 63.6% of the population (Table 2). The Rhodesia/Zimbabwe conflict that occurred in the late 1970s precipitated the enormous refugee crisis (Powell, 2013). Zimbabwe African National Union (ZANU), a militant socialist organisation that opposed white-minority rule in Rhodesia, began a gradual establishment in Zimbabwean refugee settlements in Mozambique for political and strategic reasons (Powell, 2013). Refugees provided liberation movements with a politically motivated constituency in addition to an excellent source of recruits. The nation acquired formal independence under the name of Zimbabwe on April 18, 1980.

Table 2: Summary table of total persons of concern between 1975 to 1990

Origin	Residence	Refugees SUM	Asylum-seekers SUM	IDPs SUM	Population SUM
Zimbabwe	Mozambique	336,900	0	0	486,900
	Zambia	100,570	0	0	121,110
	Botswana	64,584	0	0	100,374
	Unknown	0	0	0	57,020
	Tanzania	160	0	0	160
	Uganda	120	0	0	120
	Nigeria	110	0	0	110
	Kenya	60	0	0	60
	United Kingd...	15	0	0	15
		Total 502,519	**Total** 0	**Total** 0	**Total** 765,869

Figure 7 shows the bubble chart and flow chart that illustrate the data for Zimbabwe from 1991 to 2005. After a prolonged and contentious struggle for independence, Zimbabwe made significant advances in its economic and social spheres during the 1990s (Crush & Tevera, 2010). During the latter part of the 1990s, the country experienced a rapid deterioration in its social, political, and economic conditions, causing a significant increase in emigration (Hadebe, 2022). The adverse economic conditions, including a declining economy, high inflation and unemployment rates, the deterioration of public services, political repression, and increasing poverty, were significant elements that strongly influenced the decision-making of several Zimbabwean individuals (Besada & Moyo, 2008). The geographical proximity of Zimbabwe to neighbouring countries such as Botswana and South Africa, along with the high demand for Zimbabwean professionals in foreign nations, offered individuals a viable destination for migration (Zinyama & Tevera, 2002).

3.2.2 Movement from 1991 to 2005

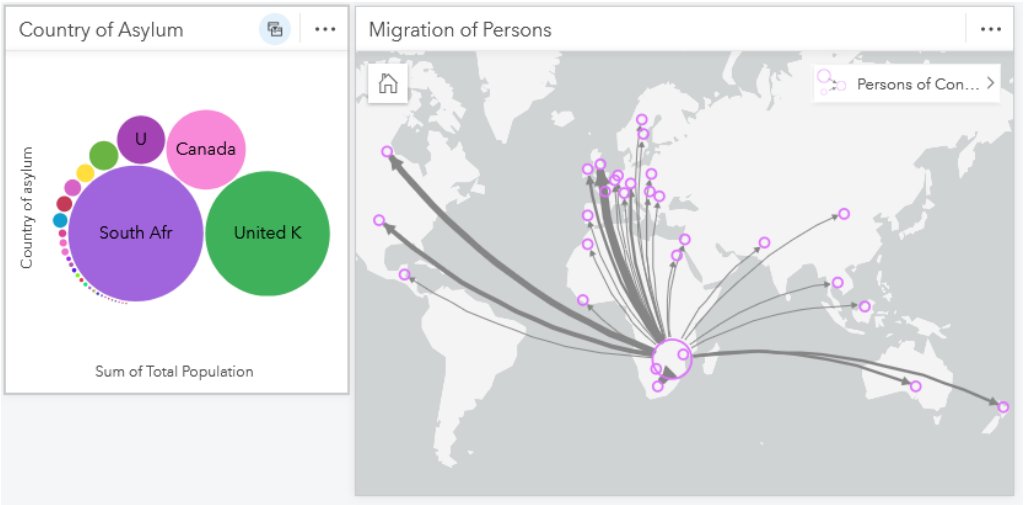

Figure 7: Bubble chart and the flow map for Zimbabwe between 1991 to 2005

Overall, there were 66981 persons of concern between 1976 and 2005, 32726 were refugees and 34255 asylum-seekers and no IDPs were reported (Table 3). The number of asylum seekers leaving Zimbabwe increased in the 1990s and has increased sharply since 2006.

Table 3: Summary table of total persons of concern between 1991 to 2005

Origin	Residence	Refugees (SUM)	Asylum-seekers (SUM)	IDPs (SUM)	Population (SUM)
Zimbabwe	South Africa	157	27,241	0	27,398
	United Kingd…	23,250	0	0	23,250
	Canada	5,299	4,176	0	9,475
	United States	1,836	1,630	0	3,466
	Ireland	1,100	172	0	1,272
	Botswana	290	202	0	492
	Germany	151	274	0	425
	New Zealand	308	61	0	369
	Australia	180	140	0	320
	Switzerland	0	92	0	92
		Total 32,726	Total 34,255	Total 0	Total 66,981

3.2.3 Movement from 2006 to 2020

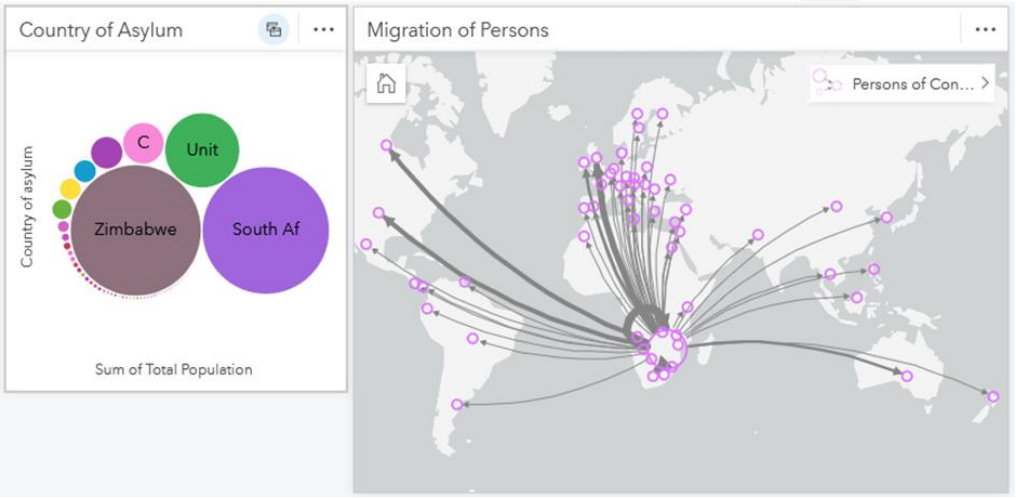

Figure 8: Bubble chart and the flow map for Zimbabwe between 2006 to 2020

Table 4: Summary table of total persons of concern between 2006 to 2020

Origin	Residence	Refugees (SUM)	Asylum-seekers (SUM)	IDPs (SUM)	Population (SUM)
Zimbabwe	Zimbabwe	0	0	442,343	443,381
	South Africa	40,534	378,076	0	418,713
	United Kingd...	139,149	4,877	0	144,026
	Canada	39,381	3,952	0	43,333
	United States	20,089	5,954	0	26,043
	Australia	10,614	1,842	0	12,456
	Botswana	9,720	796	0	11,280
	Ireland	4,973	4,836	0	9,809
	Germany	1,399	1,821	0	3,220
	Namibia	477	922	0	1,399
		Total 270,969	**Total** 405,583	**Total** 442,343	**Total** 1,120,805

The prevalence of internally displaced persons (IDPs) in Zimbabwe, as indicated in Table 4, exhibits significant variation, contingent upon the factors contributing to their relocation and the duration of their displacement. Displacement ensued due to various government policies and acts. The primary categories of internally displaced persons (IDPs) in Zimbabwe consist of agricultural workers and their dependents who have experienced displacement due to the loss of their employment on farms that were seized and redistributed as part of the fast-track land reform programme (Dziva et al., 2013). Additionally, individuals who have been displaced as a result of forced evictions in urban areas of Zimbabwe constitute another significant group of IDPs (IDMC, 2011). Government initiatives targeting informal mine workers and politically driven acts of violence resulted in the

displacement of several individuals (IDMC, 2011). Internal displacement is also the consequential outcome of global climate change, encompassing both rapid and slow-onset processes. According to Trummer et al. (2023), cyclone Idai had a significant impact in 2019, affecting a population of more than 270000 individuals. The cyclone resulted in the displacement of at least 51000 people while causing the unfortunate loss of over 340 lives and leaving numerous individuals unaccounted for. According to the International Displacement Monitoring Centre (IDMC,

2017), weather-related disasters currently result in the displacement of approximately 21.8 million individuals annually on a global scale.

3.3 Evolution of persons of concern over time

This section compares past and present refugee situations and examines the evolution of persons of concern over time.

Table 5: Summary of the centrality and number of persons of concern in Mozambique for the years 1998 through 2020 in Zimbabwe

IC – Indegree country; OC – Outdegree country; RR – Return refugees; IDP – Internally displaced persons; TP – Total persons; CTP – Country most migrated to

Year	IC	OC	Refugees	RR	Asylum-seekers	IDP	TP	CMM
1998	21	3	40	0	0	0	40	United Kingdom
1999	21	3	40	0	0	0	40	United Kingdom
2000	13	6	109	0	204	0	313	Canada
2001	23	10	257	0	2694	0	2951	Canada
2002	23	16	4024	0	1158	0	5182	United Kingdom
2003	24	17	7155	0	3471	0	10626	United Kingdom
2004	33	19	9557	0	9398	0	18955	South Africa
2005	3	25	11246	0	17330	0	28576	South Africa
2006	3	26	12774	0	1207	0	13981	United Kingdom
2007	13	26	14366	0	34318	0	48684	South Africa
2008	10	31	16825	5	34776	0	51606	South Africa
2009	10	33	22441	19	1394	0	23854	United Kingdom
2010	10	33	24081	180	1001	0	25262	United Kingdom
2011	12	31	25033	19	36685	54278	116055	Zimbabwe
2012	11	32	22082	21	41723	57926	121774	Zimbabwe
2013	13	34	19719	0	41822	60139	121777	Zimbabwe
2014	14	35	22478	55	42419	0	65068	South Africa
2015	16	36	21332	31	57376	0	78874	South Africa
2016	16	33	18141	6	43191	0	61499	South Africa
2017	16	39	17420	38	21760	0	39387	South Africa
2018	16	39	15618	21	17121	0	32870	South Africa
2019	19	39	10045	132	16179	270000	296477	Zimbabwe
2020	20	45	8614	280	14611	0	23637	South Africa

Table 5 shows data from 1998, two years prior to the decision made by the government of Zimbabwe in the year 2000 to seize land without providing adequate compensation (Takaindisa, 2021). This marked a turning point in the country's history. The so-called "rapid land reform initiative" led to the eviction of many commercial farmers and those who worked for them. According to Dore et al. (2008), the unorganised manner in which the program was carried out contributed significantly to a loss in production and continued to destroy the economy, which was already weak due to earlier neglect, corruption, and a hastily conceived Economic Structural Adjustment Programme (ESAP). The ESAP implemented in Zimbabwe in 1990 aimed to usher in a transformative period of industrialisation characterised by modernisation, competitiveness, and export-oriented growth (Brett & Winter, 2020). After the early success in the first few years, the expected dividends of ESAP did not materialise. In 2002, the total persons for concern was more than 5000 for the first time (Table 5). The collapse of commercial agriculture combined with unfavourable meteorological conditions led to significant food shortages (Andersson, 2007). As a result, approximately half of Zimbabwe's population was forced to seek emergency assistance with their food supply. As a direct consequence of this, a massive population shift occurred. Between 2000 and 2008, many countries, including Canada, the United Kingdom, and South Africa, saw an increase in the number of people applying for asylum from Zimbabwe (Table 5). Several interrelated events caused the upheaval of people's living arrangements. Operation Murambatsvina, which took place in 2005 (Musoni, 2010), was one of the other factors considered. It was formally presented as a program to rid cities of illegal structures, illegal companies, and criminal activity. In reality, it was used as a tool to punish political opponents and, as a direct consequence, an estimated 700000 people were forced out of their employment or their homes (Musoni, 2010). The vast majority of people displaced from their farms and cities sought refuge in the countries listed in Table 5. During the violent land reform and election in 2008, some people were forced to flee the country. According to Dziva et al. (2013), during the national election in 2008, suspected members of the ruling party were responsible for the deaths of over 200 people affiliated with the opposition party. During the peak of hyperinflation in 2008, the economy experienced significant devastation, resulting in an exacerbation of poverty among its population and compelling a substantial number of Zimbabwean individuals to seek emigration (Kudzai, 2023). On the other hand, according to Makochekanwa (2016), the most extreme monthly inflation rate for Zimbabwe was estimated to be 79.6 billion percent, which is equal

to 89.7 sextillion. According to Hadebe (2022), following ZANU-PF's first-ever loss of its parliamentary majority in elections in 2008, and a subsequent political standstill over the contested election results, discussion ensued, leading to the formation of a Government of National Unity (GNU) in 2009, which included ZANU-PF and important opposition groups. Initially, it resulted in a decrease in the number of people seeking asylum (Table 5). Zimbabwe switched to using the United States dollar as its official currency between 2009 and 2013, during which time the country's economy improved to the point that it was growing at a rate of 10% per year (Ncube, 2013). During the years 2014–2017, there was not only considerable inflation, but also significant political violence.

Table 6: Summary table of total persons of concern in 2015

Origin	Residence	Refugees (SUM)	Asylum-seekers (SUM)	IDPs (SUM)	Population (SUM)
Zimbabwe	South Africa	6,358	55,978	0	62,336
	United Kingd...	9,045	475	0	9,520
	Canada	2,368	42	0	2,410
	United States	1,316	261	0	1,577
	Australia	1,009	129	0	1,138
	Botswana	678	12	0	721
	Ireland	191	251	0	442
	Zimbabwe	0	0	0	135
	Namibia	42	76	0	118
	Germany	46	35	0	81
		Total 21,332	**Total** 57,376	**Total** 0	**Total** 78,874

2015 was the year with the highest outmigration, as shown in Table 5. The largest group of persons of concern who left Zimbabwe were asylum-seekers (57376) and refugees (21322), as shown in Table 6.

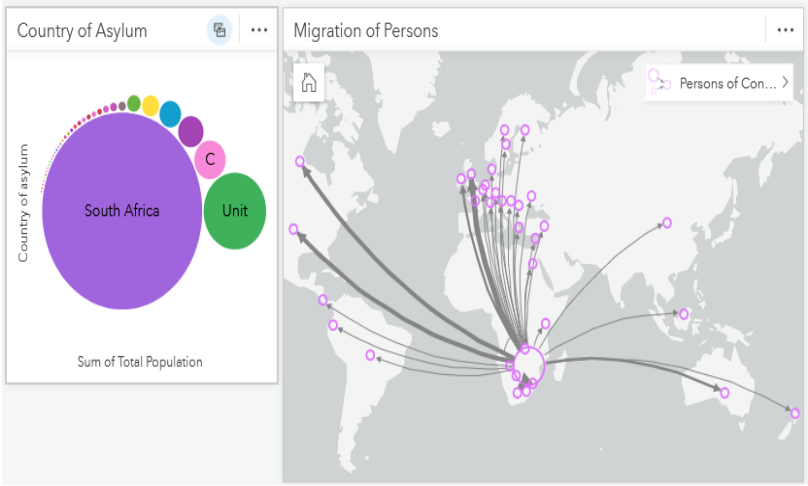

Figure 9: Bubble chart and the flow map for Zimbabwe in 2015

According to the flow map in Figure 9, the thickest line points to South Africa. The bubble chart in Figure 8 supplements the flow map and shows that the country of residence with the most persons of concern from Zimbabwe in 2015 was South Africa, with a population of 62336, representing 79% of the total population. In 2017, a new government took power in Zimbabwe, with the aim of bringing optimism to the country's population. However, this government could not eradicate corruption or improve the living conditions of the people, which led to the continued flow of refugees and asylum seekers to neighbouring South Africa.

Table 7: Summary table of total persons of concern in 2019

Origin	Residence	Refugees (SUM)	Asylum-seekers (SUM)	IDPs (SUM)	Population (SUM)
Zimbabwe	Zimbabwe	0	0	270,000	270,121
	South Africa	4,003	12,825	0	16,828
	United Kingd...	2,324	390	0	2,714
	United States	825	867	0	1,692
	Ireland	438	791	0	1,229
	Canada	728	383	0	1,111
	Australia	584	226	0	810
	Botswana	564	42	0	738
	Germany	238	298	0	536
	China	5	107	0	112
		Total 10,045	Total 16,179	Total 270,000	Total 296,477

The largest group of persons of concern was the IDP in 2019, as shown in Table 5. The second largest group was the asylum-seekers (Table 7).

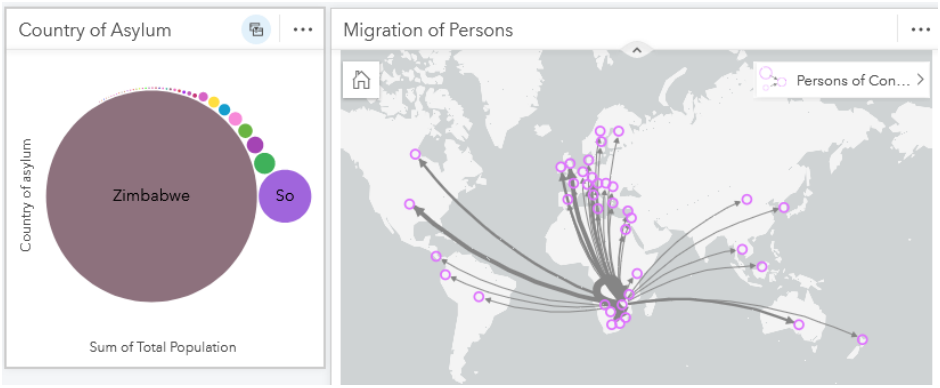

Figure 10: Bubble chart and the flow map for Zimbabwe in 2019

In 2019, cyclones Idai and Kenneth were responsible for the displacement of tens of thousands of households, putting them in need of essential resources such as food and water (Cross, 2019). The thickest line (Figure 10) was the loop back to Zimbabwe, representing mainly IDPs as a result of the two cyclones. The two storms were responsible for significant floods and extensive damage (Trummer et al., 2023).

In 2020, the number of people seeking asylum and refugees decreased (Table 5), but the number of refugees returning home increased to its highest level. Many Zimbabweans living in South Africa were forced to return to their home country due to COVID-19, increased immigration controls, and xenophobic violence (Addison, 2023).

Discussion

Upon examining the data over time, notable trends are observed. As indicated in Table 5, the first trend reveals a consistent increase in outdegree. Specifically, there is a clear upward trend in outdegree with each successive year studied in Zimbabwe. Numerous factors influence migration trends and dynamics in Zimbabwe. These include corruption, economic mismanagement, inadequate economic policies like the ESAP, politics, and the land reform programme. From 1998 to 1999, the economy was exceedingly stable and the ruling party, the Zimbabwe African National Union-Patriotic Front (ZANU-PF), did not fear losing power because there was no significant opposition. There were very few internally displaced persons (IDPs) and very few seeking asylum in other countries, but there was sufficient evidence that the economy was spiraling downward. Since 2000, there has been a gradual increase in emigration flows and cross-border movements. This upward trend has gained momentum, particularly due to the significant deterioration of the national economic condition.

The steady increase in the outdegree can also be explained by a variety of other factors, such as advances in the methods used to gather data, which have led to the compilation of more detailed information on the countries of origin. The Zimbabwe National Statistics Agency reports that 773246 of the 908913 Zimbabweans in the diaspora live in South Africa, the continent's most industrialised nation (Ndlovu, 2022). Table 3 shows that millions have fled the country due to its more than two-decade economic crisis, which has forced them to seek work elsewhere, particularly in South Africa and the United Kingdom. Bloch (2005) claimed that Zimbabweans' migration patterns and characteristics in the United Kingdom differ from those in South Africa. Cross-border migration from Zimbabwe to South Africa is cyclical, and those involved are mostly uneducated, with women outnumbering men. Zimbabweans who go to the United Kingdom mostly do so on a work permit, either to work as health care professionals or on family reunion routes (Bloch, 2005). The emergence of the COVID-19 pandemic prompted developed countries such as the United Kingdom to ease immigration procedures for healthcare

professionals seeking employment opportunities abroad (Dzinamira, 2021). Consequently, there was a notable surge in the migration of healthcare workers to South Africa, the United Kingdom, the United States of America and Australia, with many assuming the roles of caregivers. Most of the Zimbabweans who end up in South Africa are teachers, which represents 61% of the total (IOM, 2018). According to the 2021 human flight and brain drain in Africa, Zimbabwe currently has 7.1 index points, which is higher than the average of 5.25 index points seen around the world (The Global Economy, 2022).

According to Bloch (2005), most Zimbabweans living in exile have high ambitions with regard to return migration and contributing to progress in their home country. This notion is further reinforced by Nyangulu (2023), who highlights that Zimbabweans abroad play a crucial role in driving the socio-economic development of their home country while simultaneously fulfilling their aspirations and desires through a sustainable partnership. A minority of Zimbabweans who reside in the diaspora (12%) expressed no intention of relocating to Zimbabwe for the foreseeable future (Bloch, 2005). The prevalence of Zimbabwean diaspora organisations is growing in nations including the United Kingdom and South Africa. Nevertheless, these organisations generally fall into two categories: those with a political agenda that aims to bring attention to Zimbabwe or protest the treatment of migrants in their host countries and those that are humanitarian coalitions and networks committed to assisting newly arrived migrants in surviving, settling, and assimilating (Pasura, 2010). Today, the participation of refugees in the economic growth of their home countries takes the form of social networks and monetary remittances to members of their families. In particular, Zimbabwe has a large population living outside the country (Crush et al., 2006). According to Mbiba and Mupfumira (2022), the remittances that 'migrants' bring back to their home countries in the form of money, commodities, information and services are extremely important to people's livelihoods.

Conclusion

This research used ArcGIS Insights to examine the spatial and temporal dynamics of persons of concern movements in Zimbabwe. ArcGIS Insights is a geographic information system (GIS) application that may be used to conduct research, create visually appealing maps and charts, and present the findings to top management. The process recording capabilities of ArcGIS Insights will allow humanitarian experts to rerun analyses, inspire further investigations and analysis into persons of concern, and provide a measurable visual to communicate with the

audience. The link analysis method employs a network of nodes and links to identify and examine connections within a dataset. This method has broader applications in fields such as public health and forensics. The technique has the drawback of needing reliable data on the number of persons of concern. Many people leave their countries of origin without formal registration.

Disclosure statement

No potential conflict of interest was reported by the authors.

Author Contribution

The authors confirm their contribution to the paper as follows: study conception and design, data collection, analysis, interpretation of results and approval of the final version of the manuscript.

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Availability of data

The data that support the findings of this study are openly available at https://www.unhcr.org/refugee-statistics/

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