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A Comparative Study on Migration Outflows and the Effects of Remittance Inflows Utilizing ArcGIS Mapping and Cluster Analysis

Md. Ashraful Islam & Md. Rokonuzzaman

Abstract

This study's goal is to determine how remittances affect migration. Data from 45 nations is utilized for this analysis, which is separated into six regions: The Middle East and North Africa (MENA), the Association of Southeast Asian Nations (ASEAN), East Africa, South Africa, and West Africa. Utilizing descriptive statistics, significant graphs, and cluster analysis, this investigation is thoroughly and properly completed. The data displayed in ArcGIS maps also demonstrate the emigration and remittance outflows of several Asian and African nations between 1985 and 2017. By considering five clusters, cluster analysis is used to analyze similar nations in terms of how remittances affect migration. Three, eight, thirteen, nineteen, and three of these 45 nations make up Clusters I through V, respectively. Cluster V is made up of Bangladesh, India, and China. As II and III are the most distant clusters and II and III are the closest clusters, the cluster distance between III and V is low and between II and III is very high. The absence of time-series migration data is the key constant in this investigation. To achieve successful outcomes, simulation studies might be used. In order to obtain better results, anyone can also include discrimination analysis in their analysis. ArcGIS is also used to create visually appealing data distribution visualizations, such as maps, charts, and graphs with legends and annotations.

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Introduction

This research analyzes migration outflows and their effects on remittance inflows in different geographic regions. Migration and remittances have significant social, economic, and political implications for both source and destination regions. Remittances, or money transfers sent by migrants back to their home countries, constitute a substantial portion of the receiving country's GDP. Understanding the dynamics between migration outflows and remittance inflows is crucial for comprehending the broader socioeconomic landscape. Remittances contribute to poverty reduction, education, healthcare, and an overall improvement in living standards. By analyzing migration patterns and remittance inflows, policymakers and researchers can gain insights into which regions benefit the most from these flows and how they are being utilized. ArcGIS mapping and cluster analysis can visually represent and analyze complex geographical data, identifying migration trends, hotspots, and remittance patterns across different regions. This analysis can have important policy implications, allowing governments and organizations to tailor their policies to support areas with high outflows of migrants or maximize the positive impact of remittances in regions that rely heavily on them. Comparative analysis can reveal similarities and differences that might not be evident through isolated studies of individual regions. The analysis of data on international migration, remittances, inequality, and poverty in developing countries Adams & Page (2005) find that both factors significantly reduce poverty levels, with a 10% increase in international migrants leading to a 2.1% decrease in poverty and per capita official remittances a 3.5% decrease. But Ratha et al. (2011) argue that migration leads to increased incomes, poverty reduction, and improved health and education. However, these gains may come with social costs for migrants and their families. Many developing countries face challenges in integrating immigrants, reducing job competition, and providing social services. The paper recommends better integration of migration in development policies, improved data collection, leveraging remittances for finance, recruitment mechanisms, and facilitating international labor mobility through safe and legal channels. Massey et al. (1998) develop a comprehensive theory of international migration for the 21st century, examining migration levels and patterns from North America, Western Europe, the Gulf, Asia, and the Pacific. Yang (2008) examines the impact of international migration, remittances, and household investment on Philippine migrants' exchange rate shocks. The study finds that positive migrant shocks increase human capital accumulation and entrepreneurship, leading to increased child schooling, educational expenditure, self-employment, and capital-intensive household enterprises. Barham and Boucher's (1998) study examines the net effects of migration and remittances on income distribution. They impute potential home earnings of migrants and non-migrants in migrant households to construct no-migration counterfactuals. The study finds that migration and remittances increase income inequality in a sample of households in Bluefields, Nicaragua. The study examines the impact of workers' remittances on economic growth in 39 developing countries from 1980-2004. The fixed-effects method shows a significant overall fit, while random-effects models are rejected. Accurate data on remittances is needed to reveal a more pronounced effect (Pradhan., et al. ,2008). Since migration is a complex phenomenon that touches on various economic, social, and security aspects affecting daily lives in an increasingly interconnected world. Remittances are financial transfers made by international workers to family members back home, and they have grown significantly over the past 20 years. According to the World Bank's (2018) analysis, in 2017, remittances sent US $450 billion to developing countries, more than four times the value of all foreign aid for development. International migration plays a significant role in the economic interactions between industrialized, emerging, and less developed countries in the modern era Fayissa & Nsiah (2010). This study examines the impact of remittances on international migration, assesses their interaction, and discusses descriptive statistical analysis results. Cluster analysis is used

to differentiate migrated and remitted nations and to identify associated regions. Everitt (1993). The study aims to outline research objectives, identify areas where ArcGIS can be useful, and identify ways in which mapping and spatial analysis can further research objectives Mennis (2006). In order to justify the patterns and behavior of the impacts of remittance inflows on international migration outflows, this article computes descriptive statistics, univariate analysis, bivariate regression analysis, and multivariate analysis, including one-way ANOVA. Panel analysis is then used to estimate the regression analysis using various models, particularly the fixed and random effect models. The study aims to determine how remittances influence migration patterns.

Literature review

This paper provides a summary of the research on how migration and remittances affect the development of source and destination countries in Asia and Africa. International migration has an impact on the development of both the origin and destination countries in Asia and Africa. This study offers an overview of the literature on the effects of migration and remittances on the growth of source and destination nations in Asia and Africa. The origin and destination nations in Asia and Africa are affected by international migration in terms of their development. According to the UN, 244 million individuals, or 3.3% of the world's population, do not live in their country of birth. Migration from developing, emerging, and developed nations is included in this. In this paper, methodological problems such endogeneity, reverse causality, selection bias, and omitted variables are discussed. Panel data, counterfactuals, natural experiments, and instrumental variables are some of the methods. United Nation (2015). Moreover, it focuses on the development of instrumental variables and their validity testing (McKenzie et al., 2007). Giuliano and Ruiz (2008) investigate the relationship between remittances and the financial development and growth of 70 developing countries over the period of 1975–2002, and they discover that remittances offset the financial system's constraints by easing credit restrictions on the poor and encouraging financial productive investments that stimulate growth. Remittances enhance capital allocation in nations with less developed financial systems and serve as a stand-in for financial development. The detrimental impact of remittances on economic growth was discovered by Chami et al. (2003). According to their research, remittances have a detrimental impact on growth. According to them, individuals who are assured of receiving cash from overseas are not driven to work and may cut their work effort while maintaining the same level of income, which is harmful to growth (Barham et al.1998). Migration, Remittances, and Inequality: Estimating the Net Effects of Migration on Income Distribution Journal of Development Economics The impacts of foreign migration on income distribution are investigated in this study using a small, non-representative sample of 152 Nicaraguan households De Luna Martinez (2005). Employee Remittances to Developing Countries: A Survey with Central Banks on Selected Public Policy Issues According to an IMF analysis covering the years 1970–2003, remittances made by migrants are not significantly associated with growth, education levels, or investment rates. This research used a randomized field experiment to investigate the importance of migrant control over the use of remittances. In partnership with a large Salvadoran bank, US-based migrants from El Salvador were offered different types of accounts for channeling remittances into savings accounts in their home country. The treatment that offered migrants the greatest degree of control over savings had the highest impact on savings accumulation at the partner bank, with the effects concentrated among migrants who expressed a demand for control over remittances in the baseline survey by Ashraf et al. (2010). Since remittances may be endogenous, the authors estimate counterfactual incomes for migrants had they stayed and worked at home, and they control for selection bias using a two-stage Heckman procedure (Katsushi et al., 2012). In their work, Remittances, Growth, and Poverty, new evidence from

Asian countries generally confirms that remittances have a positive impact on economic growth. The work also found a positive impact of remittances on poverty alleviation. Cohen & Jeffrey (2005) paper discusses remittance outcomes and migration, examining theoretical contests and real opportunities, focusing on macro and micro levels, and contrasting negative and positive outcomes for social and economic development. Remittances positively impact economic growth in underdeveloped countries by providing alternative investment funds and overcoming liquidity constraints. Fayissa & Nsiah (2010), The World Bank's Economic Implications of Remittances and Migration, examine gains and losses from international migration, focusing on remittances sent home, and suggest policy initiatives to improve the developmental impact of migration, particularly remittances (World Bank, 2006).

Data and Research Methodology

This study aims to analyze migration outflows and the effects of remittance inflows using ArcGIS mapping and cluster analysis. Data from 45 nations is used, categorized into six regions: The Middle East and North Africa (MENA), the Association of Southeast Asian Nations (ASEAN), East Africa, South Africa, and West Africa. The research problem is introduced, emphasizing the importance of understanding migration outflows and their impact on economic and social aspects. The research objectives and hypotheses are stated, and the literature review is conducted to review relevant studies on migration trends, remittances, and their effects on economic and social aspects. Data collection is described, including migration and remittance data, geographical coverage, and time periods. Data preprocessing is done to clean, organize, and prepare raw data for analysis. The methodology is discussed, focusing on ArcGIS mapping and cluster analysis and how they were used to visualize migration outflows and remittance inflows over time. ArcGIS mapping is described, and examples of maps generated to highlight key trends and patterns are presented. Cluster analysis is discussed, including data preparation, selection of variables, and the clustering algorithm used. Results are presented, detailing the composition of each cluster and their characteristics that differentiate them. Findings are presented, and significant insights related to migration outflows, remittance effects, and identified clusters are discussed. The discussion is conducted to interpret the findings in the context of existing literature and theories, discuss the implications for policy, development, and future research, and address limitations and potential sources of bias. The conclusion is summarized, summarizing key findings and their implications, reiterating the study's significance, and suggesting avenues for future research based on the study's outcomes.

Results and Discussion

Descriptive Statistics and Geographical Analysis

In the contemporary economic environment, remittances and migration are both well-known subjects. A change of a person's regular home between clearly delineated geographical units is called migration, a type of spatial or geographical mobility. Emigration is the term used to describe the departure from a certain territory in relation to international migration. The statistical definition used to collect data on remittances is broader; therefore, global estimates of financial transfers made by migrants include transactions that are not typically considered to be remittances (IMF, 2009). Remittances can also be of a social nature, such as ideas, behaviors, identities, social capital, and information that migrants gain while living in a different region of the country or abroad and can then be transferred to their communities of origin. In our research study, we used two important variables: international migration outflows and remittance inflows for 45 countries from six regions: ASEAN, SAARC, MENA, East Africa, South Africa, and West Africa, from the years 1885 to 2017.

Table 1: Migration percentage according to Total Population

Year	*Number of migrants (in millions)*	*Migrants as a% of the world's population*
1990	153	2.90%
1995	161	2.80%
2000	173	2.80%
2005	191	2.90%
2010	222	3.20%
2015	244	3.30%
2020	281	3.60%

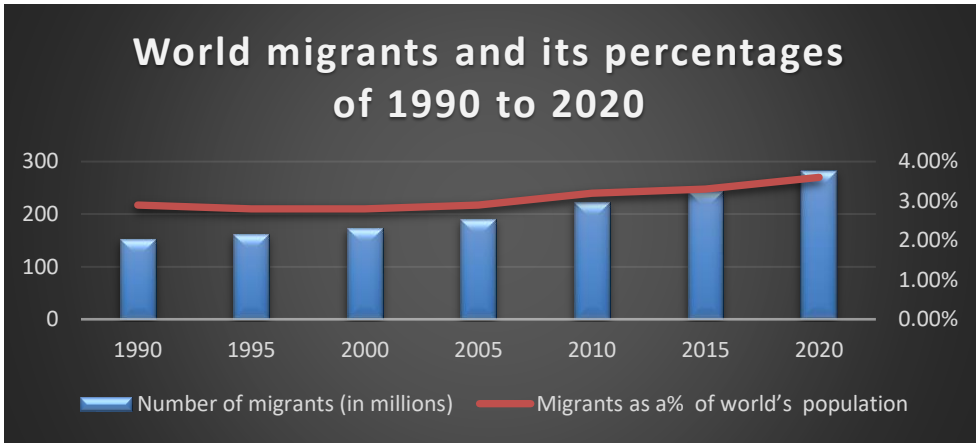

Figure 1: Migrants percentage from 1990 to 2020

From the above graph, we can see different years with a five-year interval from 1990 to 2015. Each year shows us both the number and the percentage of migrants in the world's population. In 1990, about 153 million people migrated to different countries, and the percentage was 2.90. The number of migrant workers increased to 161 million in 1995. Which is 8 million more than the previous 5 years. But the screaming increase in the world population had an effect on the percentage of migrants and the percentage decrease of 0.1%, which was 2.80% of the world population. After a five-year interval in 2000, the number of migrants increased by about 12 million over the previous year, 1995. And the total number of migrants in 2000 was 173 million. And the percentage was 2.80%, as we saw in 1995. In 2005, the number of migrants was 191 million, which was 2.90% of the world's population. And it was at an increasing rate of 0.10%. In the table, we can see a longer 5-year interval after 2005. In 2010, both the number and the percentage of migrants increased greatly from previous years. This year, the number of migrants was 222 million, which was 3.2% of the world's population in the next five years. 2015 was made up of 244 million, and 3.3 percent were migrant workers all over the world. In 2020, the migrated population broke its previous record of 281 million, and its overall percentage was 3.60%. The migration and remittances comparison of 1990 and 2017 are given below-

Table 2: Regional Data on migration and remittances in 1990 and 2017

Year	**1990**		**2017**	
Region	Migration	Remittance	Migration	Remittance
SAARC	34,29,611	5649.69	67,06,900	113082.50
ASIAN	18,90,474	2436.72	51,05,999	112161.80
MENA	8,16,165	6442.45	16,97,864	33196.32
EAST AFRICA	6,32,109	213.02	9,28,574	4913.44
WEST AFRICA	8,18,232	604.55	16,60,915	27997.54
SOUTH AFRICA	5,21,378	255.20	3,44,677	1027.56

After the short description of the table above, we can easily say that the world population was always increasing and that the vast rate of the increasing world population affected the migrant population's percentage. The number of migrants was always increasing. We can say that it depends on the statistical research of different years with a five-year interval.

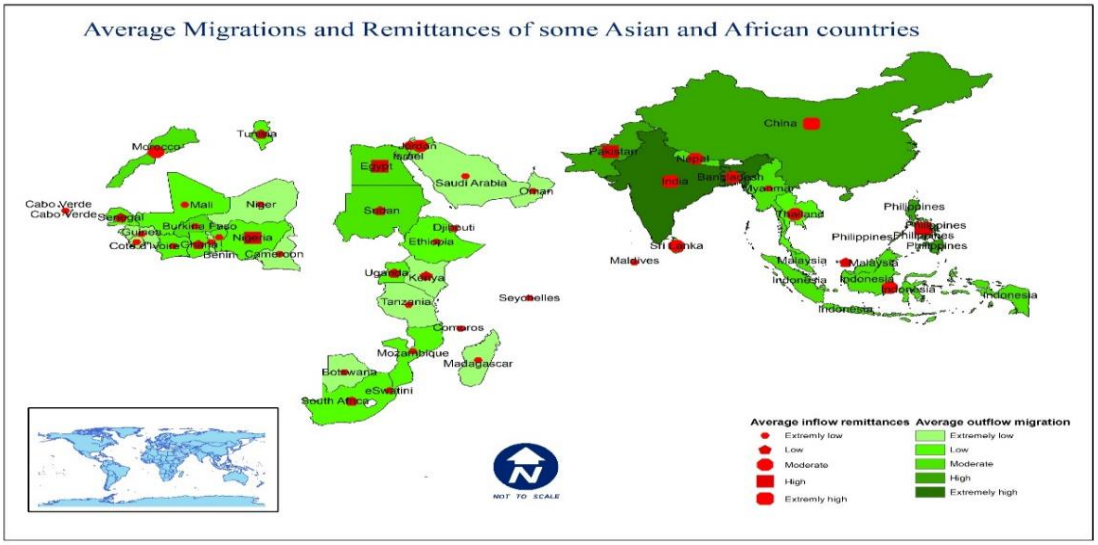

Figure 2: Average migrations and remittances of Asian and African countries

The above arc GIS graphs show average migration and remittances for the last 28 years (1990–2017) for 45 countries in six regions around the world. All the countries' migration and remittances are categorized as extremely low, low, moderate, high, and extremely high. Here, the topmost migrant countries are India, China, Bangladesh, Pakistan, and the Philippines. Whereas the lowest-migration countries are Saudi Arabia, Botswana, Mali, Guinea, Madagascar, Niger, Cameroon, and Tanzania. The top two remitting countries are India and China. Bangladesh, Pakistan, Egypt, and Nigeria are high-inflow remittance countries. In Morocco, Thailand, Indonesia, and Sudan, there are moderate migrations and remittance inflows. But most African countries receive low-income migrants with extremely low remittances.

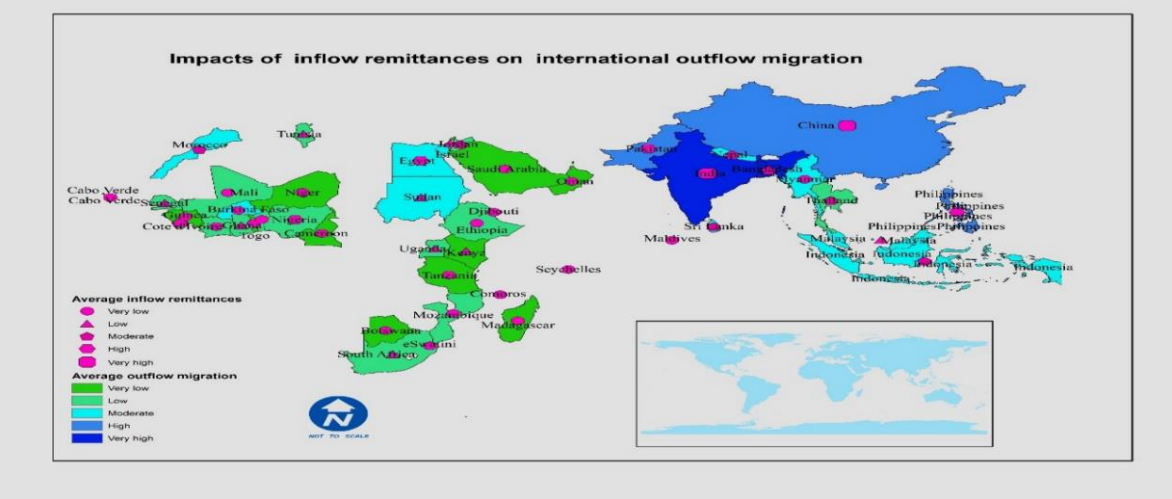

Figure 3: Average outflow migrations and average inflow remittances of Asian & African countries

The ArcGIS maps display the outflow migration and remittances of Asian and African countries from 1985 to 2017. Bangladesh and India have the highest outflows of migration and

remittances, while Pakistan and China are highly migratory and remittance-intensive. Myanmar, Malaysia, Nepal, Sri Lanka, Egypt, Sudan, Morocco, and Burkina Faso experienced moderate migration outflows and remittance inflows. Thailand, Jordan, Djibouti, Ethiopia, Uganda, Comoros, Eswatini, Comoros, Mozambique, South Africa, Tunisia, Niger, Senegal, Nigeria, Ghana, and Cote d'Ivoire experienced few migrants and few remittances. Saudi Arabia, Oman, Israel, Kenya, Tanzania, Botswana, Madagascar, Niger, Cameroon, Togo, Guinea, Cabo Verde, the Maldives, and Seychelles were followed as low-migration and low-remittance countries. The study examines 45 countries, including the SAARC, ASEAN, MENA, East Africa, South Africa, and West Africa. India has the highest average number of migrants and the highest remittances in the SAARC region, while the Maldives has the fewest average number of migrants and the lowest remittances. China, Malaysia, and Myanmar are the top three countries receiving remittances. East Africa has the highest and lowest average amounts remitted, with Sudan having the greatest average number of migrants (0.24 million), Seychelles having the smallest (5 thousand), and Sudan having the target average number of migrants (2.4 million). Nigeria has the most migrants in the West African region, with a population of 1.2 million and a GDP of 9.43 US million. Guinea has the lowest numbers. South Africa is the most migrated and remitted country, with 0.13 million migrants and 489.6 million US dollars in remittances. Botswana is the lowest-migrant and least-remitted country in the South African region. The MENA region has the top-most migrant country, Sudan, with an average number of 0.24 million migrants.

Table 3: Average remittance inflows and outflows among the 45 countries

Country	Average outflow migration	Average inflow remittances	Country	Average outflow migration	Average inflow remittances
Bangladesh	2178310	6769.61	Morocco	461944	4277.67
Benin	88043	143.23	Mozambique	174307	79.19
Botswana	8851	45.16	Myanmar	365250	255.69
Burkina Faso	259741	45.15	Nepal	242362	2596.09
Cabo Verde	30566	162.36	Niger	51565	76.09
Cameroon	44801	111.22	Nigeria	164964	9425.67
China	1442590	27727.09	Oman	3478	38.64
Comoros	17107	68.15	Pakistan	882506	8306.79
Cote d'Ivoire	129011	197.87	Philippines	774557	15266.93
Djibouti	2238	26.49	Saudi Arabia	38020	125.70
Egypt	447011	8444.71	Senegal	91972	870.88
eSwatini	11049	85.45	Seychelles	4993	9.17
Ethiopia	161449	324.13	Sierra Leone	46244	25.43
Ghana	122498	632.71	South Africa	124630	489.61
Guinea	13333	33.89	Sri Lanka	248972	3183.36
India	2209993	33214.44	Sudan	239799	545.46
Indonesia	580996	4297.87	Tanzania	51254	132.97
Israel	63165	461.31	Thailand	126215	3129.95
Jordan	99893	2621.93	Togo	68705	178.26
Kenya	72272	622.62	Tunisia	116962	1265.82
Madagascar	24302	119.94	Uganda	116161	459.78
Malaysia	264793	891.19	Tunisia	116962	1265.82
Maldives	437	3.08	Uganda	116161	459.78
Niger	169337	379.49			

Cluster Analysis

Cluster analysis is a statistical method that explores finding structures in the data. The terms segmentation analysis and taxonomy analysis are also used to refer to cluster analysis. If the grouping is unknown, it explicitly looks for homogenous groups of cases. It does not differentiate between dependent and independent variables because it is exploratory. Binary, nominal, ordinal, and scale data can all be handled by the many cluster analysis techniques offered by SPSS. Cluster analysis is frequently used in conjunction with other techniques. In order to evaluate whether the outcomes of the analysis are genuinely useful, we must be able

to interpret the cluster analysis using our knowledge of the data. Here different clusters including their members are given below-

Table 4: Clustered Countries of Average Remittances Inflows

Cluster	Countries with Region
Cluster 1	ASEAN: Malaysia MENA: Tunisia, Israel East African: Sudan, Uganda, Kenya South African: South Africa West African: Ghana, Senegal
Cluster 2	SAARC: Bangladesh, Pakistan ASEAN: Philippines MENA: Egypt West African: Nigeria
Cluster 3	ASEAN: Indonesia, Thailand SAARC: Nepal, Sri Lanka MENA: Jordan, Morocco
Cluster 4	SAARC: India ASEAN: China
Cluster 5	ASEAN: Myanmar SAARC: Maldives MENA: Oman, Saudi Arabia East African: Seychelles, Madagascar, Ethiopia, Comoros, Djibouti, Mozambique, Sierra Leone South African: Botswana, Eswatini, Tanzania West African: Benin, Burkina Faso, Cabo Verde, Guinea Cameroon, Cote d'Ivoire, Mali, Niger, Togo

Since the observations are taken from different regions, we also clustered the countries, which shows the variation of the migrants and their remittances. Where the SAARC and ASEAN regions provide highly outflowing migration and inflowing remittances.

Table 5: Cluster for average outflows of International Migration

Valid cluster	Frequency	Percent	Valid Percent	Cumulative Percent
1	3	6.7	6.7	6.7
2	8	17.8	17.8	24.4
3	13	28.9	28.9	53.3
4	18	40.0	40.0	93.3
5	3	6.7	6.7	100.0
Total	45	100.0	100.0	

The above table shows the different clusters for the average outflows of international migration along with their classifications. Here the whole countries are divided into five different clusters: the first cluster belongs to 3 countries with a percentage of 6.7%, the second cluster has 8 countries with a percentage of 17.8%, the third cluster belongs to 13 with a valid cluster of 28.9% of the total, the fourth cluster has the highest cluster frequency at 18 with a 40% valid cluster, and the fifth and final cluster size is 3 with a percentage of 6.7% of the total of 45 countries.

Table 6: Cluster for average inflows of remittance.

Valid cluster	Frequency	Percent	Valid Percent	Cumulative Percent
1	9	20.0	20.0	20.0
2	5	11.1	11.1	31.1
3	6	13.3	13.3	44.4
4	2	4.4	4.4	48.9
5	23	51.1	51.1	100.0
Total	45	100.0	100.0	

The above table shows the different clusters for the average remittance outflows per year along with their classifications. Here the whole countries are divided into five different clusters: the first cluster belongs to 9 countries with a percentage of 20%; the second cluster has 5 countries with a percentage of 11.1%; the third cluster belongs to 6 countries with a 13.3% valid cluster of the total; the fourth cluster has the highest cluster frequency with a 4.4% valid cluster; and the fifth and final cluster size is 23 with a percentage of 51.1 percent of the total of 45 countries. Different initial cluster centers for the average migration outflows and remittance inflows table are given below and as follows:

Table 7: Initial cluster center for migration and remittances

	Initial Cluster Centers				
Cluster	1	2	3	4	5
Migration per year	1992411.6	3317544	237.2	1446756.4	740118.2
Remittance per year	62429.87	65856.23	2.32	2429.97	13474.62

The first initial cluster centers have the most migrant arrivals per year, at 1992411.6, according to the data above. Cluster 4 has the second-highest yearly migrant arrivals, with 1446756.4, according to the same table. Cluster number 3 has 237.2 migrants, the fewest of all the clusters. According to the remittance scenario, cluster 2 earns the maximum amount of remittance, amounting to 65856.23 million US dollars annually, whereas cluster 3 earns the least amount of remittance.

Table 8: cluster centers for all the migration and remittances

Final Cluster Centers	**Cluster**				
Cluster Number	1	2	3	4	5
Migration per year	1836565	3051273	89796	1202334	513987
Remittance per year	42719.77	63616.20	748.51	11163.71	4296.43

We can see from the final cluster centers and migration remittance chart above that final cluster 2 and final cluster 3 have the highest and lowest annual migration rates, with figures 3051273.86 and 89796.13, respectively. The same scenario that applies to remittances is replicated here. The final cluster centers of migration outflow and remittance inflow for different geographical regions of the Asia and African continents, numbered from Cluster 1 to Cluster 5.

Table 9: cluster distance

Cluster	*1*	*2*	*3*	*4*	*5*
1		1214887.872	1747273.757	635015.901	1323136.152
2	1214887.8		2962144.952	1849683.362	2537979.612
3	1747273.7	2962144.952		1112586.985	424206.290
4	635015.90	1849683.362	1112586.985		688381.036
5	1323136.1	2537979.612	424206.290	688381.036	

In a cluster study of average migration outflows, the first cluster has a percentage of 6.7%, the second has 17.8%, the third has 28.9%, the fourth has a valid cluster of 40%, and the fifth and last cluster has 6.7% for all 45 nations. The first cluster in the cluster analysis of average remittance outflows has a percentage of 20%, the second cluster has a percentage of 11.1%, the third cluster has a percentage of 13.3% valid cluster of the total, the fourth cluster has a percentage of 4.4% valid cluster, and the fifth and final cluster has a percentage of 51.1% to the cumulative total percentages of 45 countries.

Conclusion

The migration outflows and remittance inflows of various countries in the SAARC region are analyzed using graphical data. India is the highest migrated and remitted country, with an

average of 2.21 million migrants and remittances of $3,211.45 million. Bangladesh, Pakistan, and Malaysia are comparatively highly migratory and remitting countries. In ASEAN, China is the most migrated and remitted country, with yearly average migrant outflows of 1.5 million and remittance inflows of $27727.09 million. Malaysia is the lowest-migration country, with an average of 0.27 million and 891.18 million dollars, respectively. Myanmar has a yearly average remittance inflow of 255.69 million dollars. In the East African region, Sudan is the top-most migrated country, followed by Seychelles and Kenya. The highest-remitted country is Kenya, followed by Tanzania and Uganda. Morocco is the most migratory country, with an average of 0.48 million migrants and remittances of $427.55 million. Oman is the least migrated and remitted country, with an average of 3.5 thousand and $38.64 million. South Africa is the most migrated and remitted country, with an average migration of 0.13 million and average remittances of 489.6 million US dollars. Botswana is the least migrated and remitted country. Nigeria is the most migrated and remitted country in the West African region, with an average of 0.17 million and 9425.67 US million. For cluster analysis of average migration, outflows cluster the first cluster percentage of 6.7% with 17.8%, the third cluster belongs to 28.9% with 40% valid cluster, and the fifth and final cluster with 6.7% to the total of 45 countries. For cluster analysis of average remittance outflows, the first cluster has a percentage of 20%, the second cluster has 11.1%, the third cluster has 13.3% of the total, the fourth cluster has 4.4% of the total, and the fifth and final clusters have 51.1% of the cumulative total percentages of 45 countries. ArcGIS is also used to create visually appealing data distribution visualizations, such as maps, charts, and graphs with legends and annotations. The study explores the relationship between remittances and migration across various regions and clusters of nations using cluster analysis, visualization, and statistical techniques. The study highlights the lack of time-series migration data as a limitation. Further analysis could use simulation studies and discrimination analysis. ArcGIS visualizations, enhanced with legends and annotations, provide valuable insights into factors influencing migration patterns.

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