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Forecasting Regional Trends of Land-Based Overseas Filipino Workers in the Philippines through ARIMA Modeling

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Abstract

This study employs K-means clustering and AutoRegressive Integrated Moving Average (ARIMA) modeling to analyze and forecast regional trends in the employment of land-based Overseas Filipino Workers (OFWs) in the Philippines. The Department of Migrant Workers (DMW) provided official data from 2022 to 2025, which was used to group regions with similar deployment patterns and make a five-year prediction for 2029. The clustering process revealed three distinct clusters: Cluster 1 (High Deployment) comprises Region III (Central Luzon), Region IV-A (CALABARZON), and Others (NEC); Cluster 2 (Lower/Variable Deployment) is composed of Regions IV-B (MIMAROPA), V, VIII, IX, X, XI, XII, XIII (Caraga), BARMM, and CAR ; and Cluster 3 (Moderate/Growing Deployment) includes the NCR, Region I, Region II, Region VI, and Region VII. The ARIMA time-series forecasts indicated divergent regional trends: deployment in regions like BARMM is predicted to see a substantial increase, while areas like Region IV-A and Region VII are forecasted to decline significantly. These results support data-driven labor planning and suggest the need for targeted policy actions in regions with varying growth rates.

Keywords: Labor mobility, labor planning, policy analytics, regional deployment, workforce migration.

1. Introduction

According to the Overseas Workers Welfare Administration Act [1], an Overseas Filipino Worker (OFW) is someone who has worked outside of the country or has earned money in another country, on a ship, or at an offshore installation. Their remittances definitely help with foreign exchange deposits, household income, and the growth of the national economy. This has made them known as "heroes of the Philippine economy"[2]. The establishment of the Department of Migrant Workers (DMW) by R.A. 11641 in 2021 indicates that the government is deeply committed to the improvement of migrants' lives, upgrading the institutional support systems, and acknowledging the contribution of overseas employment to the economy [3], [4]. However, the means of sending OFWs to different locations vary significantly. Cities like NCR, Central Luzon (Region III), and CALABARZON (Region IV-a) still record higher deployment rates. MIMAROPA, Caraga, and BARMM are less developed and have a weaker economy and infrastructure, thus, they are going to be at a lower level of the sending of OFWs. The COVID-19 pandemic has further aggravated these disparities by restricting people's movement and return and making the job market less accessible. This hit land-based workers the hardest [5].

When making fair and evidence-based policies for work, reintegration, and welfare, it's important to know about these differences between regions. Time-series forecasting has become a popular way to look at trends in labor migration to help with this kind of policymaking. The AutoRegressive Integrated Moving Average (ARIMA) model has been a major feature in pattern recognition over time and has been credited for its accuracy in making predictions in labor and economic research [6], [7]. A study of local deployment data from the DMW and the ARIMA (p, d, q) framework has led to predictions of land-based OFW deployment from 2022 to 2025, with forecasts extending to 2029. These predictions are intended to be a resource to the policy makers, local government units, as well as the Department of Migrant Workers in fine-tuning their recruitment strategies, employment programs, and reintegration initiatives that are aimed at the long-term [8].

2. Literature Review

Recent academic research and institutional reports are another layer of evidence that data-driven forecasting is a must to migration governance. While the Department of Migrant Workers (DMW) continues to implement measures for equal hiring and the protection of welfare [9], [10], PSA data shows that deployment has been consistently concentrated in rich areas [11]. The pandemic vulnerabilities of land-based OFWs are dramatized in the International Organization for Migration (IOM) report [12], which also aligns with Southeast Asian migration studies that call for resilient and crisis-responsive labor structures [13]. As remittances make up more than 9% of GDP and the Philippines is still among the top labor-exporting countries in the world [14], accurate forecasting becomes a must. Academic studies provide evidence for ARIMA's capacity to locally estimate labor trends in different regions [15], [16], and new laws like House Bill No. 4939 foresee record-breaking remittances of USD 38.3 billion in 2024 [17]. The research finding that ARIMA outperforms conventional models [18], serves as a basis for the migration sector in the Philippines to adopt this model for strategic policy planning and labor trend analysis [19], [20].

3. Operational Framework

The study utilized a data analytics architecture (Fig. 1) founded on the K-Means clustering methodology. Getting data, cleaning it up, and grouping it into clusters based on how many Land-Based Overseas Filipino Workers (OFWs) they send out are all part of the process.

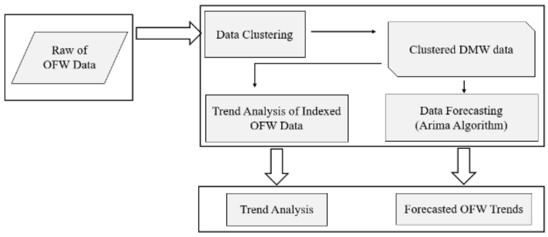

Fig. 1. Architectural Framework of the Study

A. Data Extraction

Extraction of Data is about recording structured data concerning land-based Filipinos who work abroad (OFWs) from the official database of the Philippine government. For each region, the data that was extracted gave the number of documented OFWs for the years 2022, 2023, 2024, and 2025.

B. Clustering

Clustering algorithms group similar things. The dataset includes OFW documentation figures from NCR, BARMM, CAR, and "Others (NEC)," other Philippine local government units. TABLE I displays 2022–2025 land-based OFW numbers.

Table 1. Land-Based OFW Documentation Datasets

Region	YEAR			
	2022	*2023*	*2024*	*2025*
REGION I	91,167	117,697	121,455	131,639
REGION II	61,201	79,221	83,673	96,774
REGION III	189,062	232,694	241,637	270,802
REGION IV-A	253,290	315,673	330,848	374,688
REGION IV-B	21,348	25,872	27,974	31,215
REGION V	41,268	49,932	52,444	57,538
REGION VI	87,617	105,353	110,521	114,555
REGION VII	67,916	82,226	86,636	87,158
REGION VIII	27,188	32,467	33,412	35,867
REGION IX	31,048	35,075	36,865	35,286
REGION X	38,909	45,906	49,104	48,268
REGION XI	44,051	55,628	59,390	59,327
REGION XII	40,443	51,202	55,906	53,656
REGION XIII	20,023	24,673	26,379	26,314
BARMM	15,258	26,370	27,659	24,302
CAR	24,811	32,599	34,138	35,056
NCR	143,259	163,734	169,224	196,364
Others (NEC)	297,809	501,930	473,326	496,624

K-Means clustering assigns data into K (K=3) groups over and over again. First, choose the starting centroids, which in this example are areas IV-A, BARMM, and VI. Then, find the Euclidean distance from each region to these centroids. Each region gets the nearest centroid, and new centroids stand for clusters. The steps are repeated until the assignments stop changing, which shows convergence.

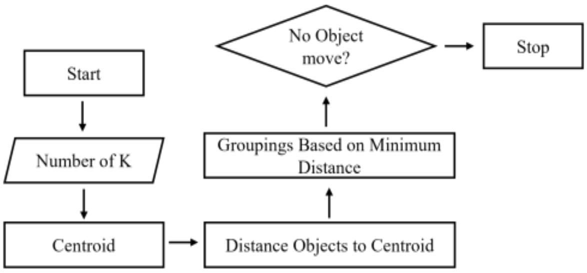

Fig. 2. Algorithm for K-means Clustering

Step 1: Centroids' initial values: Region IV-A, BARMM, and Region 6. C1 = [(253,290), (315,673), (330,848), (374,688)], C2 = [(15,258), (26,370), (27,659), (24,302)], and C3 = [(87,617), (105,353), (110,521), (114,555)] if C1, C2, and C3 are the centroids' coordinates. Step 2: Distances between objects and centroids, represented by D0: The distance is calculated using the Euclidean distance. TABLE II displays the distance matrix at iteration 0:

Table 2. Distances Between Objects and Initial Centroids At Iteration 0 (D^0)

Group	Indexed OFW Deployment		
	Region I	***Region II***	***Region III***
C1	410361.5583	480769.5958	172515.6629
C2	185530.9095	115298.5101	423469.3116
C3	24008.17044	49169.76251	260981.5104
Group	***Region IV-A***	***Region IV-B***	***Region V***
C1	0	589481.1893	541908.2185
C2	595860.1997	9231.733207	54319.57166
C3	433468.8108	156423.6956	108828.2742
Group	***Region VI***	***Region VII***	***Region VIII***
C1	433468.8108	480805.5985	578442.3886
C2	162744.7518	115420.6263	18610.33431
C3	0	47371.68315	145264.0088
Group	***Region IX***	***Region X***	***Region XI***
C1	574235.5493	551962.9928	533428.8774
C2	23032.58164	44444.14785	62599.31628
C3	140882.3259	118627.2706	100175.262
Group	***Region XII***	***Region XIII***	***BARMM***
C1	542128.5859	594272.9248	595860.1997
C2	53948.70503	5592.099606	0
C3	108854.0468	161073.1557	162744.7518
Group	***CAR***	***NCR***	***Others (NEC)***
C1	579413.723	305145.9438	268033.5427
C2	16961.31501	291374.5108	853053.0627
C3	146260.6982	129008.2479	692140.2911

The distance matrix's rows represent areas' land-based OFW data and columns represent centroids 1, 2, and 3. In Step 3, Clustering (G0 in TABLE III) grouped regions by shortest distance: III, IV-A, and Others (NEC); IV-B, V, VIII, IX, X, XI, XII, XIII, BARMM, CAR; I, II, VI, NCR. Ones in the group matrix indicate that a region belongs to that group.

Table 3. Initial Object Cluster Assignments at IteratiON 0 (G^0)

Group	Indexed OFW Deployment		
	Region I	***Region II***	***Region III***
G1	0	0	1
G2	0	0	0
G3	1	1	0
Group	***Region IV-A***	***Region IV-B***	***Region V***
G1	1	0	0
G2	0	1	1
G3	0	0	0
Group	***Region VI***	***Region VII***	***Region VIII***
G1	0	0	0
G2	0	0	1
G3	1	1	0
Group	***Region IX***	***Region X***	***Region XI***
G1	0	0	0
G2	1	1	1
G3	0	0	0
Group	***Region XII***	***Region XIII***	***BARMM***
G1	0	0	0
G2	1	1	1
G3	0	0	0
Group	***CAR***	***NCR***	***Others (NEC)***
G1	0	0	1
G2	1	0	0
G3	0	1	0

Step 4 computed the new centroids (C1, C2, and C3) by averaging member coordinates: C1 = (740,160.9999/3), (1,050,297/3), (1,045,811.0001/3), (380704.6667/3); C2 = (304,347/10), (379,724/10), (403,271/10), (406,829/10); and C3 = (451,160/5), (548,231/5), (571,509/5), (626,490/5). Step 5 repeated the distance calculation using these new centroids to generate the D1 matrix (Table IV).

Table 4. Object-Centroid Distances: Iteration 1 (D^1)

Group	Indexed OFW Deployment		
	Region I	***Region II***	***Region III***
C1	437992.8677	508524.528	201566.0719
C2	157794.716	87596.18007	395676.1275
C3	12532.60376	59331.55755	249587.2536
Group	***Region IV-A***	***Region IV-B***	***Region V***
C1	39746.37056	617140.3782	569612.2644
C2	568105.5431	21707.78678	26292.70018
C3	422045.7114	167532.749	119921.074
Group	***Region VI***	***Region VII***	***Region VIII***
C1	461230.3941	508452.198	606088.5545
C2	134885.9943	87565.27909	10576.48292
C3	12448.9473	58906.08894	156436.052
Group	***Region IX***	***Region X***	***Region XI***
C1	601871.8531	579597.3768	560995.7024
C2	7062.841473	16411.07812	34758.02725
C3	152191.4185	129927.8163	111436.6605
Group	***Region XII***	***Region XIII***	***BARMM***
C1	569668.7716	621864.3283	623220.36
C2	26195.26358	26197.18149	28173.79192
C3	120155.3771	172273.0374	173963.1943
Group	***CAR***	***NCR***	***Others (NEC)***
C1	606969.2402	334057.9395	233785.4929
C2	11422.18857	263431.8098	825903.145
C3	157435.8017	117491.1794	680996.4502

In Step 6, Objects Iterate 1. Clustering G1. Minimum distance determines object assignment. Using the updated distance matrix, TABLE V shows the new group pattern.

Table 5. Clustering of Objects: Iteration 1 (Designated G1)

Group	Indexed OFW Deployment		
	Region I	***Region II***	***Region III***
G1	0	0	1
G2	0	0	0
G3	1	1	0
Group	***Region IV-A***	***Region IV-B***	***Region V***
G1	1	0	0
G2	0	1	1
G3	0	0	0
Group	***Region VI***	***Region VII***	***Region VIII***
G1	0	0	0
G2	0	0	1
G3	1	1	0
Group	***Region IX***	***Region X***	***Region XI***
G1	0	0	0
G2	1	1	1
G3	0	0	0
Group	***Region XII***	***Region XIII***	***BARMM***
G1	0	0	0
G2	1	1	1
G3	0	0	0
Group	***CAR***	***NCR***	***Others (NEC)***
G1	0	0	1
G2	1	0	0
G3	0	1	0

4. Results and Discussion

The findings demonstrated that G0 and G1 are equivalent. The objects are stable when the groups from the previous iteration are compared. As a result, the k-mean clustering computation process has stabilized and no more repetition is required. TABLE VI displays the final grouping.

Table 6. Clustering of Objects: Iteration 1 (Designated G1)

Region	Year				Group
	2022	***2023***	***2024***	***2025***	
I	91167	117697	121455	131639	3
II	61201	79221	83673	96774	3
III	189062	232694	241637	270802	1

Region	Year				Group
	2022	*2023*	*2024*	*2025*	
IV-A	253290	315673	330848	374688	1
IV-B	21348	25872	27974	31215	2
V	41268	49932	52444	57538	2
VI	87617	105353	110521	114555	3
VII	67916	82226	86636	87158	3
VIII	27188	32467	33412	35867	2
IX	31048	35075	36865	35286	2
X	38909	45906	49104	48268	2
XI	44051	55628	59390	59327	2
XII	40443	51202	55906	53656	2
XIII	20023	24673	26379	26314	2
BARMM	15258	26370	27659	24302	2
CAR	24811	32599	34138	35056	2
NCR	143259	163734	169224	196364	3
Others (NEC)	297809	501930	473326	496624	1

A. Data Forecasting

The approximate quantity of Filipino workers abroad (OFWs) during the next five years is produced using the ARIMA (p, d, q) method. A statistical, time-series-based model called ARIMA makes use of previous data to predict (non-descriptively) future labor patterns and OFW counts.

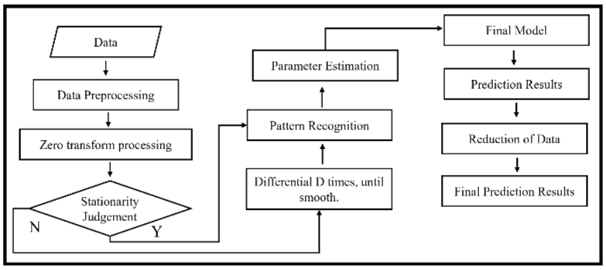

Fig. 3. Arima Methodology

Here is the formula for the ARIMA (p, d, q) model:

$$X_t = \phi_1 X_{t-1} + \ldots + \phi_p X_{t-p} + a_t - \theta_1 a_{t-1} - \ldots - \theta_q a_{t-q} \quad (1)$$

Where:

This approach uses ϕ coefficients to estimate autoregressive parameters and θ coefficients to determine moving average parameters. X represents the observed time series, while a signifies the random error terms, which are presumed to adhere to a normal distribution. GRETL (Gnu Regression, Econometrics, and Time-series Library) was employed for data visualization and analysis. Section 4 illustrates the architectural framework employed to predict future trends.

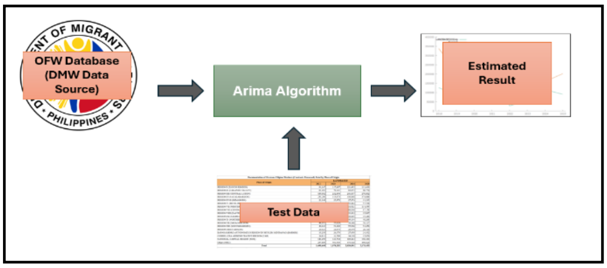

Fig. 4. Forecasting Future OFW Trends

Table 7. Results of OFW Data Clustering

Cluster 1		
Others (NEC)	Region III	Region IV-A
Cluster 2		
Region IV-B	Region V	Region VIII
Region IX	Region X	Region XI
Region XII	Region XIII	BARMM
CAR		
Cluster 3		
Region I	Region II	Region VI
Region VII	NCR	

B. Trend Analysis

The GRETL software was used to analyze the trends in the OFW documentation data. To see the deployment behavior, a time series graph was created for each cluster. The time series graphs for the three clusters are shown in Figures 5, 6, and 7, respectively.

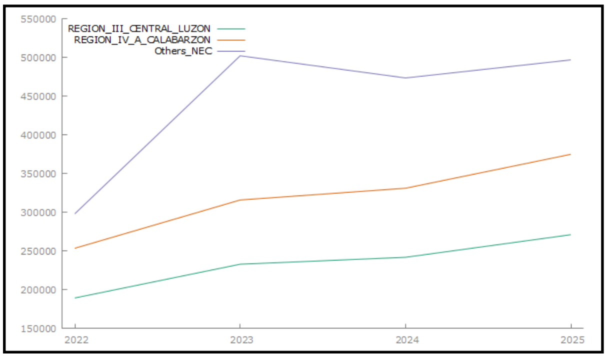

Fig. 5. Cluster 1 Time Series Plot

With the greatest number of OFW deployments, Cluster 1 is the main contributor to the rise in foreign work in the Philippines. While it continues to expand steadily in Central Luzon (Region III) and CALABARZON (Region IV, A), the "Others (NEC)" category exhibits a highly variable, nonlinear pattern with a notable increase from 2022 to 2023. Generally speaking, the primary evidence of its leadership role is its high deployment volume.

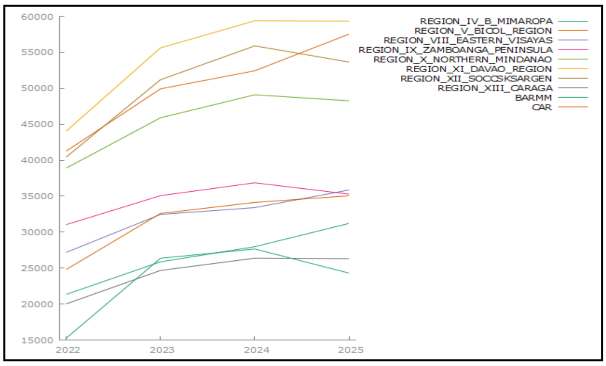

Fig. 6. Cluster 2 Time Series Plot

Cluster 2 (comprising Regions IV-B, V, VIII, IX, X, XI, XII, XIII, BARMM, and CAR) functions as the variable frontier of OFW deployment. It is defined by its historically lower overall volume and a lack of unified trend, making it the most complex segment for policy. Unlike the solid framework of Cluster 3, the time series for Cluster 2 is characterized by significant divergence and volatility, reflecting localized economic pressures rather than systemic growth. While certain members, most notably BARMM, show promising and substantial upward trends, others, including Region V and the CAR, are clearly forecasted for a sustained decline. This cluster signals both emerging migration markets that require robust governance and older sources that are either stabilizing or receding, necessitating varied policy approaches.

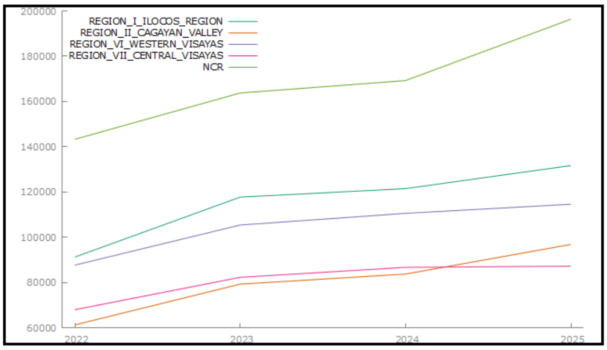

Fig. 7. Cluster 3 Time Series Plot

Cluster 3 (I, II, VI, VII, NCR) is like a solid frame that holds up the structure of OFW employment. It is characterized by a consistent and strong upward trend of the total, with all the members of the cluster showing stable and parallel growth, propelled by the National Capital Region (NCR) as the major contributor. Such a cluster stands for a resurgent and extensively expanding market segment.

C. Forecasting

Regional ARIMA models were used to make forecasts about land-based Overseas Filipino Workers. These forecasts were then checked against time series data from 2022 to 2025. The results were put together into annual totals so that future deployment trends throughout all regions could be seen more clearly.

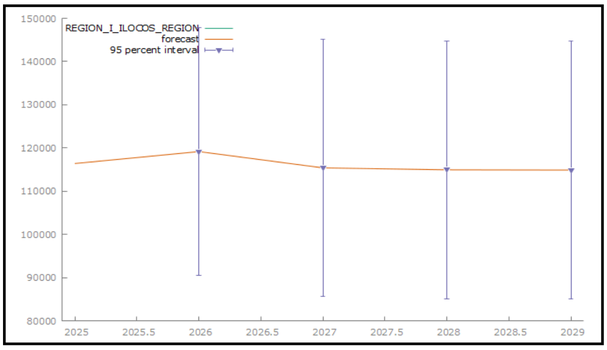

Fig. 8: The forecast shows that OFW deployments from Region I (Ilocos Region) will steadily and without stopping rise from 2025 to 2029. This shows that the tendency is always going up

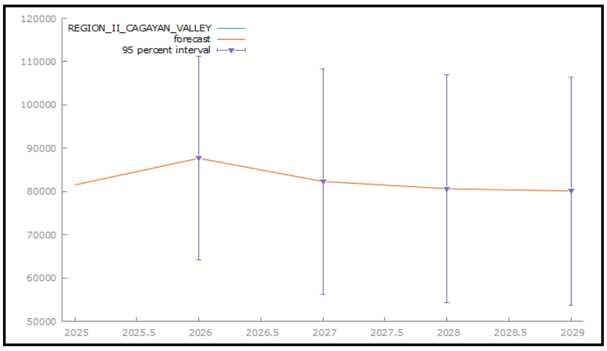

Fig. 9. The forecast shows that OFW deployments from Region II (Cagayan Valley) will keep going down a lot from 2025 to 2029. This suggests that the tendency is still going down

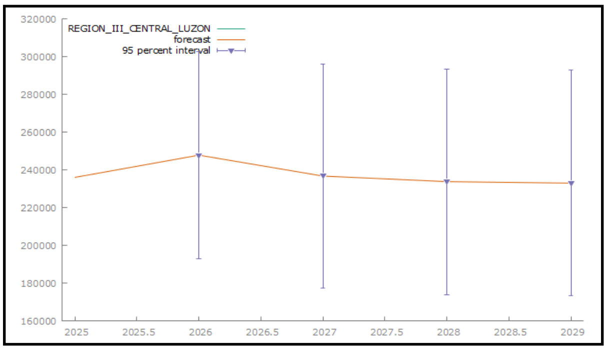

Fig. 10. The forecast for Region III (Central Luzon) from 2025 to 2029 shows generally stable OFW deployment levels with only minor fluctuations over the period

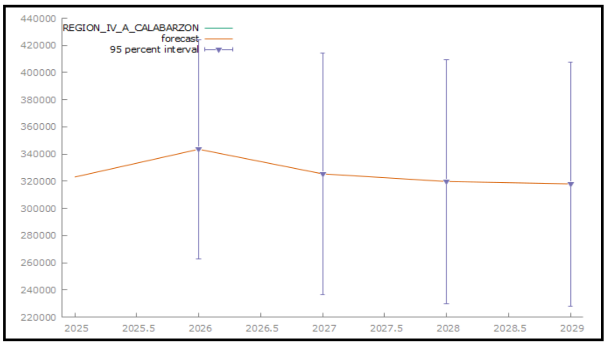

Fig. 11. The forecast shows a steady and significant decline in OFW deployments from Region IV-A (CALABARZON) from 2025 to 2029

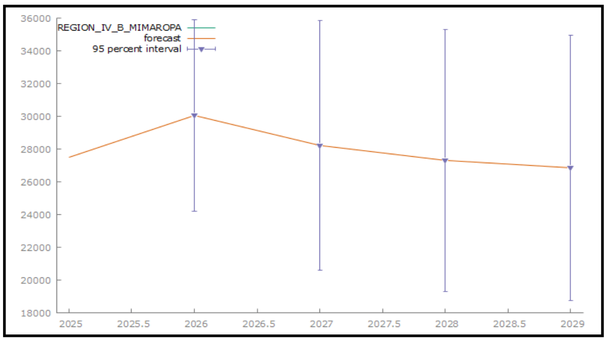

Fig. 12. The forecast states that OFW deployments from Region IV-B (MIMAROPA) will stay essentially the same from 2025 to 2029, with only a few slight variations

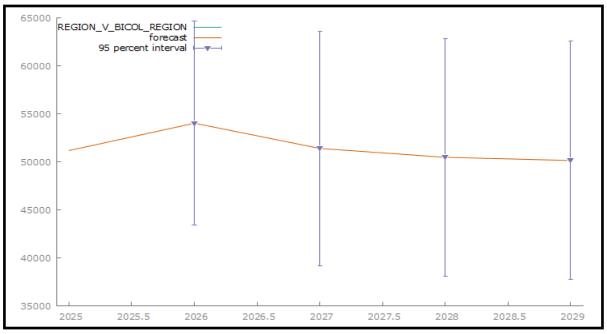

Fig. 13. The forecast indicates that deployments of OFWs from Region V (Bicol Region) will keep decreasing down steadily from 2025 to 2029

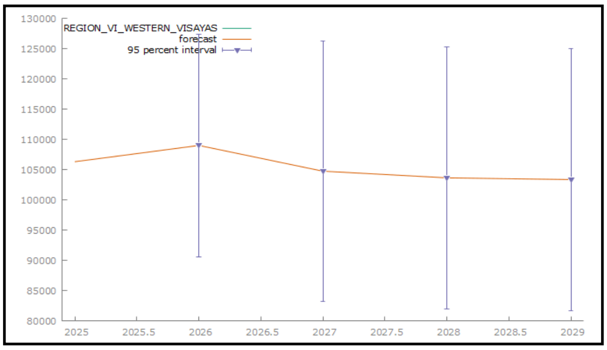

Fig. 14. The forecast indicates a moderate yet steady decline in OFW deployments from Region VI (Western Visayas) from 2025 to 2029

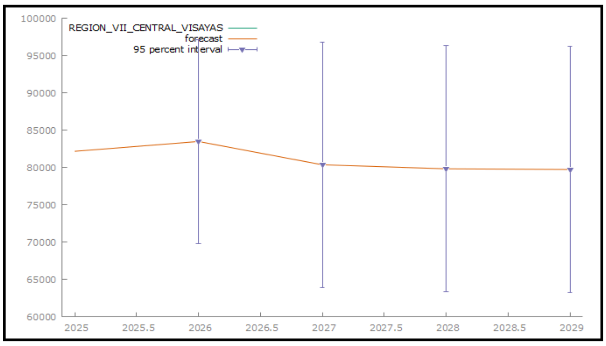

Fig. 15. The forecast suggests that the number of OFW deployments from Region VII (Central Visayas) will drop very quickly and steadily from 2025 to 2029

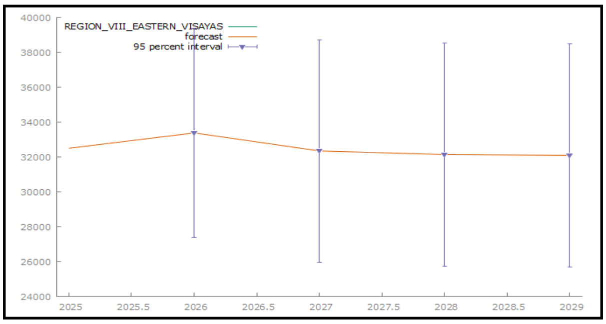

Fig. 16. The forecast shows that OFW deployments from Region VIII (Eastern Visayas) will drop significantly and at a steady pace from 2025 to 2029

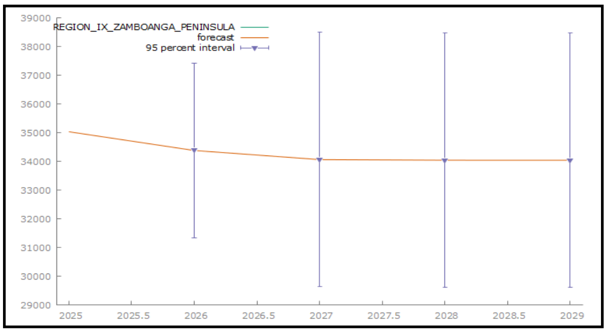

Fig. 17. The forecast shows a generally stable trend with only a slight downward movement in OFW deployments from Region IX (Zamboanga Peninsula) from 2025 to 2029

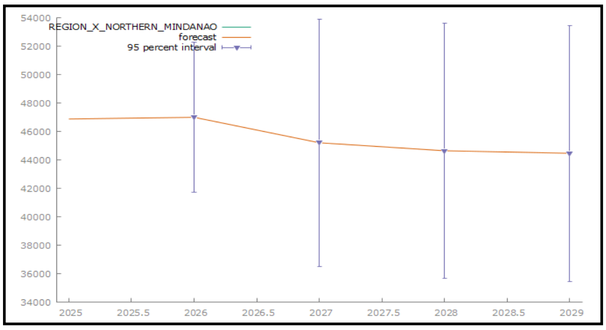

Fig. 18. The forecast indicates that OFW deployments from Region X (Northern Mindanao) will stay the same and almost never fluctuate between 2025 and 2029

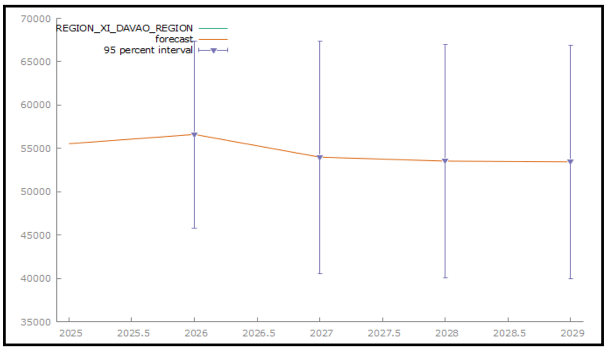

Fig. 19. The forecast indicates that the pattern of OFW deployments from Region XI (Davao Region) will be mostly the same between 2025 and 2029

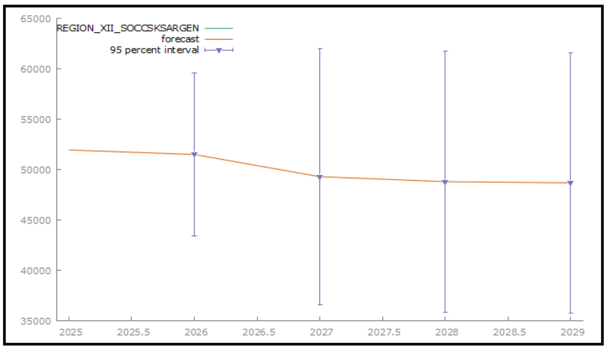

Fig. 20. The forecast illustrates a broad and consistently decreasing trend in OFW deployments from Region XII (SOCCSKSARGEN) from 2025 to 2029

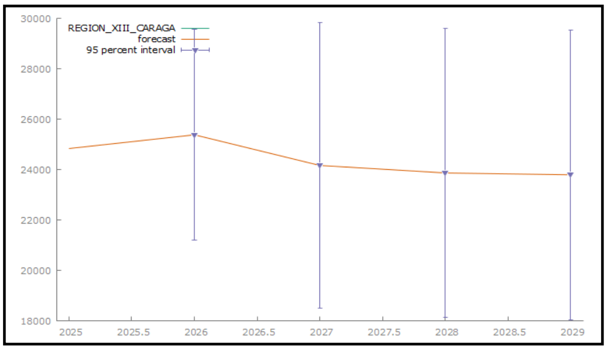

Fig. 21. The forecast indicates a stable and nearly unchanging trend in OFW deployments from Region XIII (CARAGA) from 2025 to 2029

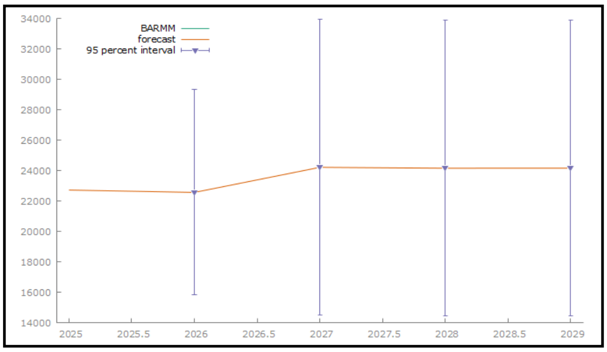

Fig. 22. The forecast shows a substantial and steadily increasing trend in OFW deployments from BARMM from 2025 to 2029

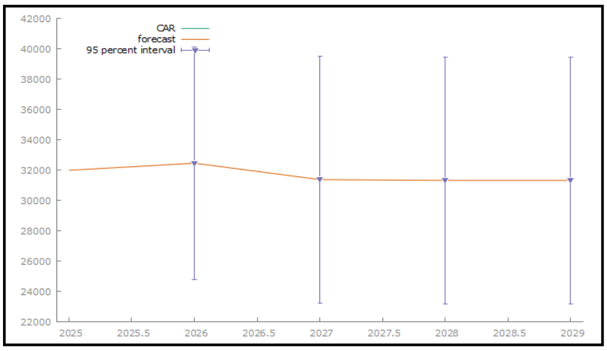

Fig. 23. The forecast indicates a broad and consistently decreasing trend in OFW deployments from CAR from 2025 to 2029

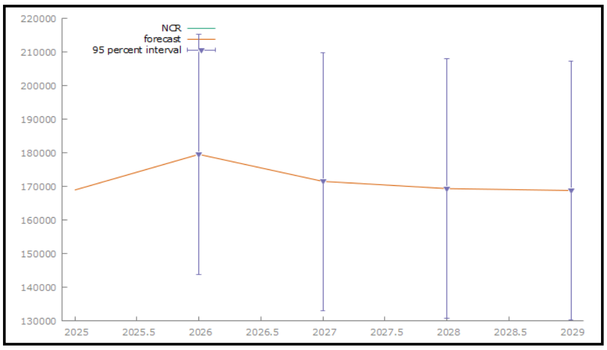

Fig. 24. Forecasted OFW Deployment from NCR 2025 to 2029. The graph illustrates a moderate and consistent reduction over time

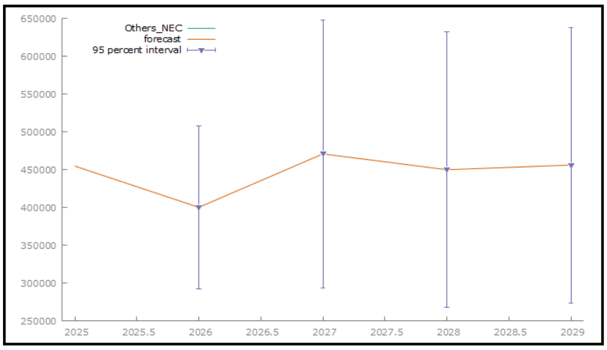

Fig. 25. The forecast indicates a stable and nearly unchanged trend in OFW deployments from Others (NEC) from 2025 to 2029

5. Conclusion

This study successfully used K-means clustering and the ARIMA model to analyze and forecast regional OFW deployment trends, confirming the reliability of ARIMA and classifying regions into three distinct clusters: Cluster 1 (High Deployment) comprising Region III, Region IV-A, and Others (NEC); Cluster 2 (Lower/ Variable Deployment), including BARMM and CAR; and Cluster 3 (Moderate/Growing Deployment), driven by NCR and Regions I, II, VI, and VII. These results highlight the need for evidence-based, targeted policies, given the divergent forecasts, such as the projected substantial growth in BARMM versus the significant decline in Region IV-A. To enhance the study's validity, future work must prioritize three specific areas: out-of-sample validation to compare the 2026-2029 forecasts with actual deployment data; robustness and sensitivity analysis to assess the model's stability under varying assumptions; and a detailed comparative modeling study against advanced methods like SARIMA, to confirm the superior performance of the chosen ARIMA model. Future research should also consider integrating exogenous variables (ARIMAX) to further improve predictive power.

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