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"Evaluating the efficacy of a marine reserve in enhancing the population growth and size of endangered fish species"

Hee-Young[1, *]
[1] *Hankuk University of Foreign Studies - Seoul CampusSouth Korea.*
Corresponding author: Young.hee123@gmail.com

Abstract
The essential purpose of this research study is to determine the efficacy of marine reserves in enhancing the population growth and size of endangered fish species. This research study, based on the secondary research data for this purpose, used the world development indicators for collecting the data on population growth. For measuring, the research study used E-views software and ran systematic tests between them. this research study is also based on theoretical analysis, and some portion is based on systematical analysis related to the marine reserve and population growth and size of endangered fish species. The overall research study found that there are positive and significant impacts of the efficacy of marine reserves in enhancing the population growth and size of endangered fish species.

Keywords: efficacy of a marine reserve (EMR), enhancing the population growth (EPG), size of endangered (SE), fish species (FS).

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Introduction

The understanding of the marine environment is related to the impacts of human-related activities on the marine ecosystem. The most common human activity that induces changes in the patterns of marine life includes water pollution. Over the past few years, the population of various marine species has been reduced tremendously due to the excess of fish catch activities of humans. The seas of today are facing the problem of a decline in marine species due to overfishing activities for fulfilling global fish demands. in the present era, the oceans have less predatory fish stock due to the depletion of most marine species over the last few years (Albano et al., 2021). The risk associated with marine species becoming extinct is increasing tremendously. Due to the depletion of fisheries in the shallow water, fishing activity extends to the deep sea, which ultimately poses serious life threats to deep-sea species. The safety of deep-sea species is at a higher risk due to unhealthy fishing activities. To conserve marine species, various managing activities are established. The managing of fishing activities mostly depends on the fishery management system (Ault et al., 2022). The proper fishing rules help in saving the endangered Deep-Sea species from becoming extinct due to the overfishing activities of humans.

The activities like recreational fishing and mining processes taking place in marine environments disturb the ecosystem of marine life by risking the life of marine species.to overcome these activities, various marine ecosystem conserving strategies are used by the marine management system. The first strategy includes the establishment of MPAs. Marine protected areas play a critical role in protecting the biodiversity feature associated with marine life (Bajaba et al., 2021). The maintenance of marine resources for a sustainable marine environment is provided by MPAs. Various conservation strategies are associated with the MPAs for improving their functionality globally. These strategies include the conservation of biological diversity strategies as well as sustainable marine development strategies. Both these strategies make the MPAs an

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ecologically safe area for protecting the marine Deep sea species from the vulnerability of habitat and harmful human overfishing activities to (Dwyer et al., 2020). In evaluating the working of various MPAs, many parameters are studied at a biological level. These parameters include; assessing the monitoring system working of MPAS, assessing the richness of species in MPAS, assessing the boundaries safety of MPAS, etc. .all these assessment parameters provide information about whether an MPA is efficient for protecting the marine reveres or not.

The second strategy used in MPAs for protecting marine endangered species includes the tracking technique .for understanding the management of marine species and their conservation, it is essential to understand their habitat and distribution patterns. The whole information about the species' distribution patterns 'is obtained by tracking the movement of marine species using tracking technology (Loury & Ainsley, 2020). Satellite tracking is considered the most widely used tracking technique in marine environments. The tracking technique provides information about the food web and environmental factors that play a part in conserving the species. The migratory pattern of certain marine species is also determined through the tracking technology that provides data about how particular groups of marine species have migrated during their life span.to enhance the functioning of the tracking system, various models are used in the marine management system. The model is designed to evaluate the statistical data obtained from the tracking services and to provide simple information from this highly complex statistical data (Macedo et al., 2019). The location of particular marine specie at various times and locations is determined through tracking technology devices. so all the data provided through tracking devices used in MPAs plays a very significant role and determining the percentage of endangered species in the MPAS.

To save marine endangered species from becoming extinct, the third conserving strategy that is used for conserving marine biodiversity is the hotspot analysis. the hotspot analysis covers a large geographical area having a high abundance of marine species. The hotspot analysis scale varies depending on the extent of geographical factors. There are two methods involved in using the hotspot analysis .these methods can be either qualitative or quantitative. The calculation of the abundance of species through the mapping process involves the use of the qualitative approach. Comparing the densities of marine species present in an ecosystem depends upon the use of a qualitative approach (McNeely, 2020). The use of the qualitative approach provides density estimation of marine species. using the correct hotspot approach according to the environment of the marine ecosystem holds great value for saving the endangered species of the marine world. The implementation of the hotspot approach provides management as well as conservation of marine ecosystems under complex boundaries of MPAS.in some special cases, various analysis techniques are used along with hotspot analysis techniques to improve its efficiency (Rodríguez-Rodríguez & Martínez-Vega, 2022a). This technique includes Integrated Step Selection Analysis .this iSSa helps in measuring the status of the habitat of a specie present in a marine area. The estimation of the relative probabilities of various marine species is done using the iSSA system.

To evaluate the efficacy of the marine environment and marine reserves, to enhance the population growth of marine species, and to save endangered species, various marine management-based conserving techniques are implemented in the marine ecosystem. The main purpose of all the marine techniques is to advance the marine protected area to save the life of deep-sea marine fishes (Simpson et al., 2020).through MPAs, the reserves of the marine ecosystem can increase to almost four hundred times. the growth of various marine species, including lobster and tuna fishes, began to increase due to the optimized marine resource conserving strategies. Implementing the marine strategies in the great barrier reef marine-based ecosystem saves its biodiversity and beauty-related features .coral reefs are an important part of the marine ecosystem, and protecting them from becoming extinct helps in preserving the natural beauty of the marine ecosystem

(Slooten & Dawson, 2021). Many countries having ocean ecosystem uses MPAs to preserve their marine species and to save their marine endangered species from becoming extinct due to several human and climatic activities.

Research objectives:

The research objectives of this paper are to comprehend the working efficacy of marine reserves and their role in enhancing the population of the marine ecosystem. The increase in growth and size of the marine population concerning the significance of the great barrier reef has also been discussed here.

This research study is divided into five specific chapters: the first section represents the introductory portion related to the efficacy of marine reserves in enhancing the population growth and size of endangered fish species. The second portion represents the literature review, the third section describes the research methods. Also, the fourth section describes the systematical analysis related to the topic. The last portion represents and summarizes the overall research study and presents some recommendations about the topic.

Literature review:

Research studies claim that the effectiveness of many areas of the South African Sea depends on the marine protected areas' connectivity with ecological factors. The MPA of African regions saves endangered species by protecting eighty-nine percent of marine species. Fully protected marine areas provide more protection to marine species as compared to partially protected marine areas. The ecological connectivity between marine protected areas and climatic alternations provides an understanding of the biodiversity of the marine ecosystem (Kirkman et al., 2021).studies show that marine protected areas provide protection zone for marine species that helps maintain the population of the marine system. To save the endangered species of parrotfishes from declining, marine protected areas with no fishing zone are maintained. these areas protect the ecologically significant reef known as parrotfish from extinction due to overfishing of this specie. for protecting various marine reefs, systematic conservation strategies are used in the marine ecosystem management system; these strategies help in managing the marine environment and its species (Pereira et al., 2022).studies explained that extreme extinction impacts are observed in the Yangtze River. The Yangtze River fisheries hold great substantial value for conserving the biodiversity of the aquatic system. The decline in fisheries resource of this river is the result of human activities. The best way to protect the fisheries resource of the Yangtze River is the natural reserves. The effectiveness of these reserves in saving fisheries is because of the use of space as well as temporal methods in the management system of natural reserves (Xie et al., 2019).studies claim that around the globe, MPAS strategies are used for conserving biodiversity factors. MPAs strategies' main goal is to protect the fish population habitat within a fixed boundary. the fish population without proper boundaries and care becomes extinct due to the overfishing activities of humans.to save juvenile and adult fish populations from extinction over some time, the fish population is kept in a fixed boundary region of marine protected areas (Roos et al., 2020).studies show that the fish population of Elasmobranchs is impacted due to fishing activities. The Elasmobranchs are protected through the MPA. For achieving the objective of protecting the endangered Elasmobranch, proper management marine strategies are employed in MPAs (Di Lorenzo et al., 2022).studies revealed that fishes population in the marine sea consists of some fish that are endangered species and are close to extinction.to protect these species from complete extinction, the habitat management system of the marine ecosystem plays a critical role. This habitat management framework conserves the fish species that are endangered using novel conservation methodologies (Malone & Polivka, 2022).studies show that assessing the MPAS provides a framework for the conservation of fish species (Chin et al., 2023).studies of scholars predicted that in the marine reserves of the Galapagos, shark fishing was prevented from saving the endangered shark species. The ban on fishing in these marine rivers helps maintain the ecosystem of the marine river by conserving endangered species (Castrejón &

Defeo, 2023).studies show that sea turtles are the marine ecosystem integral members because they contribute to keeping the environmental balance. the conservation efforts made by the marine conserving magnet system help maintain the population size of the marine ecosystem. To enrich the environment for sea turtles, various environmental enrichment methodologies are used in the marine ecosystem (Escobedo-Bonilla et al., 2022).studies predicted that fish distribution influences the factors associated with providing conservation of marine ecosystems. the conserving measures used in most of the MPAs are no-take measures. These measures prohibited fishing in the MPAs areas to save the endangered species present in MPA regions.in most marine reverses, the acoustic telemetry technique is used as it provides information about the fish movement and its habitat. Also, the no-zone areas preserve the population of coral reefs in these marine seas of Brazil (Lippi et al., 2022).studies predicted that adequate measures are used to evaluate the damage caused to the coral reef population due to climatic changes. The damage in the coral reef is mostly minimized by zoning the coral population in MPA. The management strategies are applied in MPA to protect the species inside the boundaries of MPA from harmful climatic changes (Nunes et al., 2022).studies highlighted the importance of MPA by explaining its role as an effective tool for conserving biodiversity (Rodríguez-Rodríguez & Martínez-Vega, 2022a).research studies revealed that much of the life of most fishers depends on the commercial value of marine fisheries .so, saving the marine fisheries for providing food resources to humans, protecting the marine ecosystem and its specie holds great value. commercial marine and aquarium fishers are conserved using conservation management strategies. these strategies maintain the population of marine aquarium fisheries and thus maintain their biodiversity (Anderson & Pomeroy, 2023).studies explain that in the Myanmar Sea, the marine population is maintained through sustainable fisheries strategies. these strategies strengthen small-scale fisheries by its managing and conserving marine fish (Thiha et al., 2023). moreover, strengthening the MPA through effective management strategies helps in preserving the endangered species present in these marine ecosystems. developing sustainable MPA for fish population protection and commercial value helps in saving endangered species from becoming extinct (Tranter et al., 2022).studies elaborated that MPA is effective in their working and ecosystem, maintaining the ability and providing biodiversity to the marine ecosystem (Rodríguez-Rodríguez & Martínez-Vega, 2022b).studies claim that for assessing the effectiveness of MPA on marine ecosystems, various biological parameters are studied. These parameters provide information about the increase in biodiversity value and biological; community preservation through the MPA-regulated areas. also, the survival chances of osprey species increase due to the effectiveness of Marine protected areas (Montillo et al., 2022).studies explained that anthropogenic alternation causes a change in the marine ecosystem. The influence of these alternations results in disturbance in biodiversity. The altered biodiversity of marine ecosystems poses a threat to endangered species.to preserve the biodiversity of the Marine ecosystem during anthropogenic changes, MPA with proper management strategies are established. this MPA, established based on proper management strategies of the marine ecosystem, provides economic and commercial conservation benefits (Blampied et al., 2022).studies revealed that fish monitoring apps provide information about the fish density and fish diversity present in MPA .this information helps in Assessing the fish species; that are endangered species and are more likely to become extinct in the future. Through the information provided by monitoring the population of these marines, endangered species are conserved using effective conservation strategies (Abesamis et al., 2022).researchers predicted that MPA observes the environment of the marine ecosystem and, at the same time, provides economic benefits (Albers & Ashworth, 2022).scholars highlighted the importance of the Multi decal monitoring system used in the Mediterranean marine reserve to monitor the assemblages (Bevilacqua et al., 2022).

The IMO's original mission was largely concerned with the preservation of marine life. As the guardian of the

1954 International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL Convention), the Organization was in charge of pollution concerns just a short time after it began operations in 1959. Since then, a variety of measures have been put in place to stop and manage ship-related pollution as well as to lessen the consequences of any potential harm from marine activities and accidents. These steps demonstrate the Organization's and the maritime industry's commitment to environmental preservation and have been proven to be effective in lowering ship pollution. The environment directly affects 21 of the 51 convention instruments produced by the IMO for international marine governance. The Marine Environment Division, often known as MEPC, is the IMO's leading technical body on issues related to marine pollution and is mostly governed by the Marine Environment Protection Committee. Several IMO Sub-Committees, like the Sub-Committee on Pollution Prevention and Response (PPR), assist it in carrying out its duties.

The International Convention for the Prevention of Pollution from Ships (MARPOL), which was adopted in 1973, was the organization's first emphasis. The original MARPOL Convention has undergone multiple revisions to include provisions addressing trash, sewage, air pollution, chemical pollution, and other dangerous substances under Annex VI, introduced in 1997. This has grown over the last few decades to cover a far larger range of precautionary actions for marine pollution.

Marine protected areas (MPAs) are areas of protected seas, oceans, estuaries, or the Great Lakes in the United States. These coastal regions might serve as centers for study or as refuges for threatened or endangered animals. MPAs place restrictions on human activities to protect natural resources, animals, or both. Protection of maritime resources, which vary widely across and within countries, is provided by local, state, territorial, indigenous, regional, national, or international authorities. This category covers restrictions on marine development as well as fishing laws, catch limits, season restrictions, mooring requirements, and bans on taking or disturbing marine life. In certain cases, MPAs help governments generate revenue on par with what they would generate if they granted entrepreneurs authority (such as the Phoenix Islands Protected Area).

There are sizable marine conservation zones all throughout the world. Around Hawaii, in the center of the Pacific Ocean, is where you may find the 1.5 million square kilometer Marine National Monument. The endangered green turtle and Hawaiian monkfish are nearby, along with 7,000 more species and 14 million seabirds. The Cook Islands' 2017 Marae Moana Act designated the whole 1.9 million square kilometers of their exclusive maritime economic zone as a zone for the preservation of the "ecological, biodiversity, and heritage values of the island nation's marine environment." Important marine conservation zones include Ascension Island, Alaska, Brazil, New Caledonia, Greenland, Antarctica, and New Caledonia.

As protected marine biodiversity areas grow, which is essential for sustaining marine resources, funding for ocean research has grown. In 2020, just 7.5 to 8% of the ocean's surface will be set aside for protection. Despite the misconception that successful conservation zones—those with the strictest laws—take up just 5% of the ocean's surface—roughly the same amount of land as Russia alone—this region covers 27 million square kilometers—the same amount of land as both Russia and Canada put together. Marine conservation zones are subject to many rules and regulations, much like their terrestrial equivalents. As activities like fishing, tourism, and the movement of essential goods and services by ship are essential to the fabric of a nation, only a few zones completely exclude any human activity within their borders.

Marine protected areas (MPAs) have become essential research and management tools for restoring at-risk or overfished populations to levels that allow for sustainable harvesting. MPAs have proven helpful techniques for minimizing the effects of fishing pressure on some species (e.g., Black rockfish, Blue rockfish, and Lingcod) along the California coast by functioning as zones with little or no take (recreationally or commercially). Many MPAs have helped species recover from previous loss, with lobster populations from the Mediterranean to Australia and groundfish stocks off George's Bank in the Gulf of Maine being two noteworthy examples. MPAs also help species that may be harmed by changing ocean conditions as a result of climate change by providing a buffer in the form of reduced fishing pressure. Effective MPAs increase fish and invertebrate populations in the protected regions, resulting in a spillover of individuals accessible for collection in fisheries outside of the MPA. MPAs have also been demonstrated to boost potential harvest and economic value while not negatively impacting the economic health of the communities in which they are established. The long-term repercussions of historical fishing practices may significantly impact the current dynamics of abundance and size distributions for long-lived species. Historically, fishing pressure has been strong in California waters, with much of the pressure concentrated in heavily populated areas such as the Southern California Bight and Central California/the San Francisco Bay Area. Fuel prices and weather have primarily restricted fishing pressure and access to fishing locations. Fishing pressure decreases when the distance to fishing grounds rises due to higher expenses to fishermen and the increased danger of getting caught in adverse weather. As a result, distance to the port is a major predictor of the number of fish and size as a proxy for relative fishing pressure. Recovering from strong fishing pressure takes several years due to the lifetime of nearshore rocky reef species. Intense fishing pressure from the late 1980s to the early 2000s may still be apparent within populations today, resulting in lower population sizes or smaller average sizes. Using the theories and knowledge underlying the impacts of environmental and fishing pressure on fish population dynamics, this study used data from long-term monitoring efforts to produce a set of objectives aimed at assisting fisheries managers and researchers.

SYSTEMATICAL ANALYSIS:

	EMR	**PG**	**SEFS**
Mean	3.071130	2.853621	1.993025
Median	2.908320	2.334200	1.902300
Maximum	5.908100	4.908200	3.289760
Minimum	1.119800	1.121200	1.111890
Std. Dev.	1.356361	1.257997	0.681974
Skewness	0.232734	0.256660	0.457194
Kurtosis	2.164660	1.698247	2.205971
Jarque-Bera	0.952555	2.039644	1.527696
Probability	0.621091	0.360659	0.465870
Sum	76.77826	71.34053	49.82562
Sum Sq. Dev.	44.15319	37.98133	11.16214
Observations	**25**	**25**	**25**

Table-1

the above result represents that descriptive statistical analysis research describes the mean values and the median values, and also that it explains the standard deviation, the probability values, and the sum of square deviation. The efficacy of a marine reserve is mainly independent of its present mean value is 3.07; the median rate represents 2.908 the result describes the standard deviation rate as 1.35, respectively. According to the result, the sum o the square deviation represents 44.153in . The overall research study is based on 25 observations related to the variables. The result also describes population growth and size. The result shows that the mean value is 2.85, the median rate is 2.33 the maximum rate is 4.90. also, that presents the standard deviation rate is 1.25, which shows a positive deviation from the mean. The result describes that the skewness value is 0.2566 its probability value is 0.36, showing that there is a 36% significant level between them. The result shows that the size of endangered fish species is dependent on their average value is 1.9930. The median rate is 1.90. Its maximum value is 3.28, and the minimum value is 1.11, respectively. The result describes that the standard deviation value is 0.68, presenting that 68% deviate from values. The probability value is 0.46 rate is 46% significant. Value according to the result, its sum of square deviation value is 11.162, showing positive deviation values.

Null Hypothesis: EMR has a unit root
Exogenous: Constant
Leg Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.706253	0.0876
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	

***MacKinnon (1996) one-sided p-values.**

The results of the unit root test analysis shown above describe the values of the t statistic as well as the probability values. The probability value of 0.08 and the t statistic's value of -2.706 both indicate an 8% significance level. The total results suggest that the enhanced dickey fuller test statistic has negative rates of -3.7378, -2.9918, and -2.6355.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EMR)
Method: Least Squares
Date: 04/20/23 Time: 00:24
Sample (adjusted): 2 25
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EMR(-1)	-0.504480	0.186413	-2.706253	0.0129
C	1.583406	0.634934	2.493811	0.0206
R-squared	0.249756	Mean dependent var		-0.004571
Adjusted R-squared	0.215654	S.D. dependent var		1.341686
S.E. of regression	1.188241	Akaike info criterion		3.262481
Sum squared resid	31.06219	Schwarz criterion		3.360652
Log-likelihood	-37.14978	Hannan-Quinn criteria.		3.288526
F-statistic	7.323803	Durbin-Watson stat		1.962857
Prob(F-statistic)	**0.012896**			

The previous finding uses the dickey-fuller test equation to explain how the marine reserve affects the number and size of endangered species. The coefficient values, standard error values, t-statistic values, and probability values are all described by this result. The effectiveness of a marine reserve is the first variable; its coefficient is -0.5044, and the standard error is 0.1864. The probability rate is 0.01, and the t statistic value of -2.70 both indicate a 100% significant difference between them. According to the outcome, the adjusted R square value is 0.21, and the result reveals that the R square value is 0.24, indicating a 24% model fit for analysis. 7.323 is the F statistic value. Its probability value of 0.012 demonstrates a 100% significant difference between them. The result also describes that the mean dependence var rate is -0.0045 its standard deviation dependent variance value is 1.34, respectively.

Null Hypothesis: EMR is a martingale
Sample: 1 25
Included observations: 24 (after adjustments)
Heteroskedasticity robust standard error estimates
Lags specified as grid: min=2, max=16, step=1

Joint Tests		Value	Df	Probability
Max |z| (at period 4)*		1.478206	24	0.8947
Individual Tests				
Period	Var. Ratio	Std. Error	z-Statistic	Probability

2	0.742772	0.196992	-1.305781	0.1916
3	0.564369	0.297623	-1.463703	0.1433
4	0.442875	0.376893	-1.478206	0.1394
5	0.366890	0.442846	-1.429640	0.1528
6	0.349773	0.500947	-1.297995	0.1943
7	0.474998	0.553380	-0.948718	0.3428
8	0.513881	0.600719	-0.809228	0.4184
9	0.515785	0.643562	-0.752397	0.4518
10	0.531900	0.682518	-0.685842	0.4928
11	0.488968	0.717904	-0.711838	0.4766
12	0.425858	0.750183	-0.765335	0.4441
13	0.495414	0.779874	-0.647010	0.5176
14	0.478281	0.807275	-0.646272	0.5181
15	0.447709	0.832624	-0.663313	0.5071
16	0.561209	0.856071	-0.512563	0.6083

*Probability approximation using studentized maximum modulus with parameter value 15 and infinite degrees of freedom

The above result represents that variance ratio analysis the result describes that joint test and individual test analysis the result represents the values, the probability values at joint test. The value is 1.4782 its probability value is 0.89, showing 89% significantly. Another test is individual test analysis. The result represents the variance ratio, standard error values, the Z statistic values, also that probability values. The total period of individuals is 16. According to the result, variance ratios are 0.56, 0.44, 0.36, 0.47, 0.51, 0.49, 0.47, 0.44, and 0.56, respectively. The above result describes that values of probability rates are 0.19, 0.14, 0.13, 0.15, 0.19, 0.34, 0.44, 0.50, 0.60, respectively, showing 19%, 14%, 13%, 15%, 19%, 34%, also that 50% respectively shows significant levels between them.

Test for Equality of Means of EMR
Categorized by values of EMR and PG and SEFS
Date: 04/20/23 Time: 00:26
Sample: 1 25
Included observations: 25

Method	**df**	**Value**	**Probability**
Anova F-test	(17, 7)	22.19282	0.0002
Analysis of Variance			
Source of Variation	df	The sum of Sq.	Mean Sq.
Between	17	43.34889	2.549935
Within	7	0.804294	0.114899
Total	**24**	**44.15319**	**1.839716**

The above result describes the equality test analysis. The result represents the values and probability values of each method, including the ANOVA F test. The result describes that the value is 22.192 and the probability value is 0.0002, showing the positive and 100% significant level between them. the result represents that the analysis of variance included the sum of a square and mean square values as between and within the variance. According to the result, the sum of square values is 43.3488, 0.804, and 44.153, respectively. The mean square values are 2.5499, 0.114899, and 1.8397. All values show that positive equality is related to the efficacy of marine reserves.

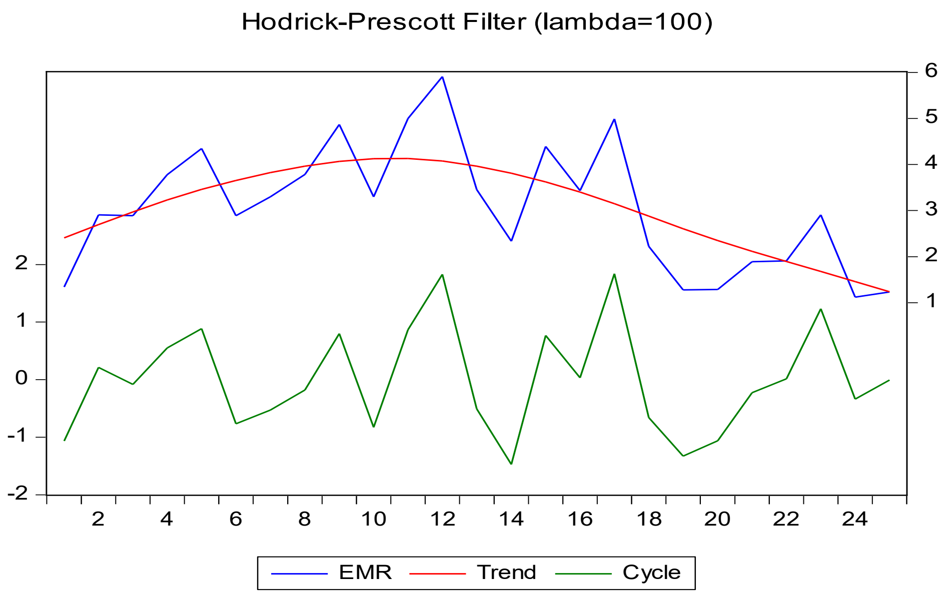
Cointegration analysis:

Sample (adjusted): 3 25
Included observations: 23 after adjustments
Trend assumption: Linear deterministic trend
Series: EMR PG SEFS
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace	0.05

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.4278256	23.2012	29.79707	0.2363200913
At most 1	0.320297208	10.36007	15.494712	0.254041
At most 2	0.062312522	1.479787	3.8414655	0.22380

The above result represents that the cointegration test analysis result describes that linear deterministic trend related to the trace statistic, 0.05 critical value, and also that probability value of hypothesis. The result describes that the eigenvalues are 0.42, 0.32, 0.06, and its trace statistic values are 23.201, 10.36, and 1.4797, showing the positive trace statistic rates of each hypothesis. According to the result, its 0.05 critical values are 29.79, 15.49, also that 3.84, respectively. The result describes that 23%, 25%, and 22% show significant values related to the efficacy of marine reserves in enhancing the population and size of endangered fish species.



The above graph represents the Hodrick-Prescott filter. It describes the trend, cycle, and efficacy of marine reserves. The vertical side presents the frequency level, and the horizontal side represents the range of trend analysis. The red line shows a trend, the cycle shows a green line, and the blue line shows a fluctuation in the efficacy of marine reserves.

Date: 04/20/23 Time: 00:38
Sample: 1 25
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
PG does not Granger Cause EMR	23	7.38900	0.0045
EMR does not Granger Cause PG		10.7168	0.0009
SEFS does not Granger Cause EMR	23	2.09697	0.1518
EMR does not Granger Cause SEFS		1.36437	0.2807
SEFS does not Granger Cause PG	23	4.18773	0.0321
PG does not Granger Cause SEFS		1.51760	0.2460

The above result describes that pairwise Granger causality test results represent F statistic values and probability values. The first hypothesis is PG does not granger cause EMR; its F statistic value is 7.38900 its probability value is 0.0045 similarly, the EMR does not granger cause PG; its F statistic value is 10.7168, and its probability value is 0.0009 shows that both hypotheses present significant relation between the efficacy of marine reserve and population growth of fish species. Similarly, the other probability values are 0.15, 0.28, 0.03, and 0.24, showing that 15%, 28%, 3%, and 24% are significant levels between them. The result also describes positive F statistic values and significant values related to the dependent and independent variables.

Conclusion:

This research study determines the efficacy of a marine reserve in enhancing the population growth and size of endangered fish species. This research study depends upon secondary research data analysis for collecting the research used world developing indicators (WDI) related to population growth and used different websites related to the fish species. For systematic analysis, I used E-views software and generated the results related to the research topic. The test of equality, paired Granger test analysis, the cointegration analysis, the descriptive statistical analysis, and unit root test analysis also that present graphical analysis between them. The overall research study concluded that the efficacy of a marine reserve shows a positive and significant impact in enhancing the population growth and size of endangered fish species.

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