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Research Article

An Analysis of LED Ban in Fishing Industry- Case study of Cutbona Jetty (Goa)

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Abstract

Economics of marine fishery depends upon the profitability of the trawler fishery, a recent technological up gradation in marine fishery is the introduction of LED lights. There are various studies put forth on the usage of LED –lights, some believe that usage of LED lights can have harmful effect on the marine fish population, while some perceive to be highly good and profitable. There are several technological institutions and researchers all over the world trying to analyze the technical aspect of light fishery. Countries that use led lights have shown a considerable increase in marine fish production, for eg led lights is highly used is Japan and Korea. The following will analyze the usage of LED and the link it has to profitability.

As per the results, we found that respondents opposing LED-ban earned a larger profit compared to respondents supporting the Led-Ban. Thus, it can be said that, LED fishing is one factor contributing to increase in revenue. But care should be taken, that with the desire to earn high profits in the short-run, long term consequences should not be neglected. Thus, there is a need for strong policy framework, to have a sustainable fishing in future.

Keywords: Fishery; LED Lights; Marine Fish

Introduction

The share of coastal and marine fisheries to the Indian economy is substantial which is characterized by the generation of employment it has created in the three major sector of the economy, viz the primary, secondary, tertiary and also meeting the needs of food security. The contribution of Indian fishery to the total GDP is approximately 1-1.4%. According to CMFRI (Central Institute of Fish Resource of India), the value of marine fish landing at the point of sale is 30,000cr and 40,000cr at the point of last sale. Fish constitutes the main diet of every Goan and it has a great significance to the people of Goa. It has a coastline of 104km and has 10,000km continental shelf. The total contribution of the state total GDP is 2.5% (third after West Bengal and Andhra Pradhesh.) The total fisherman population is 30,225 and there are five major fish landing centers in Goa.

There are two types of fishery resource in Goa. They are as follows:

1. Inland fishery and
2. Marine Fishery.

Inland fishery

Inland fishery is a fishing activity which is adopted by people residing in the interior areas. The main feature of inland fishery is that, it is practiced throughout the year. There are 47 villages practicing inland fisheries. It is one of the wealthiest source of brackish water fisheries which includes river mouth, lagoons, water lakes and fresh water includes rivers, fresh water lakes, tanks irrigation networks etc. The total inland production of Goa in 2013 was estimated to be 4678 tons, mainly coming from brackish water fisheries. Some of the major fish resources are mullets, prawns, catfish etc.

Marine fishery

Is the second popular fishing resource in Goa. Marine fishery is often seasonal in nature. This season normally begins in August-September. There are 42 fishing villages in Goa practicing marine fisheries. It constitutes a coastline of 104kms. Majority of the fishermen population, approximately 36894 are engaged in marine fisheries. The following chart shows the marine fish production from 1960-61 to 2014:

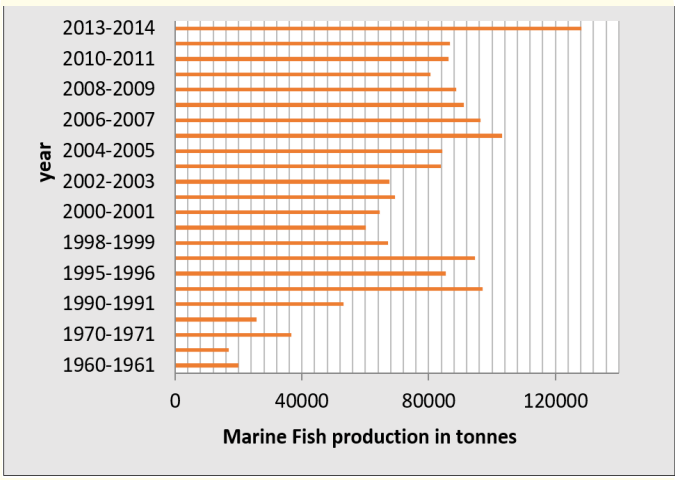

Figure 1: Marine Fish Production in Tones from 1960-61 to 2013-14.

The marine fish production is showing an increasing trend. The highest fish production recorded was in the year 2014 of 1,28,107 tonns, the reason for such a tremendous increase was the introduction of larger mechanized vessels of 70ft. These bigger vessels have helped the mechanized fishermen to explore the deep sea's and help them to engage in multi-day fishing. There are four major methods of marine fisheries. They are as follows:

a) **Gill-net Fishing:** Is a fishing method which is usually carried in deep-sea water usually 5to 6miles away from the sea-shore. The key feature of this method is that the nets are made by household themselves and they have a small mesh-size.

b) **Cast-net fishing:** It is the most primitive gear. It is widely practiced in shallow waters.

c) **Trawling:** Widely used method, it contains the use of trawl net which is usually bell-shaped. Fishing vessels pulling the trawl net is called trawling. Trawling is further classified into three types: a) Midwater trawling b) Bottom trawling c) Shrimp Trawling.

Emergence of trawlers in Goa

During the pre-liberation phase, traditional methods of fishing were adopted. In the year 1957, a Portuguese administrator introduced fishing trawler in Goa for the first time. This was primarily introduced for demonstration purpose. Seccao-de-Economia (fisheries wing) introduced 4 trawlers, two 55 footer trawler and two 46 footer. But due to unpleasant political environment, such an introduction did not create much of an impact.

However, after Goa attainted liberation, the fishing industry witnessed tremendous growth due to the introduction of mechanized vessels, This was technically referred to as Blue Revolution. The following graph shows the growth of fishing vessels during 1960-61-2009-10.

The following Figure presents the growth of mechanized trawlers from the period of 1960-61 to 2009-10.

Figure 2 Growth of trawlers In Goa from 1960-61 to 2009-10.

In the above graph, mechanized trawlers is witnessing an increasing trend, while the non-mechanized boats are experiencing a decreasing trend, this is due to upgradation and advancement in fishing methods that has attracted investment in mechanized trawler. The recent advancement in mechanization of fishing vessels include Gps, Satellite calls, Echo-sounder, Fish finder, LED.

Research problem

Since ownership of mechanized trawlers is showing an increasing trend, from the time of liberation, examination of the profitability with the rise of using Led –Lights is a requisite, In addition the study also examines if there is any association between the usage of Led-lights and profitability, the reasons behind the LED ban and also checks if there are any trawlers owners opposing Led Ban.

Scope of the study

Trawler fishery forms an important segment of marine fishery, which had witnessed a tremendous growth in fish production. Since the trawler fishery has undergone a huge technological upgradation, it is important to examine the cost and profitability. In addition the recent technological introduction i.e. LED (light-fishing) which has created a conflict between the trawler owners will also be analyzed. However due to time constraints, the main fishing center in south Goa i.e. Cutbona with 270 registered trawlers has been selected and will be analyzed.

Review of Literature

D.B.S. Sehara, K.K.P. Panikar and K.P Salani [1], studied the performance of medium and small trawlers in Andhra Pradesh. They adopted a preliminary survey at two trawl landing centers. The survey was carried out by using two schedules. The study evaluated the investment patterns, catch and revenue of both. It was observed that 1/3rd of capital was invested in medium trawlers. the revenue and catch of both depends on the number of fishing days ie higher the number of fishing days, higher the catch and revenue.

Dr. Manoj Kamat and Sanchlilaina Faria (2015) studied the performance of traditional and mechanized fishing sector of Goa. The study covered the canoe and trawler owner from Marmugao taluka. The research methodology used mostly primary data collection. The study found that mechanized trawlers were more efficient then the no-mechanised trawlers.

Margot. l. Stiles, Julie Stockberg, Michelle Ladern and Michael. F. (2010) studied the impact of bottom trawling on fisheries, tourism and Marine environment. The study found that weighted nets dragged along the seafloor destroyed coral reefs and rock garden affecting the marine environment. The study also found that the major tourism activity of deep sea diving and turtle watch were negatively affected. The study concluded that bottom trawling is one of the most destructive ways to catch fish and is responsible for up to half of all discarded fish worldwide and suggedted to use selective fishing gears.

Hai phong Nguyen (2013), made a study on size selectivity of inshore trawl fishery in Nha Trang city (Vietnam). The major aim was to study the selectivity of trawl nets and the state of Juveniles and trash fish. The state of Juveniles was determined by direct access to trawl fish samples from trawl fishery and the selectivity of trawl nets were studied during sea-trials. The study found that the mesh size of diamond mesh had a very poor selectivity and the trash fish that accounted for major part of the catch by the trawlers played an important role in the income of fisherman, specially fishery from small fleet.

J.B Jones (1992) in her article 'Environmental impact of trawling on sea-bed' published on New Zealand journal of Marine and freshwater (vol:26) said that trawl gear has a direct physical effect on the seabed wherever the ground rope, chaines contact the bottom of the sea-bed. It was also observed that beam trawlers, otter trawlers are similar in their effect, generally heavier the gear in contact with sea-bed, higher the damage [2-4].

Brief description of Cutbona-jetty

Cutbona is one of the important jetties in South Goa, of Salcete taluka. There are 270 mechanized trawlers operating through this jetty. Cutbona is a very important fishing village, which has 911 active full time fishermen engaged in marine fishing to earn their living and to ensure greater fish supply in the region and to the nearest major market centers and to minor market centers as well. The following are the important facilities provided at Cutbona fisheries complex: a) 180 meter Fishing jetty, b) 144 meter length landing platforms, c) HSD pump facility, d) Water supply and illumination, e) Approach by pass link road, f) Parking area for vehicle, g) Net mending shed, h) Maintenance workshop, i) Sulabh toilet, j) Overhead Tank, k) Kiosk.

Economics of marine fishery depends upon the profitability of the trawler fishery, a recent technological up gradation in marine fishery is the introduction of LED lights. There are various studies put forth on the usage of LED –lights, some believe that usage of LED lights can have harmful effect on the marine fish population, while some perceive to be highly good and profitable. There are several technological institutions and researchers all over the world trying to analyze the technical aspect of light fishery. Countries that use led lights have shown a considerable increase in marine fish production, for eg led lights is highly used is Japan and Korea. The following will analyze the usage of LED and the link it has to profitability.

Figure 3: Relationship between Number of trawlers and profits.

It is observed that from the field study that maximum respondents own one trawler, the above graph shows the relationship between profits and number of trawlers owned. From the above graph it can be observed that there is a positive relationship between number of trawlers and profits, ie individuals who own more trawler have higher profits than individuals owning less trawlers.

LED –Ban analysis

According to science, all marine animals and plants depend on light for their survival. Without light organism cannot carry out the process of photosynthesis. Marine animals respond to light in various ways. Some scatter away from light while some may stand still as soon as light hits them. Others swim toward the light and gather around it in great numbers. Marine animals also respond differently to differing hues and intensities of light. Thus, understanding the behavior of the fish, light fishing is one of the recent developments in marine fisheries. Therefore, fishermen often use artificial lights to catch fish that are attracted to light, LED-fishing is one of the recent developments in Marine fishery.

LED stands for light-emitting diode. LED fishing is a type of fishing that involves usage of LED-lights to capture a large amount of fish. It has been introduced only in two Indian states ie Karnataka and Goa. However, in recent times there is lot of agitation between the fishing community with regard to usage of LED Lights. The following section presents the number of people opposing Led-ban and the reasons for supporting and opposing Led-ban.

Figure 4: Number of trawler owners supporting and Oppose Led-ban.
Source: Field Survey

As per the survey conducted, it was observed that 23 trawler owners support led ban that is being introduced while 32 trawler owners oppose led ban. Thus, it is clear from the study that, a greater number of trawler owners do not support the led ban, the reason being is that with LED usage, there is less consumption of fuel and diesel, which is highly profitable for the trawler owners. This also means that with a decrease in fuel and engine consumption, there is a decrease in total cost that was being incurred before the introduction of lED. Thus, with decrease in cost, the trawler owners are now in a position to yield a high profit.

Figure 5: Reasons for supporting/Opposing Led -ban.
Source: Field Survey

The above graph shows two views on LED-Ban. One view supports led ban and the other view opposes led ban. The following explains the reasons for supporting as well as opposing led ban in Cutbona.

Reasons for supporting LED-Ban

A1: Leads to over-fishing: Figure 2 (a) indicates that 22.22% of the respondents have said that usage of LED –lights will lead to over-fishing, as the light attracts larger school of fish. the mechanism by which, LED-lights can capture a large school of fish is as follows: the colour of LED lights is usually white or green, these colors' are attractive to plankton. Plankton is a primary food for most of the fishes. When plankton gather in the lighted area of the water, predator fish move in to enjoy the banquet. The predator fish in turn attract game fish looking for an easy meal. Thus LED-lights creates food chain mechanism by which, fisherman can capture a large school of fish.

A2: Less Breeding: Figure 2 (a) Indicates that 23.33% of the respondents have said that there will be less breeding. Because in their opinion, the light also attracts the juvenile fish, and as a result, they were wont be mature fish to breed in the long run. Capturing juvenile fish, also means that there will be a depletion in fish stock in future. As a result, there will be less fish spawning, and less fish-stock in future. Reasons for Opposing LED ban.

B1 less Diesel: Consumption of less diesel is one the main factor for opposing LED-ban. Consumption of fuel and engine oil occupies a major part of the cost that trawler owners incur. From the above graph 19 respondents support led because of less diesel consumption. The trawler owners need not travel long distance to capture the target fish. By studying the seas, they can immerse the lED lights into the water and the fish automatically gets attracted to the light. Thus its not the trawlers that have to go near the fish, it's the fish coming to the trawler due to the attraction of lights.

B2: No ecological harm: it is noted that 8 respondents said that the using led has less ecological harm as opposed other trawler owners. They are of the view that led light attracts only the mature fishes, the juvenile fish escapes through the net.

B3: Less labor: From the above graph it can be noted that 5 respondents say that employing led lights will lead to employment of less labour, because with LED usage, the amount of work is reduced, thus it less labour is demanded.

B4: Uniform Ban: 17 individuals said that there should be a uniform ban. They are of the view that, the government should propose a uniform ban nation wide because according to their perception, it is unfair, to deny them to use lED lights, when led ban is being used in Kerala and Karnataka.

The above table shows the mean, standard deviation and frequencies of profits earned in relation to Led-ban. The above table is classified on the basis of number of trawlers owned. The following is the analysis of profit with and without Led-usage on the basis of number of trawlers owned.

C1: One trawler: In this category it is observed that the total number of trawler owners who support the led ban are 20 and the ones who oppose are 13, this is analyzed on the basis of number of trawlers owned, thus the above holds true for individuals owning one trawler. In order to find the relationship between profits and led usage, the means, standard deviation and frequency of profits has been calculated.

	Led -ban	
Number of trawlers	**0 (do-not support led ban)**	**1(Support LED ban)**
1 Trawler Mean	16,20,000	14,80,769.2
Standard deviation	490273.82	521032.01
frequency	20	13
2 Trawler Mean	1812500	1707142.9
Standard deviation	| 530330.09	577659.48
frequency	8	7
3 Trawlers Mean	2000000	1500000
Standard Deviation	707106.78	0
Frequency	2	1
4 Trawlers–Mean	2500000	2500000
Standard Deviation	0	0
Frequency	1	0

Table 1: Means, Standard Deviations and Frequencies of With The usage LED and _Profit.

Thus, from the above table trawler owners own a profit of 16,20,000 with the usage of led lights, which is comparatively low to 14,80,769.2 with no usage of led lights. The standard deviation of profits with using led lights is 49,0,273.82, while the standard deviation of profits without led lights is 5,21,032.01. thus, there is a significant difference between the mean and standard deviation of profits with and without usage of LED lights. Thus, trawler owners using Led light earn a higher profit than the trawler owners who do not use the Led Lights.

C2: Two trawlers: the total number of respondents owning two trawlers, that support led lights is 8 and the total number of trawler owners that don't support led is 7. The mean of profits with led usage is Rs18,12,500, while the mean of profits with no led usage is Rs.17,07,142.9. Thus, in the category of trawler owners, owning two trawlers, the mean of profits with led usage is higher than the mean of profits without using led lights. With respect to standard deviation, the standard deviation of profits with led usage is 5,30,330.09 and the standard deviation of profits with no led usage is 5,77,659.48. Thus, in case of ownership of two trawlers the profits is much higher with Led usage as compared to no Led usage.

C3: Three trawlers: The total number of respondents owning three trawlers that support led lights is 2 and the number of respondents not supporting led is 1. The mean of profits using led lights is Rs.20,00,000 and the mean amount of profits without using

led lights is Rs. 15,00,000. With respect to standard deviation the trawlers that use led lights, the standard deviation is 707106.78.

C4: Four trawlers: the total number of respondents owning four trawlers that support led light is 1 while no trawlers owner in this category oppose LED. The mean amount of profits Trawlers owners own is 2500000, while since there is no data with no led usage, we cannot compute the mean and standard deviation of the same.

Reasons for supporting LED-Ban

Group	Observations	Mean Profit
0 (Oppose LED-ban	60	1842417
1 (Support LED- ban	30	1603333
T-calculated =1.7980	T-critical= 0.0378	Df=88

Table 2

The Independent Samples *t* Test compares the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. The Independent Samples t Test is a parametric test. To run an Independent samples T-test, we need to variables ie test-variable and grouping variable. In the above test the test variable taken is profits, who's means are compared. And the grouping variable Taken is Led-ban which comprise of respondents supporting led ban (marked by 1) and respondents not supporting Led Ban (marked by 0).

Null Hypothesis: there is no significant difference in means of profits with led ban u=0.

Alternative hypothesis: there is a significant difference between the means of profits with led ban.

$u \neq 0$

In the above test, the result yielded are as follows, the mean of profits with led –ban supporter is 16,03,333 and the mean of profits non-led ban supporters is 1842417, thus there is a significant difference in mean in both the selected samples. Thus, respondents oppose LED ban because it is profitable for them. Ie respondents opposing LED –ban the profits they earn are much higher than LED-ban supporters. And the t-calculated value is 1.7980 and the t-critical value is 0.756. since t-calculated is greater than t-critical we reject the null-hypothesis at 5% level of significance.

Model, 1 Profit= f (shrimp,num of trawlers length_ft satellite memasso)

OLS regression using observation

	Coeffient	T-ratio	P-value
Constant	975368.4	2.26	0.028
Shrimp Trawling	343609.4	1.18	0.246
Number Of trawlers owned	169100.3	2.45	0.018
Length of the trawler	11360.15	1.90	0.043
Satellite	55984.27	-0.33	0.746
Member of assocoation	-275630.1	1.42	0.163

Table 3

R sq = 0.29 Adjusted R sq = 0.22

F-cal = 4.07 F*= 0.0036

The dependent variable is profits and the independent variables are constant shrimp, number of trawlers owned, length, and member of association. the model is that will be used to understand if profit is a function of shrimp-trawling, number of trawlers, the length of the trawler and member of association.

Since the data collected is cross-sectional data the following is presentation of the model i.e. profits = (β1+β2shrimp+β3number of trawlers+β4length of the trawler + β5memeber of association).

Therefore, Profit = 998995.5 + 336969.5shrimp + 163895.4number of trawlers + 11124.88 length + (-291372.6).

The r-squared value is 0.29, and F calculated value computed is 5.15. since r-squared is 0.29, the model shows 29% variation in the dependent variable i.e. Profits.

Statistical significance of F

Null hypothesis: Ho: β1 = β2 = β3 = β4 = β5 = 0

Alternative hypothesis: Ha: at-least one of them is not equal to zero.

The f-calculated value is 5.15 and the f-critical is 0.0015, thus since the f-calculated is greater than f-critical we reject the null hypothesis and accept the alternative hypothesis. It means that independent variable jointly explains variations in dependent variable in dependent variable.

Hypothesis testing of the co-efficient

In this, the t-ratio, is taken into account. if the T- calculated is greater than t-critical we reject the null hypothesis.

Shrimp

In the above model the estimated T-value for shrimp is 1.18 and the t-critical is 1.7. Since the calculated t-calculated value is less

than t-critical value, we do not reject the null hypothesis. It means that Shrimp trawling is not a determinant of profit. The reason could be, capturing shrimp is seasonal, and mostly a good quantity of shrimp is captured only in the month of august.

Number of trawlers

The calculated t-value is 2.45, and the t-critical is 1.18. Since the calculated t-value is greater than t-critical, we reject the null-hypothesis and accept the alternative hypothesis. It means that the value of beta coefficient is statistically different from zero., thus it means that Number of trawlers owned is a determinate of profit. the more the number of trawlers owned, the higher is the profit. Thus, there is a positive relationship between number of trawlers owned and profits.

Length of the trawler

In the above model the estimated T-value is 1.90 AND the critical is 1.18. Since the calculated t value is greater than t-critical, we reject the Null hypothesis/Therefore, we can conclude that profit is a function of length, and length plays an important role in profit determination in the marine fisheries. The reason can be trawlers with larger length have a large holding capacity, which results in more catch.

Led Ban	Coefficient	z	p-value
Engine capacity	-0.0084817	-2.73	0.006
length	-0.0815915	-2.92	0.003
Owns motorized boat	-2.501355	-3.20	0.001
constant	7.06691	3.51	0.000
	LR chi 2 (3) =29.39 Prob>chi =0.000 Pseudo R2 =0.2663		

Table 4: Logistic Regression Model: LED ban =F (Engine capacity, Length, non- motorised boats).

The above model is a logit model, the dependent variable taken is Led ban which is a dummy variable. The independent variable taken are engine capacity, length and own Motorized boats.

The likelihood ratio chi-square of 29.39 with a p-value of 0.0001 tells us that our model as a whole fits significantly better than an empty model (i.e., a model with no predictors).

In the table we see the coefficients, their standard errors, the z-statistic, associated p-values, and the 95% confidence interval of the coefficients. All the variables i.e. engine capicty, length and owns motorized boats are statistically significant, as are the three indicator variables for led-ban. The logistic regression coefficients give the change in the log odds of the outcome for a one unit increase in the predictor variable.

- For everyone unit change in engine capacity, the log odds of led ban decreases by --.0084817
- For a one unit change in length, the log odds of led ban decreases by -.0815915
- For a one unit change in owns motorised boats log odds of led ban decreases by - 2.501355

Conclusion

The study has been a very informative, as it presented both the sides of the same coin. Led fishing, is a type of fishing, which emits LED into the sea, to attract large school of fish, the key advantage of using led –fishing is that, it saves fuel and diesel, thus there is decrease in the fuel charges. It was quite interesting to note that, during the course of the study, that's some respondents supported led-ban, while some opposed Led ban.

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