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Technological Expansion and Some Key Labour Market Outcomes in Marine Fisheries Sector in Odisha, India

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ABSTRACT

In the contemporary literature and some policy circles, the growth in marine fish landing in Odisha has been ascribed to the rapid technological up gradation through widespread mechanisation of the sector over last three decades. Contrary to this notion, the paper, on the basis of analysis of primary and secondary data on marine fisheries sector in Odisha finds that technological up gradation of the marine fisheries sector in Odisha has little impact on the landing figures in the state. On the other hand, the technological expansion has resulted in a decline in wages and employment in the sector, even if the sector operates with excess capacity.

Keywords: Technological Expansion, Marine fishery economy, Income inequality, labour market

JEL Classification: J -21, J-31, J-33, J-79, J-81

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Introduction:

Marine fisheries sector in Odisha has undergone some peculiar changes over last several decades. A sector that accounts for direct livelihood options for around 0.45 million people in the state, has registered an average annual growth in the landing of marine fish produce between 1995 and 2011 at a rate of more than 40 per cent in Odisha compared to a mere 3.5 per cent national average. Such a phenomenal growth in marine fish landing in the state is often ascribed to a rapid adoption of modern capital intensive technologies immediately after the Super cyclone of 1999 that destroyed a substantial technological asset base in the traditional sector. The present paper seeks to study some of the impacts of such a substantial shift from traditional low capital technology to capital intensive modern sophistications in the sector on the labour market outcomes in the marine fisheries sector in Odisha.

Many contemporary literature hold that fisheries go through a "fishing up" process in their trajectory of evolution (Regier and Loftus,1972). Such a fishing up process may be explained through (a) an expansion of the geographic spread of the fishery as a specific species of fish gets exhausted locally (b) new and hitherto less preferred species also get extracted (Gobert, 1992), (c) eventually, the species that can grow faster than the pace of exploitation would dominate the basket of catch with new demand evolving around those species (Formacion and Saila 1994). In the first two phases of the fishing up process, technological improvements do play a significant role in defining the expansion of the range, expansion of landing and specialisation in catch of new species that were earlier less preferred and fishers therefore were less specialised in terms of the method of their catch. Such a phenomenon has been observed by researchers working on fisheries around the world (Deimling and Liss, 1994; Garcia and Newton, 1994). This may be the primary reason for why even if the total landing have increased the composition of catch might have changed with technological advance and exploitation of specific species (FAO, 1993; Pauly and Christensen, 1995). No matter how the process evolves, it clearly involves a technological advance of some sort. While the so called 'fishing up' process in open access

marine fisheries may be an interesting read, it may also be pertinent to look into the issues concerning the people who draw a living from the fishery resources. The paper seeks to study some such issues pertaining to the labourers during this process of technological advance in marine fisheries with a special reference to Odisha. The paper is divided in four major sections. The first section provides an overview of the marine fisheries sector in Odisha and the context of such technological advance. The second section deals with the data and literature on the issue. The third section presents the results of the analysis with a special reference to wages, distribution of wealth and employment conditions. The last section draws some broad conclusions of the analysis.

I. Overview and the Context

Odisha with a coastline of around 480 kilometres and a continental shelf area of around 24000 square kilometres of continental shelf area made for almost 9 per cent of total marine fish production of the country and employs around 14 per cent active marine fishers of India (FAO, 2004). The sector has undergone some major trend reversals over last three decades. From a sluggish low return sector in mid 1980s, it has emerged as one of the major attractions among upcoming investors in the state. As per the estimates, the production of marine fish in Odisha increased from a mere 38.70 thousand tonnes in 1980-81 to 133.46 thousand tonnes in 1996-97. In 1997-98, it reached its maximum to 156.08 thousand tonnes after which it suddenly declined and again saw a phenomenal growth in the recent years (CMFRI 2013 and Naik 2006).

As presented in Figure-1, we may classify the entire period from 1985 till 2011 in three distinct phases. The first phase witnessed stagnation in the sector. Such stagnation was primarily on account of predominance of the traditional sector and lack of willingness of the marine fishers to adopt new technological advances that was already in operation in the west coast of the country. In the second stage with the opening up of the sector and a policy orientation towards an export led growth strategy, there was a sudden but short lived increase in the fish landing figures. It may also be rational to assume that the sudden increase in the production of a highly perishable commodity like marine fish may be an outcome of the increased domestic and export demand for the commodity in the wake of an emerging consumer class as well as increased awareness on the food choices and the sector responding to the demand expansion effectively. However, the production again declined and the downfall continued till 2003. Such a decline may be ascribed to the devastating impact of 1999 super cyclone that probably destroyed the asset-base of the traditional sector. The impact of the super cyclone was so strong in some of the major fish landing districts of coastal Odisha that the fisher population

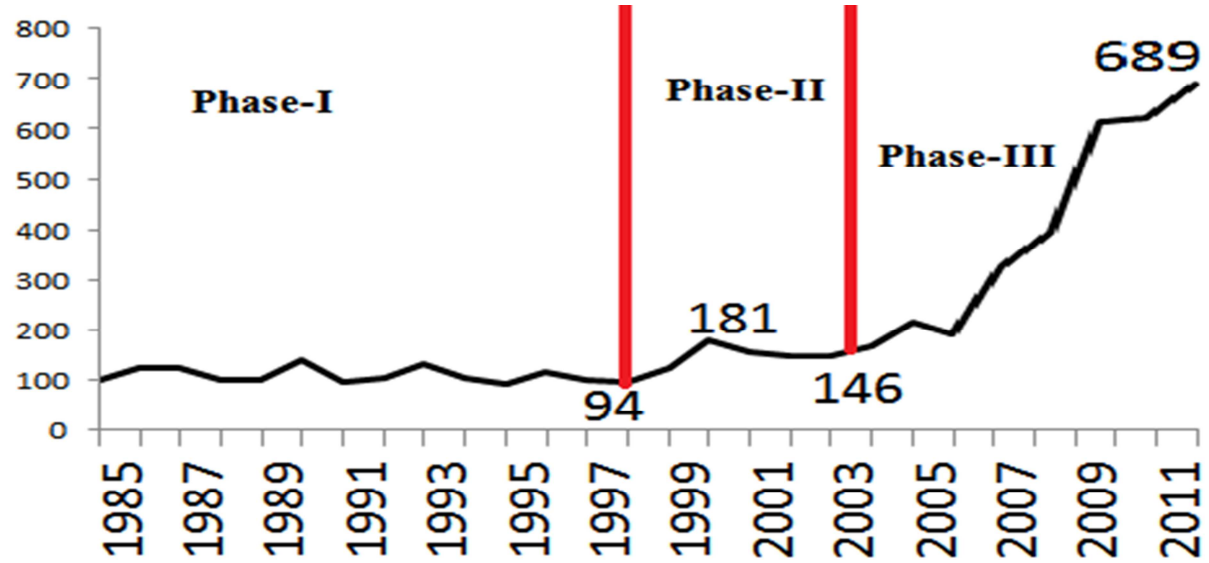


Figure-1: Index of Marine Fish Landing in Odisha(Base 1984=100)
Source: CMFRI 2013

could not respond to the post disaster resuming of the activities for quite some time. In the third phase, the sector again witnessed an exponential growth in the marine production. The third phase is characterised by a shift in fishing technology from traditional catamarans to semi mechanised crafts procured by the traditional fishermen through the post disaster relief and rehabilitation assistance extended by the government, philanthropic organisations and institutional credit. The phase also witnessed in increase in the operation of big trawlers and highly sophisticated fishing vessels in the state. At the same time, there has been an increase in the number of traditional fishing units. Probably, Odisha is the only state in the country to witness an increase in the traditional fishing vessels along with modern fishing technology during the same time. As can be seen in Table-1, the number of active fishermen in Odisha increased by four folds during 1980 and 2005 compared to a two fold increase in the national scenario. While the number of modern sector fishing crafts in Odisha increased from mere 106 crafts in 1980 to 8296 in 2005, the number of non-mechanised crafts also increased from 9728 crafts to 15444 crafts during the same period. On the other hand, in the country as a whole, the number of non-mechanised fishing crafts declined substantially during this phase (Mohanty, 2013). The shift towards mechanisation has led to an increase in output in the sector, but at the same time it might also have resulted in a deterioration of the health of the coastal resources due to overfishing, unbridled catch of juveniles and thus posing threats to the sustainability of the sector (John, 2014).

There are some other peculiarities of marine fisheries sector in Odisha compared to the national scenario. While more than half of the fisher population in India are dependent, in case of Odisha it is much lower at 39 per cent. The proportion of people engaged in different economic activities related to marine fishery is more in Odisha than the national scenario (Table-2). While the number of mechanised crafts in the country grew by 14 times between 1985 and 2005, in Odisha it grew by almost 78 times. The number of fisher households increased by almost 4.5 times in Odisha compared to a 3 fold increase in the country (CMFRI, 2005).

Clearly, the marine fisheries sector in Odisha deserves a special research attention for several reasons. First, it is a sector that provides employment to a large number of people, even if at a subsistence level. Second, the sector has witnessed a remarkable growth that need to be explained further. Thirdly, the sector has witnessed a remarkable technological advance although substantial sections of the people drawing a living from it are still doing that with traditional and non-mechanised methods of capture. It is in this context that we seek to observe the labour market outcomes in the sector in Odisha.

I. Data and Literature

The analysis presented in this paper is based on a mix of both primary and secondary data. Primary data was collected through questionnaire survey of fishers from three marine fishing districts namely Puri, Ganjam and Bhadrak. Table-3 presents the sample distribution across districts. The secondary information was gathered from different agencies such as FAO, CMFRI, and Directorate of Fisheries, Cuttack. The paper made an attempt to present a comparative analysis of some of the major labour market outcomes in the sector across specific types of technologies they are endowed with. For this the respondents were classified into five groups. Those are, modern trawl owners (MTO), labourers in the modern sector (LMS), traditional fishers with assets (TFA), traditional fishers without assets (TFWA) and controlled samples.

The available literature dealing with the role of technology in capacity expansion and production growth is diverse in their approach and conclusions. While some emphasise on the role of technology as a policy action tool for in enhancing production, some others find it difficult to ascertain all the costs involved in implementation of policies for technological expansion.

Technological progress has been addressed by most paradigms of economics as an important factor contributing to production growth, whether it is the paradigm led by early classical economists who viewed production as a network of sequential activities, post Ricardian arguments signifying the role of energy or power or the concept like ‘motive power’ by J S Mill and Seniors, technology have played a significant role in defining the production growth (Christensen, 1989: 6-7). The Neoclassical paradigm too, although made a shift from production approach to an exchange approach, evolution of concepts like marginal productivity theory of supply and subsequent universal modelling in economics, the paradigm abandoned the concepts like complementarities of natural resources and proposed the strategy of substitution of technology and capital (in terms of financial resources) to overcome the problem of scarcity of raw materials in a specific place through instruments like exchange and prices. Economists like Walras (Archibugi and Nijkamp:

1989) argued that finished goods for final consumption are obtained through a production process by combining different factors of production including natural resources and raw materials. However, inputs like raw materials themselves obtained by combining land labour and capital. Therefore, the significance of natural resources and the concept of time were eliminated from the discussions of production as they do not explicitly figure in the process. The Marshallian reference of 'incidental expenses' further eliminated the role of natural resources and raw-materials and reinforced the significance of technology represented by use of machines and financial capital in production process.

Use of analysis tools like forecasting as a combination of processes for determining the likelihood of specific events in future also helped in promoting the idea that technological advance may be used as a tool in designing actions for production growth. As argued by Armstrong (1999) argues that there are at least two reasons for making efforts for future forecasts over and above the enumeration for the present while designing policies for the environmental sustainability. Firstly, in the event of a no-action policy prescription, it should be clear whether the current trends will be favourable or unfavourable in future. Secondly, if an intervention is suggested, the policy makers 'must evaluate both its probable success given future trends and its impacts on the human and natural environment' (Armstrong, 1999: 199). If policy action has to be taken up, given the exogenous nature of the factors of production, the only way left with the policy makers to address the concerns raised about future outcomes through the method of forecasting is technological advancement.

However, the problem with a policy proposal for technological advance to overcome future supply gaps is the inability of policy makers to foresee the adverse impacts of such advances in a dynamic and chaotic socioeconomic set up. Unlike experiments in medical sciences, policy makers do not really have any controlled environment where they can pre-test policies on non-human entities. Although methods of simulation do pose a limited help, policy actions are primarily learning by doing approaches. A technology once introduced would eventually spread through social interactions and it may be difficult to control it if something goes wrong. Again, in cases where the policy priorities are biased towards any specific policy goals as in the present case towards achieving more output from an open access resource, often the darker sides of such technological advance are ignored as long as it does not create a political problem. Lacks of adequate orientation as well as expertise to quantify the externalities also pose a problem with technological advance in specific sectors (Glenn-Marie Lange, 2003).

It is interesting to note the swift changes in policy approaches that happened in marine fisheries sector in India. Whenever there has been a stagnation in the fisheries sector, the governments have proposed policies for a technological advance and created necessary institutional ambience towards such expansion. But whenever there had been an expansion of technological intervention in the production process in marine fisheries, there had been conflicts of interests among the technologically advanced groups of fishers and traditional fishers. Looking at such dynamics, the Majumdar committee report of 1976 proposed a seasonal ban on trawlers within 22 km off the shore through the Marine Fishing Regulation Bill (Government of India, 1976). However, this legislation was hardly respected due to legal complications in ascertaining the violation of the terms. Owing to the processes of economic reform programme for export led growth strategy, the government of India introduced the New Deep Sea Fishing policy in 1991 and started leasing out the operational permission to fishing crafts from foreign countries in the Indian EEZ (Soumya and Shah (2006). This move was vehemently opposed by millions of fishers across the country. The reasons for such opposition was simple. The predominant technology of Indian marine fishing industry was much backward compared to its foreign counterparts. Such opposition by the Indian fishers led to the constitution of the Murari Committee in 1995 that although recommended a restriction on the new permissions for foreign fishing crafts, also recommended an upgradation of Indian vessels to equip them for deep sea fishing activity (Sankaran, Sinha and Madhav). In 2000, the Government of India proposed a horizontal expansion of marine fisheries sector by proposing a Coastal Mono-Aquaculture Bill. The Bill had fundamentally subverted the land mark aquaculture judgement of the Supreme Court on 11 December1996 by Justice Kuldip Singh to demolish aquaculture industries/shrimp culture industries/shrimp culture ponds operating/set-up of the coastal regulation zone as defined under the CRZ Notification (Kocherry, undated and Mishra, 2002). The Supreme Court Judgement was welcome as it sought to protect the livelihood of over 100 million coastal people, biodiversity of the ecosystem, estuaries, rivers, seas, 100,000 acres of ecologically fragile coast along the 9600 km long coastline of the country. With a lot of opposition from the fishing community, the Bill was

finally revised with some regulatory mechanisms and got enacted in 2005 as the Coastal Aquaculture Authority Act 2005 (Government of India 2005). In the meantime, the government also introduced a Comprehensive Marine Fishing Policy 2004 with an objective to 'augment marine fish production of the country up to the sustainable level in a responsible manner so as to boost export of sea food from the country and also to increase per capita fish protein intake of the masses'(Government of India 2004).

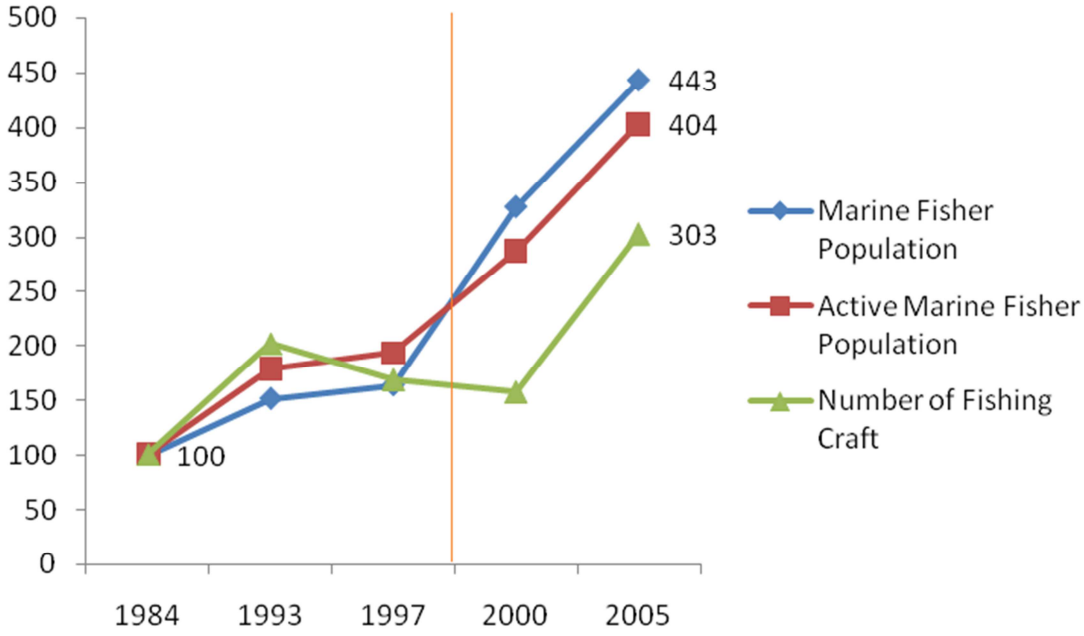


Figure -2: Evidence of Labour Displacement in the Study Area (Base 1984=100)
Source: Computed from Directorate of Fisheries, Odisha and Marine Fisheries Census 2005

It is in this context that we notice a growth promoting and an approach towards technological advance in marine fisheries sector in Odisha after 1991. At the same time, there were some other efforts to overcome social overhead bottlenecks related to storage, processing as well as safe transportation of perishable fishes and availability of institutional credit for technological up gradation. However, probably due to huge sunk costs involved in the efforts towards modernisation of a predominantly traditional sector, the fishers in Odisha took little interest in such effort till 1999 when the Super Cyclone hit the coasts and destroyed a substantial part of the fishery asset base of the traditional sector. When the sector sought to overcome the shock through capital replenishment, not only there was a substantial advance in the technology of the sector in the state, there also was an expansion of the traditional sector. It is also interesting to note that a majority of the technological advance was undertaken by new entrants in the sector, while the majority of the fishers hitherto engaged in marine fishing created new assets in the traditional technology itself. This is quite evident from the fact that in the sample respondents covered under study while there were around 24 per cent fishers who were first generation fishers, in case of modern trawl owners, 63 per cent fishers were first generation fishers (Table-4).

II. Labour Market Outcomes in Marine Fishing Sector in Odisha

The last three decades of experiments with economic liberalisation in India has also been an era of distress[1]. In almost all commodities producing sectors the growth has primarily been labour displacing and the marine fisheries sector in Odisha is no exception. The entry of new technology in the sector in a massive way has resulted in a shift in the production process from a labour intensive traditional one to a capital intensive one. With the focus on the government towards more production and more exports, a lot of promotions were made towards

[1] Such a statement is primarily based on the established debates on the nature and pattern of growth process achieved in India during the era of liberalization. For more details, one may see Chandrasekhar and Ghosh (2006)

mechanization of the sector, motorization of the traditional crafts and gear specialization in order to target fish species. In the context of Odisha's coastal areas where the space reserved for the traditional sector is actually being exploited by everyone, the share of traditional fishers declined drastically. The more the technology gets sophisticated, the per worker output in the capital intensive sector increases and so is their real wage. The information collected from the field suggests that the wage of asset less labourers in the modern sector is more than the asset less fishers in the traditional sector. This has many implications. First, the modern sector with higher wage rate attracts skilled but asset-less fishers to shift their sector. This option has limits in terms of the number of workers that can be absorbed in the modern sector. Therefore, many former traditional fishers shift their occupation from fishing to other activities in the services related to fishery such as manual transportation of fish from shore to godowns and trucks, and engage in other activities which are related to the marine fishing sector but not directly related to capture fisheries. Table-7 shows that number of people in the community per active fishers have increased from 3.4 in 1993 to 7 in 2000. This may indicate an increased unemployment (or shift of occupation) in the fishing communities. Such a shift might be a result of the declining returns per fisher and craft as presented in Table-6.

We present these discussions below both on the basis of secondary information as well as data collected from the field.

Evidences of Labour Displacement based on Secondary Information

The analysis of secondary information throws some light on the labour displacing shift in the sector's production relations. Figure-2 suggests that with 1984 as base year, the growth of active fisher population was higher than the fisher population in the initial decade of the economic liberalization process, after 1997, the growth in the active fisher population was lower than the growth in fisher population. Clearly, the sector is not able to support fishers from the community in a manner it used to do before 1997. Not only in terms of employment, in terms of returns too, has the performance of the sector deteriorated. As is evident from table-6, the average catches per fisher and per craft have gone down even compared to 1984. There is no dearth of literature to suggest that in recent decades, the sector's capacity to provide employment to an ever increasing population has gone down.

While there is a predominant opinion that the technological shift might have resulted in an increase in fish production in recent years, the discussions above present a different view altogether. At one hand, there has been an expansion in technology as well as a rapid growth in the total production itself, and on the other hand the returns to fishers in the sector have gone down. This may indicate the role of some other factors such as demand for fish produce as a driving force behind the growth in the fisheries sector. In order to understand the relative impact of these factors in determining production of marine fishery sector, we undertook an OLS regression with technology (represented by GFCF), domestic demand for marine fishery produce for food purposes, domestic demand for fishery products for non food purposes and the volume of exports as independent variables. Table-8 and Table-9 presents the main results of this exercise.

As seen from Table 8, marine fishery production is affected by all these factors in a significant manner with a model coefficient of determination of 0.99 and a very high F value. This model presented in Table 8 highlights some interesting insights into the issue of production growth in the marine fisheries sector. The negative coefficient for GFCF indicates a negative relationship between gross fixed capital formation in fisheries and the production of marine fishery produce. There may be several factors contributing to such a result. Firstly, the sector is already running with excess capacity. So, capital formation in the sector may not be useful in contributing to the production in the sector. The most significant driver of marine production is probably the demand for fishery produce especially the domestic demand for the marine fishery product for direct consumption as food. In order to understand the situation in different regimes, we introduced a dummy '0' for the years till 1986 and '1' for the succeeding years[2]. Table-9

[2] The Planning Commission Working Group report on fisheries for the 11th Five Year Plan classified Phase-1 as the period till 1968 when fish landing was predominantly done by the traditional sector. Between 1968 till 1985, the second phase represented motorization of traditional fishing crafts, introduction of target specific gears and increase focus of the government on the sector. Phase 3 intensified the process of mechanization and sophistication through multiday fishing activities and extension of new fishing grounds. In order to understand the factors influencing production across different phases, we divided the information with us into two groups; the periods before and after 1986. For more details on these phases, one may please refer to Government Of India (2006) "Report of the Working Group On Fisheries For The Eleventh Five Year Plan (2007-2012)", Planning Commission, December 2006

discusses the relations with the introduction of the dummy variable. As seen from Table 9, the high value of the coefficient of determination along with significant 't' values for variables related to demands both for food and non-food purposes may direct us towards inferring that in both the phases, capital or capacity of the sector was not a predominant factor contributing to the production in the marine fishery sector. The change in signs for GCCF during both the phases may indicate that before 1986, capital had a positive contribution in growth while after 1986, the output produced in the sector was responding negatively to the amount of capital used in the sector. Here also what significantly drove output in the sector was demand for marine produce both as food and non-food purposes. Another interesting observation in the aftermath of 1986 was an increase in the role of demand for non-food purpose in driving output in the sector. Inferences drawn may be summarised as below.

Domestic demand for food purposes is the main driver of the growth in the marine production in the sector. As mentioned earlier, a growth of the middleclass consumer group with increased awareness and orientation towards marine fishes might be the reason behind such a relationship. Domestic demand for non food purposes have started influencing marine production more in the aftermath of 1986. This might be because of the increasing demand for marine produce used as inputs in the industrial sector. Probably, the growth in demand for items like seaweed, pearls, marine produce for medicinal purposes, input in poultry feed and even demand for fresh fish for processing for export may be the reasons behind such a phenomenon. Capital formation in the sector has no significant role towards production in the sector. This may be primarily because of the fact that the sector is already operating with excess capacity. Any further increase in capacity may not impact on production and may even impact negatively because of several factors.

First, even after rapid mechanization noticed in last decade, the fishers are operating in the same fishing grounds and the excess capacity remains unutilised in the absence of discovery of new fishing grounds or a substantial leap towards deep sea fishing activities.

Secondly, the existing fishing grounds may not be suitable for modern technology given its limited carrying capacity, degradation of resources due to exogenous factors[3] such as pollution of waters due to intrusion of urban wastes, restriction of spawning movements of specific fish species due to building of dams and so on. Paradoxically, the focus of the policy makers and the individual fishers are however in favour of rapid expansion of technology in the sector. One may therefore question the rationale behind such a focus. No doubt, modern technology makes the fishing activity easier and efficient. But, whether output will respond positively to introduction and expansion of technology would depend on the availability of fish in the oceans and if the availability does not commensurate to the increase in technology the only outcome would be an increase in unequal redistribution of resources available.

So, the third issue we want to highlight in this context is that, the competition among modern and traditional sector over the same near-the-shore fishing grounds would eventually lead to an appropriation of larger share by the modern sector managed by fewer fishers and the large chunk of traditional fishers would get little fish.

The analysis of information collected from the three districts highlighted many concerns related to labour issues in the marine fisheries sector. Those include, level of inequality, indebtedness and wages.

Level of Inequality

In order to understand the level of inequality across districts as well as types of respondents associated with different technologies, we observed the Gini coefficients[4] for the level of equality in the distribution of income, value of asset holding and value of holding of productive assets. The Gini coefficients obtained through GRETL[5] software is presented in Table 10, 11 and 12.

[3] These factors are exogenous only to the marine fishing sector.

[4] Gini Coefficient is a widely used measure of inequality that satisfies all the four principles of inequality measurement such as anonymity principle, population principle, relative income principle and Dalton principle. For more details, please see Ray Debraj (2010) "Development Economics", Oxford University Press, pp. 175-189.

[5] Gnu Regression, Econometrics and Time-series Library (GRETL) is a Free Open Source Statistical Package

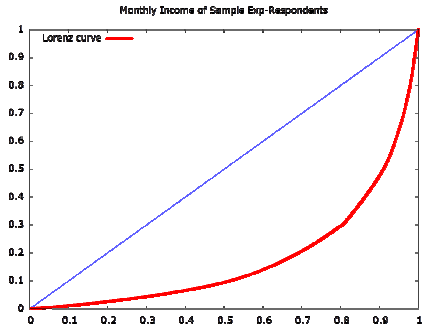
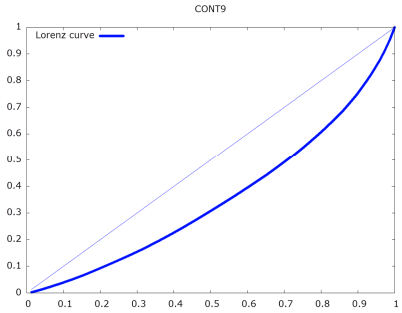
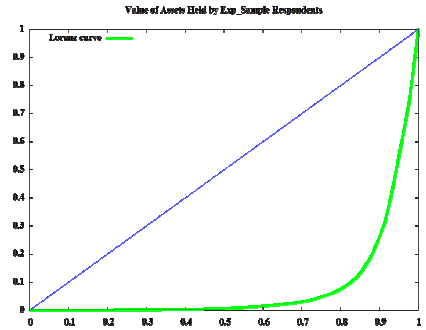
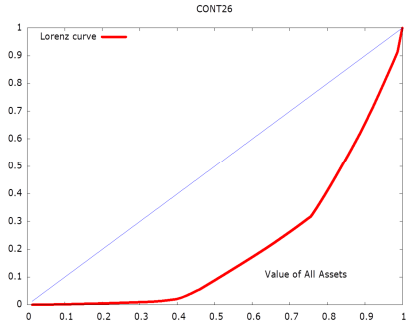
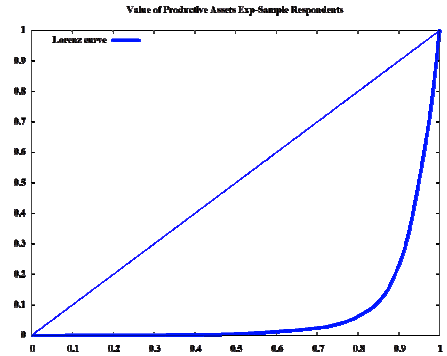
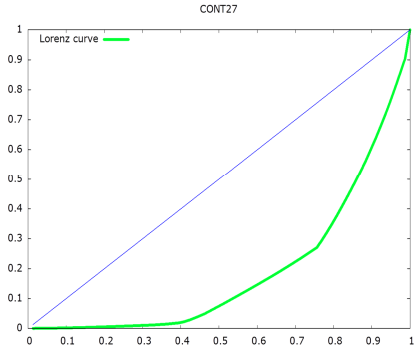
Monthly Income (Exp-Sample)	Monthly Income (Controlled Sample)
	
Value of Assets Held (Exp-Sample)	Value of Assets Held (Controlled Sample)
	
Value of Productive Assets Held (Exp-Sample)	Value of Productive Assets Held (Controlled Sample)
	

Figure-3: Inequality (Lorenz) Curves displaying level of inequality in the distribution of monthly income and holding of assets among Experimental Sample and Controlled Sample Respondents.

Source: Based on the information from the field

These tables show that the level of inequality is lower for controlled sample groups associated with agriculture as their primary source of income and livelihoods. While the value of Gini coefficient in terms of distribution of all assets was 0.584 for our controlled sample respondents, the same was as high as 0.84 in case of respondents among the fisher groups. As far as distribution of monthly income is concerned, the controlled samples show a Gini coefficient of only 0.292 compared to 0.64 in case of respondents associated with marine fishing. The panels presented in Figure 3 give a comparative picture of such differences through Lorenz curves drawn in GRETL. A further discussion over the

issues and possible explanations on the level of inequality in our study area is presented in the subsequent paragraphs.

the asset-less workers in the modern sector, the level of inequality is higher than their traditional counterparts. This may be because of the fact that in

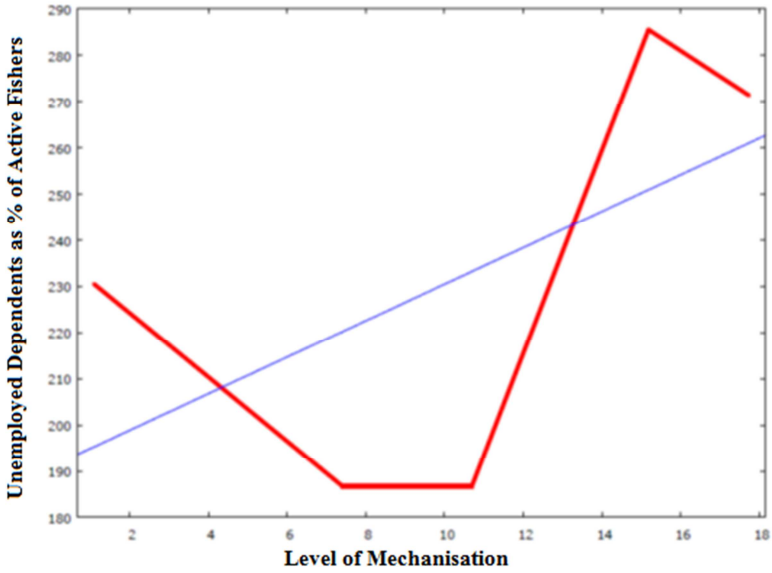


Figure 4: Level of Mechanisation and Unemployment in the Marine Fishery Sector in Odisha
Source: FAO Fisheries Statics

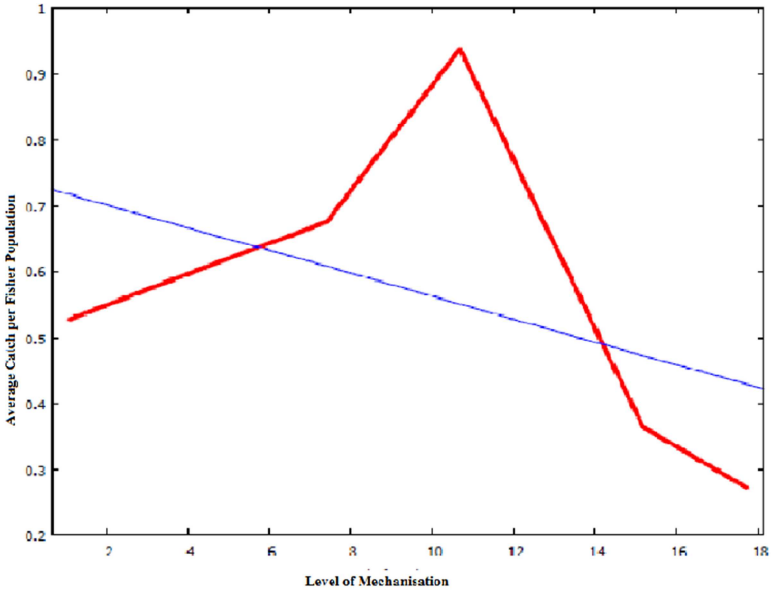


Figure-5: Level of Mechanisation and Returns to Fisher Population
Source: FAO Fisheries Statics

In terms of monthly income (Table-10), the community of traditional fishers with or without assets are having a generally equitable level of distribution. The highest level of inequality is found among the fishers in the modern sector. Even among

the modern sector, the level of income may depend on the use of capacity of the sector and since there are significant variations in the use of capacity in the modern sector, the impact might have been reflected in the monthly flow of income as well. As far as the

holding of assets is concerned, both for the distribution of productive assets as well as total assets the level of inequality is lesser for asset holding modern trawl owners and traditional fishers with assets. It is possible that due to promotion of modernization by the authorities, and due to imitation of the peers, the assets held by people in these categories are similar in value. Therefore, such reversal in trend to what we had observed in case of flow of monthly income may reinforce our earlier understanding that while the value of assets are varying within a smaller range, the level of production, and thereby income, by these assets (especially those in the modern sector) may depend on the ability of the assets to utilize their capacity. Since in the traditional sector the excess capacity is less, the flow of income varies less frequently. The opposite might have happened in case of modern trawl owners.

One interesting point to note here is that the level of inequality as expressed through Gini coefficients is less in terms of monthly income earned compared to holding of assets, indicating a fairer distribution of income flows compared to the assets held. This may signify that the structure of asset holding has a limited power to dictate the terms of income distribution in our study area.

Inferences drawn from the field adequately suggests that the entry of big business into the fishing trade has deprived the traditional fishing community in the study area and resulted in large-scale unemployment and wage-loss among the coastal poor dependant on fishing. The traditional fisher folks have been marginalised in their competition to get a share of the total catch. As seen from figure-4 the level of mechanisation (as represented by the ratio of mechanised crafts to non-mechanised crafts), has gone up from 1.09 per cent in 1980 to more than 17 per cent in the year 2005. This had initially led to an increase in employment as the proportion of unemployed members of the fishers in total active fishers[6] had gone down from 230.6 per cent in 1980

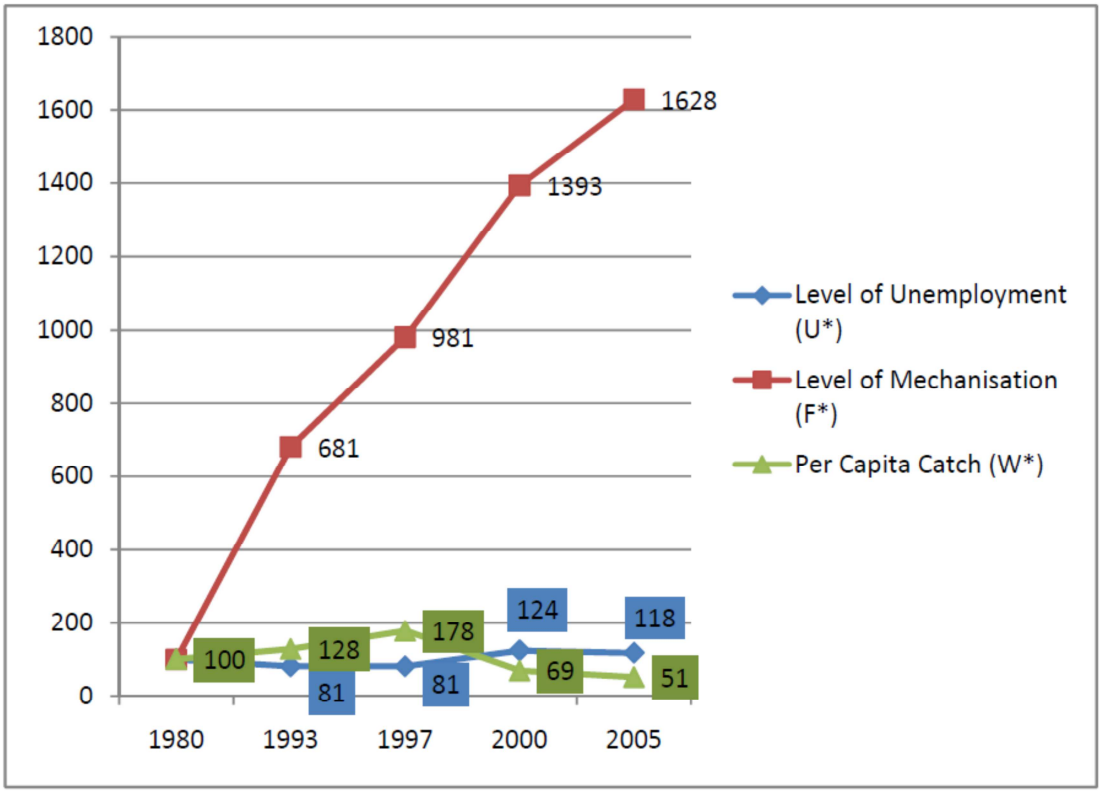


Figure-6: Trend of Growth in the Index of Mechanisation, Unemployment and Per Capita Catch in Odisha (1980-2005)

Source: : Indices constructed by researcher on the basis of information from FAO and other sources

[6] Inactive members of the fisher community as percentage of active members

to 186.6 per cent in 1996-97. However, with further increase in mechanisation, the trend reversed and the ratio increased rather sharply to 285 per cent in the year 2000. In the recent years, there has been a decline in unemployment which might be as a result of diversification of production from capture to coastal aquaculture. Figure 5 exhibits this phenomenon quite sharply.

With the increase in mechanisation in the post 1980 period, there also was an increase in per capita catch per member of marine fishing community till 1996-97. In terms of numbers, the catch increased from around 0.53 tonnes in 1980 to almost a tonne in 1996-97. But after 1996-97, there has been a decline in the catch per fisher population. While in case of employment, there seems to be an increase after 2000, in case of per capita catch there is a consistent decline to 0.36 tonnes in the year 2000, which further declined to 0.26 tonnes in the year 2005. Figure4 and 5 show these trends of deterioration in terms of wage (per capita catch) and unemployment over these years. Again, the graphs show that the slope of the line of best fit is not zero indicating a relationship between level of mechanisation and deterioration of employment/wages.

In order to assess whether such deterioration has taken place more significantly in case of traditional fisher, we need to draw inferences from our field data. The conclusions we draw from our field data regarding this can be summarised as below.

In all the districts under study, the average monthly income and average value of assets of the modern trawl owners (MTO) was substantially higher than other sections of the fishing community. The monthly income of the MTO section in the three districts ranged above Rs. 27000 compared to that of the traditional fishers with assets (between Rs. 5000 and Rs. 6000), traditional fishers without assets (between Rs. 1200 and Rs 1400), labourers in modern sector (between Rs. 1700 and Rs. 2050) and the controlled sample (between Rs.2900 and Rs. 3700). Around 24 percent of the total fisher samples taken in our study were first generation fishers. But among the MTOs, around 63 percent and among the TFAs around 26 percent sample fishers were first generation fishers.

I. Conclusions

It may be concluded here that the growth in fish landing in Odisha's coasts may be on account of an effort to respond to the increased food and non-food demand for marine produce rather than technological expansion. There are evidences of labour displacement and marginalisation of traditional fishers in the wake of technological advancement of the marine fisheries sector in Odisha. While the technological growth of the sector has also coincided with the production growth, the level of capital use has little to do with the output in the sector. Evidences from the field suggested that the sector might have responded well to the increased infrastructure and extension services in the initial years of expansion, but with more and more entries in the sector with modern technology, the average catch per fisher as well as per craft has gone down, which is a serious issue indicating fragility of the sector for any further expansion. The unequal distribution of income and wealth among fishers associated with the modern sector also need some serious attention. Going by the fact that the entry of new fishers in the trade accentuated only after the shift of focus from a subsistence economic activity to an export promoting activity after 1991 (Figure- 9, 10 and 11), we may conclude that even in the event of an overall wage loss (as indicated from the analysis presented in earlier paragraphs of this section), a majority of the share of the produce has been appropriated by the fishers in the modern sector that has been able to portray the sector as a lucrative area for new investors. As our analysis of the field data suggests, the average income of the first generation fishers in all the sections is more than the fishers who are in occupation for generations; more so in case of MTOs From the regression analysis undertaken, it is evident that the wage in the marine fisheries sector is primarily a function of value of output. Since the value of output is also logical function of market knowledge and access, it is rational to presume that the fishers with better exposure are able to exploit market in a better manner. Such capacity may be presumably higher in case of modern sector fishers.

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Tables Used:

Table-1: A Comparison of Growth of Marine Fisheries in Odisha and India

Items	**Odisha**		**India**	
	1980	2005	1980	2005
Number of active fishermen in marine sector	30724	121282	437899	889528
Total Mechanised Boats and crafts	106	8296	9289	134502
Total Non-Mechanised Boats and crafts	9728	15444	134741	104270
Fisher Families	20329	88352	333038	755212

Source: National Fisheries Census 2005

Table-2: Scope of Marine Fisheries as a Source of Livelihoods in Odisha and India

Activities	**Odisha**	**India**	**Composition in Odisha**	**Composition at National level**
Active Fishers	121282	889528	26.9	25.3
Fish Marketing	31691	207362	7.0	5.9
Making/Repairing net and other related activities	52046	218082	11.6	6.2
Curing/Processing and peeling	31016	110285	6.9	3.1
Labourers in fishery sector	37781	220662	8.4	6.3
Dependent Population	176576	1873197	39.2	53.2
Total Fisher Population	450392	3519116	100.0	100.0

Source: National Marine Fishery Census 2005

Table-3: Composition of sample as per type of respondents

	Sample Number	**Rel. Frequency**	**cum. Frequency**
Modern Trawl Owner	35	11.33%	11.33%
Labourer in modern Sector	51	16.50%	27.83%
Traditional Fisher with Assets	68	22.01%	49.84%
Traditional Fisher without Assets	61	19.74%	69.58%
Practising Coastal Aquaculture	16	5.18%	74.76%
Controlled Sample	78	25.24%	100.00%

Source: Primary Information from field

Table-4: Proportion of First Generation Fishers among different types of Respondents

Type of Respondents	Number of Sample Respondents	Percentage of First generation Fishers	% of First Generation Fishers
MTO	46	29	63.0
LMS	56	7	12.5
TFA	68	17	25.0
TWFA	61	3	4.9
Total	231	56	24.2

Source: Field Survey

Table-5: Income and Assets of First generation Fisher-folk Respondents

Generation	Average Monthly Income	Average Value of total Assets	Average Value of Productive Assets	Average Borrowings	Productive Assets as % of Total Assets
First Generation LMS	1954	23756	6848	33414	28.8
Other LMS	1789	26685	5838	55732	21.9
First Generation MTO	30391	4079919	2032267	528843	49.8
Other MTO	24948	3930955	1929759	597728	49.1
First Generation TFA	6436	309066	101248	233779	32.8
Other TFA	5121	160453	49200	185829	30.7
First Generation TFWA	1798	11266	4190	19725	37.2
Other TFWA	1319	10308	1968	40181	19.1

Source: Field Survey

Table-6: Decline in Average Fish Caught per Fisher and Per Craft

Year	Total Marine Capture (in '000 Mts)	Fish caught per fisher population (in MT)	Fish caught per Active Fisher (in MT)	Fish caught per Fishing Craft (in MT)
1984	53.581	0.53	1.78	6.84
1993	103.925	0.68	1.94	6.58
1997	156.081	0.94	2.69	11.81
2000	121.086	0.36	1.40	9.82
2005	122.214	0.27	1.01	5.15

Source: Directorate of Fisheries, CMFRI and Marine Fisheries Census 2005

Table-7: Growth in the Number of Active Fishers Operating Per Craft in Odisha

Year	Marine Fisher Population (in 1000)	Active Fisher Population (in 1000)	Number of Fishing Craft	Number of fisher population depending on Active Fishers	Number of Active fishers operating per craft
1984	101.559	30.05	7.829	3.4	3.8
1993	153.759	53.646	15.789	2.9	3.4
1997	166.433	58.069	13.214	2.9	4.4
2000	332.772	86.312	12.326	3.9	7.0
2005	450.391	121.28	23.74	3.7	5.1

Source: Directorate of Fisheries, Odisha and CMFRI, Marine Fisheries Census 2005

Table-8: Factors Affecting Marine Fish Production in India: OLS, using observations 1961-2006 (T = 46) (Dependent variable: Marine Production in India)

	B	Standardised Beta	Std. Error	t-ratio	p-value	
Const	-22505.6	.00	17176.6	-1.3102	0.19740	
GFCF	-26.689	-.04	5.04977	-5.2852	<0.00001	***
DEMt1	1.03172	.86	0.0161124	64.0329	<0.00001	***
DEMt2	0.861539	.09	0.0780429	11.0393	<0.00001	***
EXPQ	0.941847	.10	0.107727	8.7429	<0.00001	***

Mean dependent var	3285924	S.D. dependent var	1755744
Sum squared resid	3.26e+10	S.E. of regression	28213.30
R-squared	0.999765	Adjusted R-squared	0.999742
F(4, 41)	43557.70	P-value(F)	8.90e-74
Log-likelihood	-534.0118	Akaike criterion	1078.024
Schwarz criterion	1087.167	Hannan-Quinn	1081.449
Rho	0.475637	Durbin-Watson	1.047963

Note: *** indicate 99 percent confidence interval

Table 9: Factors Affecting Marine Fish Production in India: OLS, using observations OLS, using observations 1961-2006 (T = 46) Dummy= 1 after 1986 (Dependent variable: Marine Production in India)

	B	Standardised Beta	Std. Error	t-ratio	p-value	
Const	-37960.3	.00	28904.4	-1.3133	0.19739	
EXPQ	0.935913	.10	0.539845	1.7337	0.09153	*
DEMt1	1.00123	.83	0.0484924	20.6472	<0.00001	***
DEMt2	1.05591	.10	0.240148	4.3969	0.00009	***
GFCF	66.5611	.09	79.4819	0.8374	0.40787	
DUMMY	123342	.04	66926.5	1.8429	0.07358	*
D_EXPQ	0.174231	-.02	0.557996	0.3122	0.75666	
D_DEMT1	-0.0131873	-.03	0.0580152	-0.2273	0.82147	
DDEMT_2	-0.192058	.02	0.259162	-0.7411	0.46346	
D_GFCF	-88.9368	-.13	79.7205	-1.1156	0.27198	

Mean dependent var	3285924	S.D. dependent var	1755744
Sum squared resid	2.84e+10	S.E. of regression	28063.36
R-squared	0.999796	Adjusted R-squared	0.999745
F(9, 36)	19567.00	P-value(F)	1.24e-63
Log-likelihood	-530.7755	Akaike criterion	1081.551
Schwarz criterion	1099.837	Hannan-Quinn	1088.401
Rho	0.476591	Durbin-Watson	1.045765

Notes: * 90% confidence interval, ** 95% confidence interval, *** 99% confidence interval

Source: Data based on FAO Fishstat Database

Table 10: Level of inequality (Gini Coefficient) across Sample and Controlled respondents in the study area

Controlled Sample		**Exp- Sample**	
Value of All Assets	0.584	Value of All Assets	0.840
Value of Productive Assets	0.621	Value of Productive Assets	0.854
Monthly Income	0.292	Monthly Income	0.645

Source: Field Survey

Table-11: District Wise Level of Inequality in the Distribution of Income and Assets in the Study Area

Monthly Income Per Household	**Gini Coefficient**
Bhadrak	0.632473
Ganjam	0.608006
Puri	0.585232
Value of All Assets	
Bhadrak	0.799259
Ganjam	0.788554
Puri	0.779749
Value of Productive Assets	
Bhadrak	0.817911
Ganjam	0.807262
Puri	0.798509

Source: Field Survey

Table 12: Respondent type wise level of inequality in Income, Total Assets and Productive Assets

Monthly Income Per Household	**Gini Coefficient**
Controlled	0.292
Labourers in Modern Sector	0.221
Modern Trawl Owners	0.351
Traditional Fishers With Assets	0.169
Traditional Fishers Without Assets	0.156
Value of All Assets	
Controlled	0.584
Labourers in Modern Sector	0.540
Modern Trawl Owners	0.391
Traditional Fishers With Assets	0.424
Traditional Fishers Without Assets	0.605
Value of Productive Assets	
Controlled	0.621
Labourers in Modern Sector	0.576
Modern Trawl Owners	0.432
Traditional Fishers With Assets	0.455
Traditional Fishers Without Assets	0.629

Source: Field Survey