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Nile Perch Export and Welfare around Lake Victoria

Has the boom in exports been positive for welfare?

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Abstract

Alarming voices claim that the increased revenues from the Nile Perch industry in Lake Victoria fail to benefit the local population. This paper aims to investigate the evolution of welfare and income inequality alongside the expansion of the Nile Perch export industry in the regions of Mwanza and Mara, Tanzania, during the past 20 years. We find evidence of a decreased poverty and convergence between rural and urban areas in the regions. However our results also indicate increased income inequality with the fishing villages being especially poor compared to the region. Hence the revenues from the increased exports seem to have benefitted the Lake Victoria region as a whole but failed to benefit the people directly involved in the fishing industry. The unequal distribution of income between different actors is less apparent in the case of the Nile Perch sector as opposed to other fish sectors. This fact suggests that the prevailing poverty in the fishing communities is not mainly caused by the exports but rather due to an unequal organization of the fish industry in general.

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TABLE OF CONTENTS

ABSTRACT 1

ACKNOWLEDGEMENTS 2

I. INTRODUCTION 3

II. THE EVOLUTION OF LAKE VICTORIA FISHERIES 5

III. HOW TO MEASURE WELFARE AND INCOME DISTRIBUTION 8

Different measurements of welfare 8

Income inequality 9

IV. EMPIRICAL APPROACH 11

Data 11

Measures 13

V. RESULTS 16

Evaluating welfare 16

Income Inequality 18

The distribution of income in Igombe-Kayenze 20

VI. DISCUSSION AND CONCLUSIONS 24

APPENDIX 27

REFERENCES 28

I. Introduction

For centuries fishermen have been practicing small scale fishing along the shores of Lake Victoria. However, in the last couple of decades something has happened; the small scale fishing has transformed into a major export industry. The export earnings have increased from a few tens of thousands US dollars in the 1980s to over a hundred million US dollars in 2003 with an ever increasing demand from developed countries as the main engine.

The incomes from the fish industry; harvests, processing and trade, have contributed to the Tanzanian GDP and brought in valuable foreign exchange (Onyango, 2007). However the economic progress is not specific to Lake Victorian region alone. In fact the Tanzanian GDP has close to doubled in growth rate over the last decade; from 4.1 percent in 1998 to 7.4 percent in 2008. The growth is a historically high for Tanzania and is comparable to the fastest growing economies in Sub-Saharan Africa (Research and Analysis Working Group, 2009).

The exports revenue from the fisheries and the strong growth performance of the Tanzanian economy in general should lead to a reduction in poverty in the region, under the assumption that these resources are able to trickle-down through the economy improving income also for the poorest population. Hence, in order for the trickle-down effect to work by improving welfare for the poor there must be some kind of redistributive effects in the society (Béné, 2008). Accordingly research has shown that countries succeeding in combining rapid growth and improved income equity have been the most successful in reducing poverty (Bigsten and Levin, 2000).

The question whether the increased revenues from the Nile Perch exports have reduced poverty in the Lake Victorian regions is yet an unclosed discussion among researchers. While some researchers point out that fish trade might help development because of an increased inflow of cash and positive externalities such as additional work opportunities, others advocate the opposite. Critics of the fish trade are prone to point out that few developing economies have yet been able to prosper from fish trade with developed countries. This is mainly due to poor terms of trade, low reinvestment rate, capital flight and the low degree of usage of local processing facilities (Allison et al., 2009).

The distribution of resources generated by the Lake Victorian fisheries is another recurrent subject discussed in the literature. Henson and Mitullah (2003) find empirical evidence suggesting a very unequal distribution of the Nile Perch supply chain. Only an estimated 16 percent of the export revenues go to the fishermen. However, people involved in the export supply chain have a higher income than people involved in the local market supply chain.

Some fishermen state that the export industry has improved incomes, although researchers claim that the revenues fail to benefit the locals in general since people around Lake Victoria are still undernourished and lack basic entitlements such as health care, education, transport and electricity (Jentoft et al., 2010). In fact some authors even claim that food insecurity and malnutrition is an increasing problem due to higher prices (Henson and Mitullah, 2003; Kirema-Mukasa and Reynolds, 1991; Abila, 2000). Other researchers point out that the increasing exports have reorganized the supply chain and led to fewer jobs available for local people (Abila and Jansen, 1997).

As to conclude, there are numerous inconclusive theories concerning the impact the increased Nile Perch export has had on local communities. However few studies have been able to identify the linkage and to quantify the impact in economic terms. This study aims to fill this gap in the literature by investigating how welfare and income distribution has changed in two of the three main regions involved in the Nile Perch export industry in Tanzania over the past two decades. Our analysis will focus on food share of total expenditure, the basic needs poverty line and current consumption as measures of welfare and the Lorenz curve and Gini coefficient as a measure of income inequality. Our aim is to investigate whether the resources gained from the fish export industry have affected the welfare and income distribution on both regional and local levels in the Mwanza and Mara regions in Tanzania.

In order to introduce the reader to some of the basic organization of the Lake Victorian fisheries a short background on this topic will follow. A third section will introduce some of the basic theories concerning welfare and income inequality, while our method is presented in section four. We proceed by analysing our results in section five and the discussion with concluding remarks will follow in section six.

II. The evolution of Lake Victoria fisheries

This section will provide a brief historic picture of the Lake Victoria fisheries; how the traditional fisheries were organized and how the sector has changed since the introduction of Nile Perch in Lake Victoria.

Until the mid-1970s there were exclusively small scale fishermen operating in Lake Victoria. The ownership was decentralized and the income from the fisheries was distributed fairly equally among the fishermen. The processing and trading were dominated by small scale operators in the local communities around the lake and a great majority of both the processors and traders were women. Some fish was sold fresh, others smoked or sun-dried on the beach and then sold on the local markets. Fish was likewise the main source of protein both for the fishermen and the people living in the communities along the shores of the lake.

Since the introduction of Nile Perch in the late 1950s the composition of the fish biomass in the lake has changed. From being a multi-species lake, there are now mainly three species: Nile Perch, a sardine-like fish locally called Dagaa and Tilapia. The transformation of the biomass comes from the fact that the Nile Perch is a predator, feeding on most of the other species in the lake.

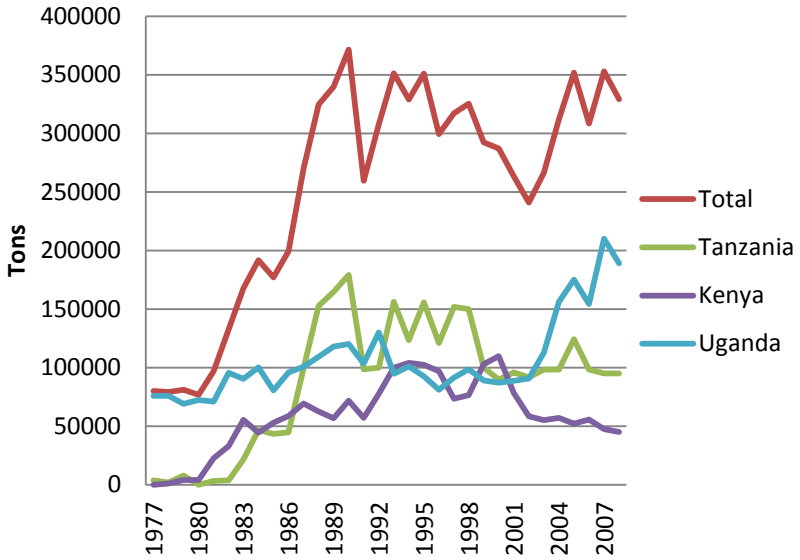
Initially, as a response to the increased landing of Nile Perch, more fishermen were employed to work on the lake, more boats were built and more women engaged in fish processing. During the 1980s many new fish consumers gained when large amount of fish from Lake Victoria were available at affordable prices (Jansen, 1997). Along with the rapid increase in the supply of Nile Perch came an increase in demand for the fish from developed countries; Europe, Japan, Middle East and the United States. This led to processing factories being established along the shore of Lake Victoria in Kenya, Uganda and Tanzania. The first Nile Perch factory in Tanzania was established in June 1992 (Bagumire, 2009).

The establishment of the factories along the shores of Lake Victoria changed the Nile Perch industry; from being directed towards local and regional markets, to focusing on international markets (Jansen, 1997). The establishment of the export industry around Lake Victoria also changed the composition of labour relations within the fisheries. From being a decentralized ownership, there are today many fishermen, especially in Nile Perch, who works as fishing crew

on boats owned by someone else. Boat owners in their turn often operate directly on the behalf of the fish processing factories and in some cases the fish processing factories own the boats themselves as to be sure to get the fish they need (Geheb et al., 2007). Other ways for the factories to obtain their supply of fish is by buying it directly from the fishermen at the landing sites or via agents who operate on the landing sites, either connected to the specific factory or independent. Further, the Nile Perch export industry has changed the processing of fish. The Nile Perch goes straight from the landing sites to the processing factories without any processing on the landing sites. Hence, many local small scale fish processors, mostly women, have lost their traditional jobs since there is no Nile Perch to process and trade (Abila and Jansen, 1997).

Figure 1 displayed below, shows how the catch of the Nile Perch in Lake Victoria has evolved from the end of 1970s in the three countries bordering Lake Victoria as well as the total catch. Over time the total catch of Nile Perch has increased substantially and from the 1990s the total catch per year has been stabilizing around 300 thousand tons, though with large declines in the figures in the early as well as late 1990s (FAO, 2010). The declines in catches in were probably due to the new EU regulations in the early 1990s and an EU ban on Nile Perch imports in 1997 and 1999 (Ponte, 2007).

Figure 1. Nile Perch catch in Lake Victoria



Source: FAO, 2010

Tanzania's Nile Perch export has steadily increased since the beginning of the 2000s, almost doubling in value from 2001 to 2008. In 2009, there were nine Nile Perch factories in Tanzania. The factories have an average production capacity of 50 tonnes of raw fish per day each, giving a total export value of US$ 174 million annually in 2008. Over 90 percent of the fish export from Tanzania is Nile Perch from Lake Victoria (Bagumire, 2009). Nile Perch was also the second most imported freshwater fish in the EU in 2010 (FAO Globefish, 2012a) and Tanzania was the biggest supplier of Nile Perch to the European markets, followed by Uganda and Kenya (FAO Globefish, 2012b).

III. How to measure welfare and income distribution

Although the Nile Perch exports have undoubtedly generated additional resources to the Tanzanian economy, the question of whether or not these resources has benefited the poor still remains. This section aims to clarify what characterizes welfare – how to define and measure it. Further, in order to be able to assess how the resources have been distributed among the people in the region, measures of income inequality will be presented.

Different measurements of welfare

In development economics the standard of living is often used as a measure of welfare. The standard of living is generally dependent on individual consumption of privately supplied goods. Current consumption is often the preferred indicator of welfare in applied work, whereas income is often only used as a proxy for consumption. A potential problem when comparing living standards across households is differences in household size and composition, leading to different household needs at the same level of total income (Ravallion, 1992). It is especially important when heterogeneous households must be dealt with for poverty and inequality purposes, and when comparisons are made over time. A solution to the problem is to use a tool which converts nominal incomes into a comparable measure of well-being. An equivalent scale can be seen as an index converting nominal incomes of heterogeneous households into comparable measures of welfare in order to make the households comparable in inequality and poverty analyses (Bellù and Liberati, 2005).

'Per adult equivalent' is an equivalent scale which measures the number of adult males which the household is considered to be equivalent to. A usual way of constructing this equivalent scale is to use observed consumption behaviour from household surveys; how aggregated household consumption of different goods vary with household size, composition, prices and income during the survey period. Most equivalent scales assign an adult male equivalent less than one to adult females and children, hence women and children are assumed to need less consumption to achieve the same level of well-being as adult males (Ravallion, 1992).

Consumption as the only indicator of well-being is often viewed as inappropriate and should be complemented by other measures (World Bank Institute, 2005). Hence, a suitable measure of

poverty should depend on both monetary and non-monetary indicators to capture the different aspect of welfare and poverty (Bourguignon and Chakravarty, 2003).

One non-monetary standard of living indicator is the share of consumption expenditure devoted to food. The theory behind this indicator is the Engel's Law; the budget share devoted to food tends to decrease with total real consumption expenditure (Ravallion, 1992). In developing countries, a household is considered poor if it is spending 60 percent or more of its total expenditure on food, and considered severely poor if spending 80 percent or more (Central Bureau of Statistic, 2008).

In order to obtain a percentage of the population in poverty, a poverty line can be used where a person is considered poor when having an income less than the given poverty line (Bourguignon and Chakravarty, 2003). A poverty line can be either relative or absolute and in developing countries an absolute poverty line is often preferred. The absolute poverty line is defined as some absolute standard which household should meet in order to obtain basic. One poverty line often used in assessing absolute poverty in developing countries is the basic needs poverty line. The basic needs poverty line defines the poverty line by an explicit bundle of foods typically consumed by the poor at local prices plus basic non-food goods (World Bank, 2011).

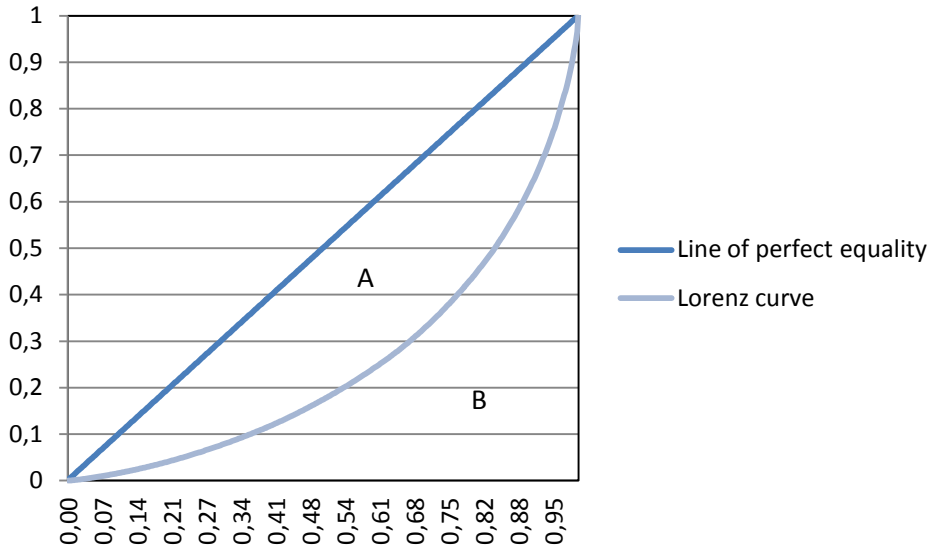
Income inequality

There are many different ways of measuring income inequality and the most widely used single measure is the Gini coefficient which is based on the Lorenz curve (Haughton and Khandker, 2009).

In order to construct the Lorenz curve, one needs all household incomes, or a representative sample, from the country or region of interest. The households are arranged from lowest to highest income, which enables calculation of a series of figures. The first step is then to calculate how large of a fraction of the total incomes in the country or region that is earned by the poorest first percent of households. The second step is to find the fraction of total incomes earned by the poorest second percent of households, and so on. The calculations are made for each fraction of households through 100 percent. Graphing these data gives the Lorenz curve, with the cumulative percentage of household income on the vertical axis and the cumulative percentage of household on the horizontal axis.

The Lorenz curve is displayed in figure 2 below, where the 45 degree line is the line of perfect equality. If the poorest 20 percent of households would receive 20 percent of total household income, the poorest 40 percent 40 percent of total household income, and so on, the income distribution would be perfectly equal and hence the Lorenz curve and the 45 degree line would coincide. The more bowed out the Lorenz curve is, the higher is the income inequality and hence the more unequal is the income distributed (Weil, 2009).

Figure 2. Lorenz curve



It is possible to compare income distributions between countries and the change in the distribution over time in a specific country with the help of the Lorenz curve. Though, the comparison is only possible when the Lorenz curves do not intersect (Persson and Skult, 2008). Therefore, when wanting to compare income distributions for different time periods or countries, the Gini coefficient is often the preferred measure.

From the Lorenz curve, the Gini coefficient can be calculated. The Gini coefficient is an index summarizing the income inequality with one single number, ranging from zero to one. By measuring the area between the Lorenz curve and the line of perfect equality (area A in figure 1), and dividing this area by the total area under the line of perfect equality (area A+B in figure 1), the Gini coefficient is obtained. A more unequal income distribution, provides a more bowed out

Lorenz curve, and hence a higher Gini coefficient. An income distribution that is perfectly equal will give a Gini coefficient of zero and a perfectly unequal distribution will give a Gini coefficient of one (Weil, 2009).

An alternative analytic approach of obtaining the Gini coefficient, which can be done without constructing the Lorenz curve, is shown below (Creedy, 1996).

$$Gini = 1 + \frac{1}{N} - \left(\frac{2}{N^2}\right) \sum_{i=1}^{N} (N + 1 - i)\left(\frac{y_i}{\bar{y}}\right) \qquad (1)$$

where

$N = \text{number of households}$

$y_i = \text{income of household i}$

$\bar{y} = \text{arithmetic mean income}$

and $y_1 < y_2 \ldots < y_N$

IV. Empirical Approach

In order to investigate how the welfare and income distribution have changed during the past two decades we will depart from the techniques discussed in the previous section. Hence the change in welfare will be evaluated by calculating the change in expenditure devoted to food, the current consumption and the ratio of the population below the basic needs poverty line. The changes in income distribution will be evaluated by calculating and comparing the change in the Lorenz curves and the Gini coefficients for the region. After summarizing how the welfare and income distribution have changed for the whole region we will investigate how income and welfare varies within a typical fishing community in the region. This approach will allow us to identify and differentiate the indirect regional effects of the Nile Perch export industry from the direct effects experienced by those directly engaged in the fisheries.

Data

In order to capture both local and regional effects of the fish industry we use three different samples. Two of the samples contain about 500 respondents each on regional level from 1993 and 2008 in order to capture the change in welfare and income distribution in the region. The third sample with 51 respondents from 2012 contains only people directly active within the

fisheries and will serve to describe how income and welfare varies within the fishing communities. This sample will occasionally also serve as a comparison to the regional sample of 2008 when discussing expenditures and poverty ratios. In this perspective the local survey from 2012 will be treated as a sub-sample of the regional survey in 2008 although there are disparities in time and, to a certain extent, survey design and sampling techniques.

Our approach raises the issue of how to compare the income and consumption between different surveys in an adequate way. Comparing survey results can be problematic due to changes in the questionnaires and sampling methods, as well as problem arising when adjusting for inflation. (Minot, 2007) The comparisons made in this paper have been made with these problems in mind, minimizing the possible sources of biased results mentioned above.

The local sample

The local sample contains 51 respondents from the fishing village Igombe-Kayenze in Mwanza region, Tanzania. Igombe-Kayenze is a typical fishing community 16 kilometres northwest of the city of Mwanza, and one of the six major and busiest landing sites in the region. Most of the processing factories in the region buy Nile Perch from the landing site in Igombe-Kayenze. The population of approximately 10 000 people are highly dependent on fishing and related activities. (The United Republic of Tanzania, 2002)

The sample was collected during mid-April 2012. Following advice from TAFIRI (Tanzania Fisheries Research Institute) the village Igombe-Kayenze was chosen since it is considered to be representative for fishing communities along the Tanzanian part of Lake Victoria. In order to minimize the problem while comparing different samples, the questions in the survey are based on the questionnaire from the 2008 survey. With the help of the Beach Management Units at the fish landing site in Igombe-Kayenze the respondents were chosen as to make the sample as representative as possible.

In order to capture all different aspects of fishing activities our sample is quite evenly distributed between the two main types sectors; Nile Perch and Dagaa. The sample contains people from the four main activities within fishing; fishing crew, processors, factory agents and boat owners.

The regional samples

The regional samples from 1993 and 2008 were collected from the regions of Mara and Mwanza, two out of three regions bordering Lake Victoria in Tanzania. The figures from 1993 originate from a survey made on a national level by the Population and Human Resources Division of the East Africa Department of World Bank and include 516 households in Mwanza and Mara region (HRDS, 1996). The sampling procedure was two-stage cluster sample, indicating that the village weights should be used in the final analysis. The sample from 2008 consists of 520 households from Mwanza and Mara and where executed as a collaboration between the University of Gothenburg and the University of Dar-es-Salaam. The survey was based on the questionnaire from 1993 in order to minimize errors due to context and method differences. The sampling method was proportionate probability sampling which implies that no further adjustments are needed for the analysis (Eggert et al., 2012).

Measures

The first measure of welfare used in the analysis is the proportion of expenditure devoted to food. This measure is constructed by dividing the food expenditure by the total expenditure.

$$Proportion\ of\ expenditure\ devoted\ to\ food = \frac{Expenditure\ on\ food}{Total\ expenditure}$$

For the datasets of 1993 and 2008 the proportion can be calculated by taking the amount of money spend on food divided by total expenditures. In the 2012 dataset a proxy for food consumption is used; household expenditures. The proxy is considered suitable due to indications in the fishing village that the main household expenditure is food; hence other household expenditures such as transport, telephone, health services and education are negligible costs.

Consumption is the second measure used while evaluating welfare. In order to be able to analyse the current consumption and to make comparisons over time, the expenditures for the 1993 and 2008 data sets are corrected for inflation (Mars 2012) using average consumer price index from IMF (EconStats, 2012).

One challenge with household expenditure data as a proxy for welfare is to be able to translate it into individual welfare. In order to compare the households, regardless of household size, the

annual total expenditure per household has been scaled using the adult equivalent scale. The equivalent scaled used is the calorie based equivalent scale developed by WHO (Dercon and Krishnan, 1998) in which individuals are divided into males and females, and into 13 age classes given a weight from 0.33 to 1.14, see appendix for age classes and weights.

The third measure of welfare is used in order to evaluate the percentage of people living in poverty in Mwanza and Mara. The basic needs poverty line per adult equivalent is obtained from the Household Budget Survey 2007 and corrected for inflation using IMF's average consumer price index (EconStats, 2012). The poverty lines need to be corrected for inflation since they are calculated for 1991/92 and 2007.

The significance of the changes in food-expenditure ratio, current consumption and fraction below the basic needs poverty line will be estimated using the Welch's t-test approach. This test is an adaptation of the conventional student's t-test suitable when using two separate samples, with possibly unequal variances (Welch, 1947). We obtained the test statistics for this test using the 'two sample t-test with unequal variance' command in Stata software.

The measures used in order to evaluate income distribution are the Lorenz curves and the Gini coefficients. The Lorenz curves for Mwanza and Mara in 1993 and 2008 have been constructed as described in the theory part of the paper, and graphed with the help of Microsoft Office Excel. The Gini coefficient has been calculated both by hand with the help of equation (1) as well as by using Stata software in order to obtain the integral under the Lorenz curve. These two methods are used assure that the calculations are made correctly.

In order to test whether the difference in the estimated Gini coefficients is significant we have set up the following hypothesis test:

H_0: *The difference between the estimated Gini coefficients is equal to zero*

H_1: *The null hypothesis is not true*

The test statistics used is purposed by Davidson (2009):

$$\tau = \left(\frac{\widehat{Gini_{2008}} - \widehat{Gini_{1993}}}{\widehat{\sigma^2_{Gini2008}} + \widehat{\sigma^2_{Gini1993}}}\right)$$

where $\widehat{\sigma_{Gini2008}}$ and $\widehat{\sigma_{Gini1993}}$ are the estimated standard error for the Gini coefficients from 2008 and 1993 respectively. The standard errors are obtained with the help of the Distributive Analysis Stata Package in Stata software (Abdelkrim and Duclos, 2007). The chosen level of significance is 5 percent. The null hypothesis is rejected and the alternative hypothesis accepted if

$\tau \leq t_{(\alpha/2,\ N-2)} or\ if\ \tau \geq t_{(1-\alpha/2,\ N-2)}$ hence if

$\tau \leq t_{(0.025,\infty)} = -1.960\ or\ if\ \tau \geq t_{(0.975,\infty)} = 1.960$ (Hill et al., 2008).

If we can reject the null hypothesis we can conclude that the change in the estimated Gini coefficients for 1993 and 2008 is significant.

V. Results

Our results are summarized in three main parts. In the first part we evaluate the change in welfare using the three measurements discussed in the method; share of expenditure devoted to food, current consumption and basic need poverty line. We continue our analysis by looking at the change in income inequality in Mwanza and Mara by studying the Lorenz curve and Gini coefficient. Finally, we investigate how income and welfare are distributed within the fisheries of Igombe-Kayenze by regression analysis.

Evaluating welfare

The share of expenditure devoted to food can be used as an indication of welfare as mentioned in the theory section. Table 1 below depicts changes in the percentage share devoted to food out of total expenditure in urban and rural regions in Mara and Mwanza and in Igombe-Kayenze.

Table 1. Percentage share of expenditure devoted to food

	1993	2008	Δ (se)	p-value Δ	2012
Mwanza and Mara Rural	78.3	71.1	7.3 (1.3)	0.0000	-
Mwanza and Mara Urban	68.7	60.6	8.1 (1.6)	0.0000	-
Igombe-Kayenze	-	-	-	-	70.4

The results show that the average share of expenditure devoted to food dropped from 78.3 percent to 71.1 percent in the rural parts of Mara and Mwanza between 1993 and 2008. This decrease corresponding to 7.3 percentage points is a statistically significant drop in food share expenditure at a one percent level. The share of expenditure devoted to food also dropped in the urban parts of Mara and Mwanza by 8.1 percentage points; from 68.7 percent in 1993 to 60.6 percent in 2008. This decrease in food share is also statistically significant.

As to compare, the share of expenditure devoted to food in Igombe-Kayenze was 70.4 percent in 2012. Since this is only a marginal difference from other rural areas in the region there does not seem to be any big disparities when considering food share expenditure.

Focusing on the weekly expenditures per adult equivalent (inflation adjusted) the results presented in table 2 indicate statistically significant increases in consumption in both rural and

urban areas of Mara and Mwanza. Even though the increase is approximately four US dollars in both rural and urban parts the increase in the rural parts is larger, looking at percentage increase, suggesting that rural expenditure are converging towards urban levels.

Table 2. Weekly expenditure per adult equivalent in US dollars*

	1993	2008	Δ (se)	p-value Δ	2012
Mwanza and Mara Rural	9.6	13.4	3.8 (1.4)	0.0043	-
Mwanza and Mara Urban	16.2	20.2	4 (1.6)	0.0062	-
Igombe-Kayenze	-	-	-	-	9.4

*Adjusted for inflation and using May 2012 exchange rate US$ 1 = 1580 Tsh

The total expenditure suggests decreased poverty and a more equal distribution of income between rural and urban areas; however the expenditure in Igombe-Kayenze is strikingly low in comparison. The expenditure in Igombe-Kayenze today is slightly lower than the average expenditure in the rural areas 20 years ago. Thus, if the average rural areas of Mara and Mwanza have increased their expenditure, approaching to urban levels, Igombe-Kayenze seems to be lagging behind.

The percentage of the people living in poverty in Mwanza and Mara is shown in table 3 below. The results indicate that the share living below the basic needs poverty line has decreased at a statistically significant level in both urban and rural parts of Mwanza and Mara. In the rural areas it has decreased from 19.9 percent to 10.8 percent between 1993 and 2008. In the urban parts the share has dropped from 12.5 percent to 7.7 percent. The relative reduction of poverty has thus been most apparent in rural areas, which is in line with previous findings. The share of people living below the basic needs poverty line is relatively high for the sample of Igombe-Kayenze. With a share of 17.6 percent living below the basic needs poverty line it is comparable to average share in the rural areas 20 years ago.

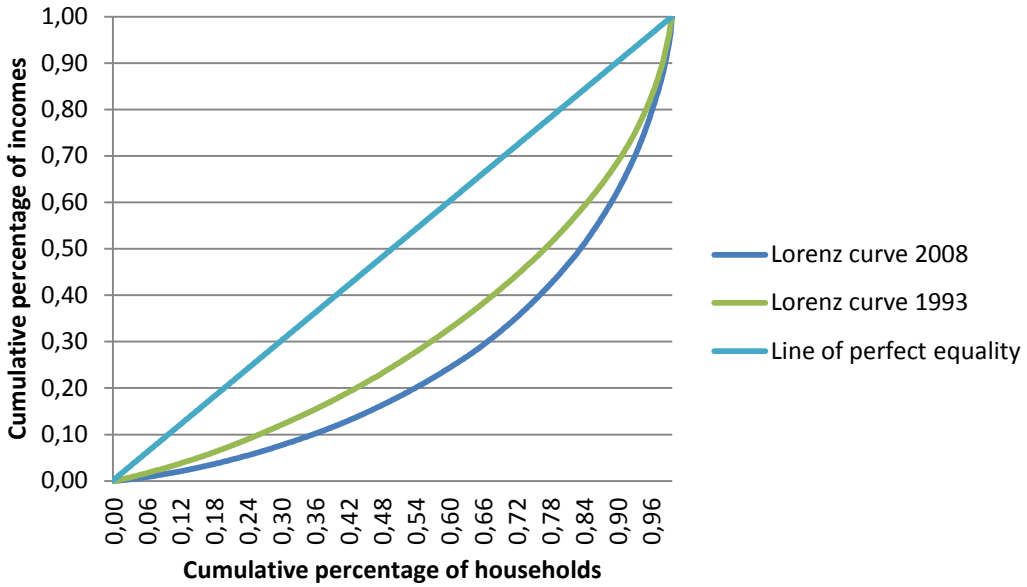
Table 3. Percentage share below basic needs poverty line

	1993	2008	Δ (se)	p-value Δ	2012
Mwanza and Mara Rural	19.9	10.8	- 9.1 (3.1)	0.0019	-
Mwanza and Mara Urban	12.5	7.7	- 4.8 (2.6)	0.0331	-
Igombe-Kayenze	-	-	-	-	17.6

Income Inequality

The Lorenz curves for Mwanza and Mara are displayed in figure 3 below. Since the two Lorenz curves do not intersect they are comparable and it is possible to investigate how the income inequality in Mwanza and Mara has changed over time with the help of the Lorenz curves. Since the Lorenz curve for 2008 lies outside the curve for 1993, we can conclude that the income inequality in Mwanza and Mara has increased for time period of interest.

Figure 3. Lorenz curve for Mwanza and Mara



With the help of the Gini coefficient we are able to investigate how large the increase in the income inequality in Mwanza and Mara has been. The estimated Gini coefficients for Mwanza and Mara are displayed in table 4 below and it has risen from 0.38 in 1993 to 0.50 in 2008.

Further, we want to test if this change in the estimated Gini coefficient is significant. Using the approach and hypotheses set up earlier in the paper, the calculated t-value is displayed below.

$$\tau = \left(\frac{0.4984875 - 0.377664}{0.0244585^2 + 0.0194551^2}\right) = 3.86604$$

The observed t-value is larger than the critical (3.87 > 1.96) and we can reject the null hypothesis and accept the alternative, hence the difference between the estimated Gini coefficients is not equal to zero. We can therefore conclude that the change in the estimated Gini coefficient is significant.

Further, we are also able to compare the income inequality in the Lake Victoria regions with the rest Tanzania with the help of the Gini coefficient. Comparing the Gini coefficient for Mwanza and Mara with the rest of the country it is clear that the Lake Victoria regions have a higher degree of income inequality than the rest of the country. In the beginning of the 1990s Mwanza and Mara had a Gini coefficient slightly higher than rest of the country, while almost 20 years later the difference is much larger. While Mwanza and Mara have seen a worsening of the income equality, it seems to have remained the same for the rest of Tanzania.

Table 4. Gini coefficient

	1993	2008	Δ (se)	Δ p-value
Mwanza and Mara	0.38	0.50	0.12 (0.031)	0.0001
Tanzania Rural	0.35*	0.35**	-	-
Tanzania Urban	0.33*	0.33**	-	-

* 1991/92 **2007, source**:** Household Budget Survey 2007

The distribution of income in Igombe-Kayenze

This section aims to investigate how income and welfare are distributed among different actors within the fisheries in Igombe-Kayenze using regression analysis. Table 5 below summarizes the main characteristics of our sample.

Table 5. Summary statistics of Igombe-Kayenze sample 2012

	Mean	St. Dev.
Size of household	6.8	4.3
Adult equivalent size of household	5.3	2.7
Age	36.4	7.6
Female	0.37	0.48
Dagaa	0.49	0.39
Work experience	11.2	7
Hours worked per week	66.6	17.6
Age coming to Mwanza	21.7	9.6
Primary	0.56	0.50
Secondary	0.37	0.48
Post-secondary	0.03	0.19
Crew	0.17	0.38
Processor	0.39	0.49
Agent	0.13	0.34
Owner	0.29	0.46
Income per week in Tsh	119 860	121 291

The sample is quite evenly distributed between the main activities; crew (17 percent), processors (39 percent), agents (13 percent) and boat owners (29 percent). People engaged in these different types of activities are either specialized in Dagaa (49 percent) or Nile Perch (51 percent). The average size of household is almost 7 people; however adjusting this number to an adult equivalent scale the mean is closer to 5. The average worker in this sample works about 66 hours per week and has on average about 11 years of work experience. Most of the workers in the sample are not originally from Mwanza region, and the mean age of entering Mwanza region is almost 22 years. Almost everyone in this sample have participated in either primary or secondary education and earn about 120 000 Tanzanian shillings per week (approximately75 US dollars).

In an attempt to determine with factors that influence income and welfare on a local level, we depart from the following models:

Model 1

$$LogIncome = \beta_0 + \beta_1 age + \beta_2 experience + \beta_3 hours\ week + \delta_1 female + \delta_2 secondary + \delta_3 dagaa + \delta_4 crew + \delta_4 processor + \delta_5 agent$$

Model 2

$$LogIncome = \beta_0 + \beta_1 age + \beta_2 experience + \beta_3 hours\ week + \delta_1 female + \delta_2 secondary + \delta_3 dagaa * crew + \delta_4 dagaa * processor + \delta_4 dagaa * owner + \delta_5 agent$$

Model 3

$$FoodShare = \beta_0 + \beta_1 age + \beta_2 experience + \beta_3 hours\ week + \delta_1 female + \delta_2 secondary + \delta_3 dagaa + \delta_4 crew + \delta_4 processor + \delta_5 age$$

The first two models have weekly income from main activity in logarithmic form (LogIncome) as dependant variable, while the third model have share of expenditure devoted to food (FoodShare) as dependent variable. The set of control variables in all three models are age, work experience (experience), hours worked per week (hours week), gender (female) and secondary schooling (secondary).

The first model includes dummy variables for sector (Dagaa) and for the four main activities, using boat owners as the reference group. This model aims to describe whether there are significant differences in income between different activities within the fisheries. By controlling for sector we are sure to exclude any sector specific influence.

The second model aims to describe if there are any differences in income within each main activity dependent on which sector you work in. Therefore we have included interaction dummies for crew in Dagaa, processors in Dagaa and boat owners in Dagaa. For example, the interaction dummy for crew workers in Dagaa will tell us whether crew workers in the Dagaa sector earn significantly more than the crew workers in Nile Perch.

The third model investigates if the share of expenditure devoted to food is significantly dependent on whether you work in Nile Perch or Dagaa and which type of activity you engage in. This model aims to investigate if the groups with the highest share of expenditure devoted to food are the same as those receiving the lowest income as predicted by Engel's law, if not we might suspect that there are alternative sources of food, such as payment in fish catch for example.

Table 6. OLS regression with logged income and expenditure devoted to food as depend variables

	Model 1: LogIncome	Model 2: LogIncome	Model 3: FoodShare
Age	0.04**	0.08***	0.0021
	(0.21)	(0.021)	(0.0041)
Work experience	-0.02	-0.03*	0.0003
	(0.02)	(0.021)	(0.004)
Hours worked per week	0.02***	0.007	-0.0012
	(0.008)	(0.008)	(0.0018)
Female	-0.68	-1.06***	0.045
	(0.68)	(0.39)	(0.10)
Secondary	-0.04	-0.12	-0.003
	(0.31)	(0.30)	(0.06)
Dagaa	0.62**	-	-0.13***
	(0.31)		(0.06)
Crew	-1.62***	-	0.14*
	(0.41)		(0.09)
Processor	-0.05	-	0.17*
	(0.69)		(0.12)
Owner	Ref.	-	Ref.
Agent	0.013	0.7*	0.16**
	(0.46)	(0.42)	(0.09)
Dagaa*crew	-	-1.8***	-
		(0.69)	
Dagaa*processor	-	1.52***	-
		(0.41)	
Dagaa*owner	-	-0.05	-
		(0.53)	
Cons.	8.53	9.22	0.62
	(1.03)	(0.98)	(0.21)
N	48	48	42
R-squared	0.48	0.49	0.29

Standard error in parentheses

***p < 0.05 **p < 0.10 * p < 0.20

The regression based on the first model tells us that income is positively dependent on age and hours worked per week, and also dependent on sector and to certain extents which activity you engage in. Workers in the Dagaa sector get about 86 percent[1] higher wages on average than those active in the Nile Perch sector, a difference significant at a 10 percent level. Moreover, one group that demarks itself as having an especially low wage is the crew members. The average boat owner earns about four times[2] as much as the average crew member, which is significant at a 5 percent level. There are however no statistically significant differences between boat owners, factory agents and processors income wise.

The results from the second regression implies that the income within each activity also depend on whether you work in the Nile Perch or Dagaa sector. Crew members active in Nile Perch earn significantly more than those in the Dagaa sector while the processors in Nile Perch earn less than those in the Dagaa sector. The first regression model suggests that crew members are the most marginalized group income wise. Hence, the higher income of crew members in the Nile Perch sector compared to the Dagaa sector indicates a more evenly distribution of income within the Nile Perch supply chain.

Looking at the determinants of food share expenditure in the third regression; the results indicate that the share is lower among those active in the Dagaa sector. This result is in line with Engel's law since workers in the Dagaa sector have a higher average income than those in the Nile Perch sector. However, even though crew members earn the least according to the first model they have approximately the same share of expenditure devoted to food as other groups. This indicates that the crew members receive payment in the form of catch which permits lower food expenditures.

[1] $(e^{0.62} - 1) * 100 \approx 86\ \%$
[2] $(e^{1.62} - 1) * 100 \approx 405\ \%$

VI. Discussion and conclusions

Over the past 20 years the Mwanza and Mara region on the shore of Lake Victoria has been characterized with the rapid expansion of Nile Perch export industry. The aim of this paper is to investigate how the export industry has affected the welfare and income distribution in the region as a whole as well as the local fishing communities.

Our results indicate that the overall welfare has increased in the region over the past two decades in both urban and rural areas. This conclusion is supported by three important findings; a significant reduction in the share of population living below basic needs, a significant decrease in the share of expenditure devoted to food and a significant increase in consumption. Moreover we find evidence of a convergence in the level of welfare between rural and urban areas in the region estimating changes in consumption and the share of population living below basic needs. Due to difficulties isolating the effect of the Nile Perch export industry from other factors which might affect development, we cannot be fully sure that the changes in the region are due to the export industry.

The rural areas in the region have made progress during the past two decades; however the current situation in the fishing community of Igombe-Kayenze seems bleak in comparison. The share of people living in poverty in Igombe-Kayenze and the current consumption is at the same level as the regional mean for rural areas 20 years ago. Hence the prevailing poverty in the region seems to be at its highest level in this fishing village, indicating that the revenues from the Nile Perch exports have failed to benefit those directly engaged in the fisheries.

The average share of expenditures devoted to food also dropped between the years 1993 and 2008 both in the urban and rural parts of Mwanza and Mara. Looking at this measure, the fishing village Igombe-Kayenze is close to the regional mean. The village has approximately the same share of expenditure devoted to food on average as other rural parts of the region.

The explanation behind the relatively low share of expenditure devoted to food in Igombe-Kayenze despite the relatively poor conditions might be due to the fisheries. Although crew members by far have the lowest income they have approximately the same share of expenditure devoted to food as other groups. This might indicate that the fishing crew receives payment in the form of catch which permits lower food expenditures. This result opposes the hypothesis

presented by some authors that the expanding export industry has created food insecurity problems for communities along the Lake Victorian shore.

When consulting the Gini coefficient it is apparent that income inequality in Mwanza and Mara increased dramatically between 1993 and 2008, while remaining constant for the rest of Tanzania. This may seem somewhat contradicting to the earlier results, indicating convergence between rural and urban areas. However, although income inequality seems to have decreased between urban and rural areas it might have risen within the rural and/or the urban areas leading to a higher inequality in the region as a whole. If previous inequality in income distribution were characterized by disparities between the rural and urban environment it might have been currently replaced by another underlying factor. Unfortunately due to the sample size we are not able to construct the Gini coefficients for the urban and rural parts separately.

The process of an ever increasing income inequality in the region combined with the extended poverty in the village of Igombe-Kayenze suggests that the revenues from the exports might have been concentrated to a small group in the region rather than to have improved conditions for the average worker within the fisheries. While suggesting that the fishing villages have become increasingly marginalized as compared to the rest of the region since the establishment of the Nile Perch export industry, it is however hard to tell whether it is the industry per se that is at the root of the problem. As a matter of fact the disparities in earnings within the fisheries are explained both by the type of activity and type of sector.

It is clear that the crew members are especially marginalized when it comes to earnings looking at the fisheries as a whole, and that this might explain some of the unequal distribution of the exports revenues. However crew members in the Dagaa sector, specialized in the local markets, are even more marginalized as compared to the rest of the supply chain. The relatively higher wage of crew members in the Nile Perch sector might indicate a more evenly distribution of incomes within the Nile Perch supply chain. Hence we suggest that the slightly more even income distribution within the Nile Perch sector might have occurred as the supply chain reorganized in response to increased exports. Consequently the unequal distribution of the ever increasing exports revenues for the Nile Perch seems to be associated with the organization of the fisheries in general.

As to conclude; the general impression is that the establishment and expansion of the Nile Perch export industry has benefitted the people living in the regions bordering Lake Victoria since poverty has declined and rural areas approaches urban levels of welfare. However in the fishing village of Igombe-Kayenze poverty remains high, indicating that those directly participating in the fisheries do not benefit from the exports to the same extent. The root of the problem seems to be large inequalities within the supply chain, not specific for the Nile Perch industry per se since it is equally apparent in other sectors.

Appendix

Table 7. Adult equivalent scale

Adult equivalent scale		
Years of age	Male	Female
0	0.33	0.33
1	0.46	0.46
2	0.54	0.54
3-4	0.62	0.62
6-8	0.74	0.7
9-10	0.84	0.72
11-12	0.88	0.78
13	0.96	0.84
14-15	1.06	0.86
16-17	1.14	0.86
18-29	1.04	0.8
30-60	1	0.82
60 plus	0.84	0.74

Source: Dercon, S., and P. Krishnan (1998)

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