Export Externalities and Food Security in Developing Countries

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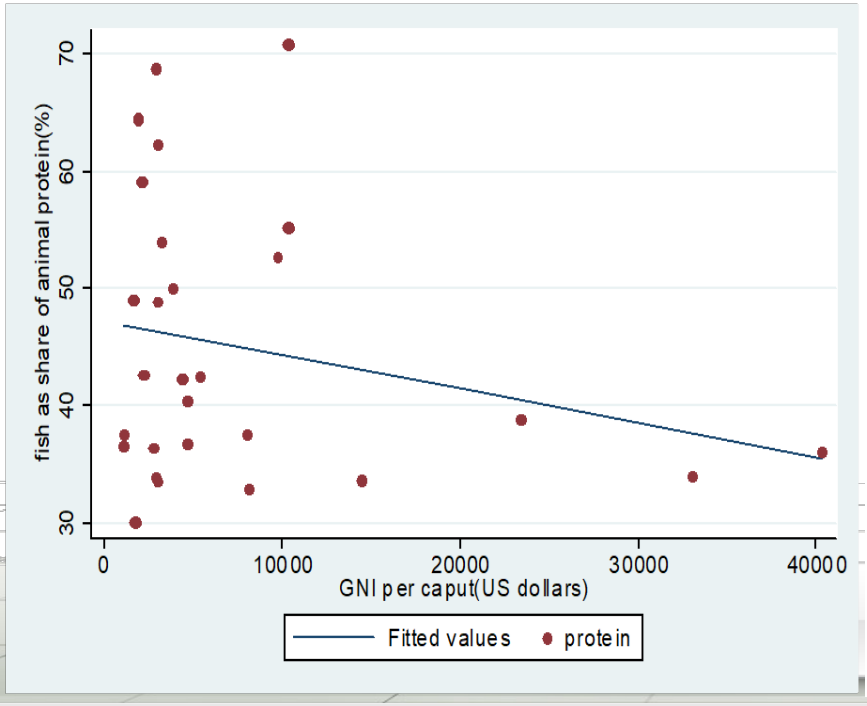
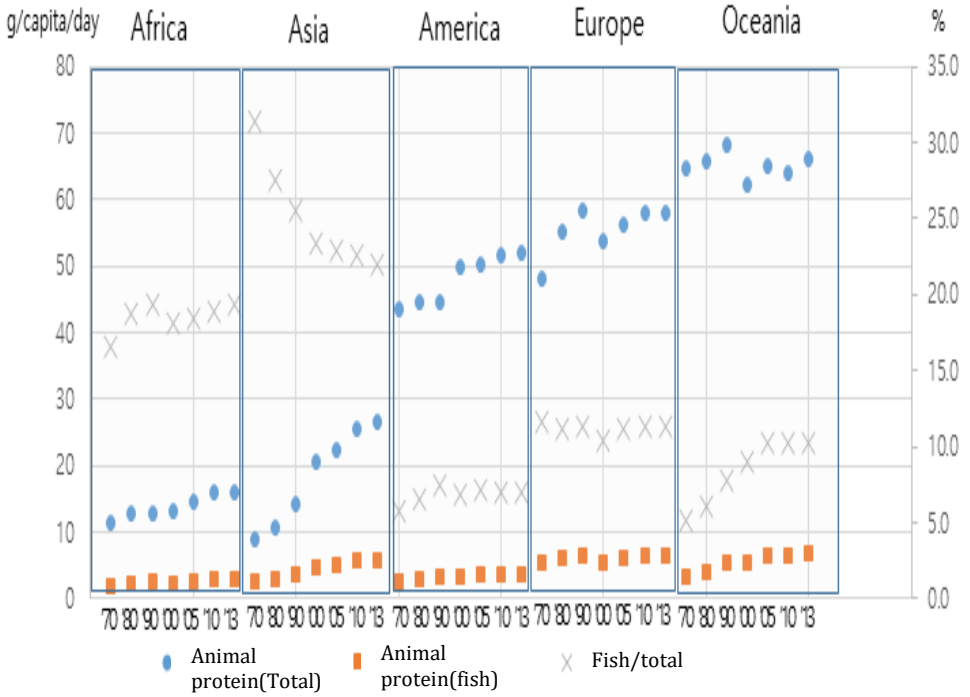
- The importance of fisheries

Fish has served as one of the major sources of animal protein for human beings

- Fisheries account for about 16.8% of the current global animal protein consumption(FAO)
- As of 2013, there are 28 countries where fish is responsible for more than 30% of total animal protein intake in the nation
- 21 out of them are low-income economies with GNI per capita of less than 10,000 dollars, lacking alternative sources of protein





Research Background

The most critical issue in the discourse on the relationship between fisheries and food security / How fish export affects food security?

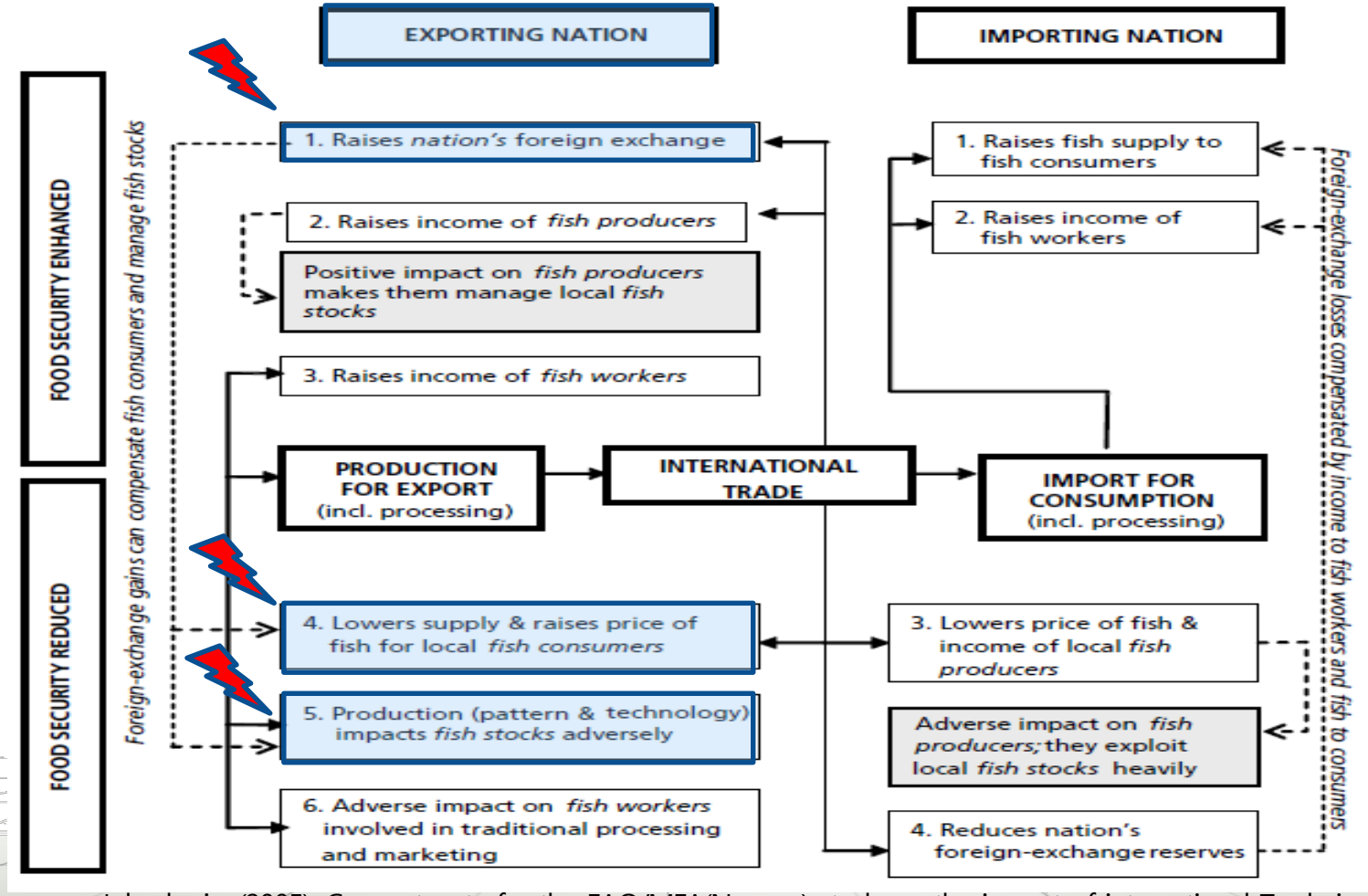
Exporting fish(renewable resources), over-fishing, a reduced food accessibility

- These studies basically point out the risk that trade liberalization of fisheries could damage food security in developing countries, and accordingly demand careful approaches to the issue which take into account the characteristics of fisheries industry

Exporting fish, economic growth(obtaining foreign currencies), importing foods at low costs

- These arguments are based on the export-led growth hypothesis which says that export increases productivity through specialization and helps reallocate domestic resources in efficient ways, eventually leading to economic growth

- The relationship between fisheries trade and food security



source: John kurien(2005), Concept note for the FAO/MFA(Norway) study on the impact of international Trade in Fishery products on Food Security (unpublished)

- Purpose of Study

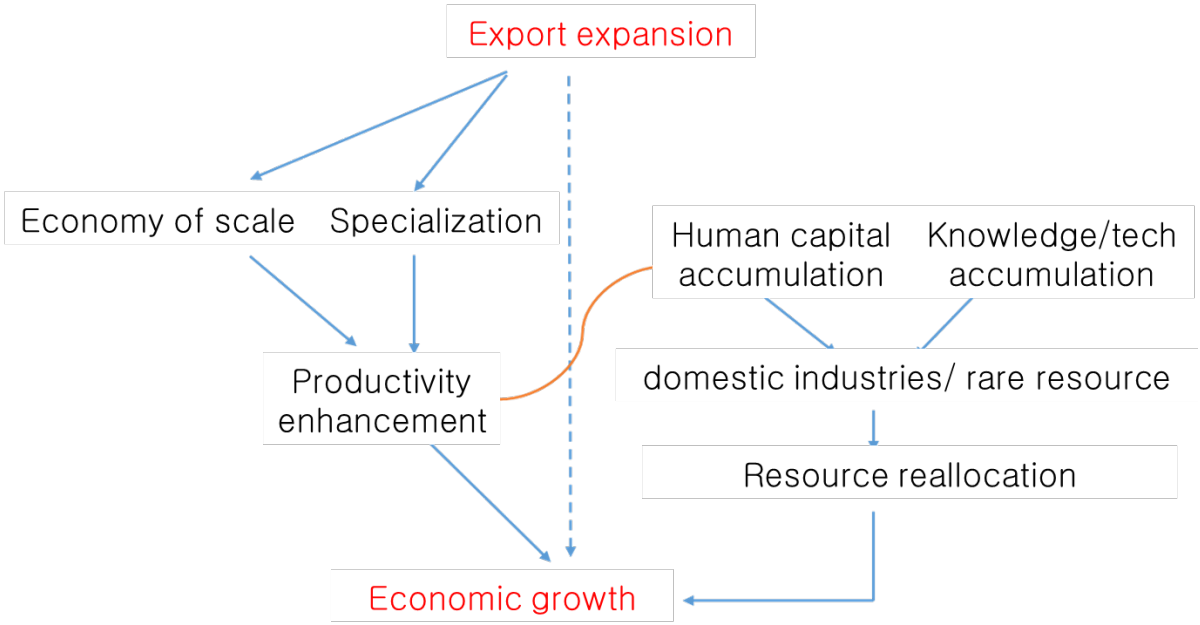
Positive effects of food security through fish export :

- The hypothesis holds only when a country's industry system exhibits positive export externalities

- Export externalities refer to positive effects of export which are not reflected in market prices, including increased efficiency, improved management skills with international competitiveness, introduction of enhanced production technologies, and high-quality labor training programs

This paper attempts to verify whether the increase of foreign exchange reserves coming from fish exports does lead to the growth of domestic industries, which is one of the most important ways that fisheries can positively affect food security in developing countries

- Export and economy growth



- export increases productivity through specialization, economy of scale and helps reallocate domestic resources in efficient ways, eventually leading to economic growth

- Views on food security of fish export

views	reasons	papers
Negative	decrease fish supply in local area decrease right to food of the poor unfair fishery agreement over fishing lower welfare	McRae(1978), Gordon(1954) Chichilnisky(1994), Kent(1997) Jansen(1997), Abila, R. O(1997) Brand and Tayler(1995, 1997, 1998) Emami and Johnston(2000) Kaczynski et. el(2001) Abgrall, J. F.(2003) Alder and Sumaila(2004) Kim Geheb(2008)
Positive	Raise nation's foreign exchange Raise income of fish producers Import low price food Redistribute wealth	Giles and Williams(2000) Cunningham(2000), Hannesson(2000) Valdimarsson and james (2001) Thorpe(2004), EU(2006), FAO(2007)

- **Brander and Taylor(1995)**, exporting fish, common goods by nature, can reduce utility levels in the steady state, thereby shrinking social welfare in the exporting country
- **Brander and Taylor(1997),** exporting fish from a country practicing no resource management to a country with strict resource management can reduce the level of welfare in the exporting party
- **Emami and Johnston(2000),** high fish prices will shrink consumption opportunities for consumers in the exporting country, ultimately reducing its consumer welfare
- **Geheb(2008),** a case study for Lake Victoria in Africa / Despite the overall increased incomes coming from Nile Perch export, the undernourishment of residents near Lake Victoria turned out to have worsened
- **Kaczynski et. el(2001),** West African nations which entered into fisheries agreements with the EU actually have been financially hurt due to the deals.
- **Kurien(2005)**, international fish trade can have both positive and negative impacts on low-income food-deficit countries(LIFDCs)

- **Bene(2008, 2016)** attempted a variety of analyses to find out how fisheries affect food security, but failed to produce statistically significant results based on quantitative methods
- **Bene(2008)** suspected that economic gains coming from fish export will help improve food security, but failed to find quantitative evidence supporting the prediction for the African countries included for the study
- Bene et. al(2016) says "it cannot be denied that fish helps improve food security in some ways, but also admits that the chain starting from fisheries(including aquaculture) all the way to poverty reduction is complicated and unclear."

- These studies show the limitations of fish export: fish export can improve food security when a given developing country has export externalities through which export improves resource allocation, thereby leading to a greater GDP, and the growth of export sector also help grow non-export sector
- But for a country without such externalities, fish export may not be so beneficial

- Selecting subject countries for study

This study uses Prevalence of Undernourishment, PoU in short, as a variable representing poverty in a given country

It started by considering the seventy two 'vulnerable countries' selected for study by Wieck et (2014)

- which consist of low and middle income countries with high or aggravated levels of PoU

And finally decided upon twenty seven countries for analysis on the basis of fish production and export records during the last decade.

The subject countries selected are

- 17 African countries including Benin, Chad, Democratic Republic of Congo, Gambia, Guinea, Kenya, Malawi, Mali, Mauritania, Mozambique, Rwanda, Sierra Leone, Swaziland, Uganda, Tanzania, Egypt and Morocco
- 5 Asian countries including Armenia, India, Bangladesh, Vietnam and Indonesia
- 5 Latin American countries including Bolivia, Guatemala, Honduras, Nicaragua and El Salvador.

- Estimating export externalities to see how fisheries affect food security

This study estimates export externalities for the 27 subject countries as a whole as well as for each individual country in the group

Many previous studies attempting to establish the impacts of fish export on food security have failed to produce statistically significant results

- the difficulty of obtaining reliable data from developing countries with food issues
- fish is not a staple food makes it difficult to directly solve food shortages through fish consumption, thereby making it hard to tell how fish affects food security

Fish can at least indirectly improve food security

- exporting fish will earn foreign money, which will lead to economic growth and higher incomes, thereby improving the quality of life for the poor

- Estimating export externalities to see how fisheries affect food security

This study aims to capture

- the indirect route through which fisheries can improve food security
- which requires an analysis of whether incomes earned through fish export do contribute to a better food security in significant ways

For most countries, however, fish export takes up only a very small proportions of their GDPs, and industrial environments vary considerably from country to country, making it extremely difficult to estimate externalities of fish export in a statistically significant way

To overcome the problem, this study uses Feder(1982)'s model

- which conceptualizes a national economy as consisting of export sectors and non-exports sector, and sets up a total production function incorporating externalities of exports sector into non-exports sector

- Estimating export externalities to see how fisheries affect food security

Through Feder(1982)'s model , the study tries to estimate whether exports sector can positively affect non-export sector

- If export sector turns out to have positive impacts on non-exports sector, it can be said that fish export can, through externalities, help reduce poverty and improve food security in the countries

$$N = F(L_N, K_N, X, t) \quad (1); \quad X = G(L_X, K_X, t) \quad (2)$$

- Domestic gross production Y(=N+X) can be divided into non-exports sector, denoted by N, and exports sector, X
- Formula (1) shows that non-exports sector (N) is a function of the amount of labor (L_N) and capital (K_N) used in non-exports sector, and export sector (X)
- Formula (2) shows that exports sector (X) is a function of the amount of labor (L_X) and capital (K_X) used in exports sector

- Estimating export externalities to see how fisheries affect food security

$$\frac{G_K}{F_K} = \frac{G_L}{F_L} = 1 + \delta(\delta \neq 0) \qquad (3)$$

- Formula (3) only considers cases where there is difference between exports and non-exports sector in marginal factor productivities of capital and labor
- In many cases, it is highly likely that marginal factor productivities will be higher in exports sector than in non-exports sector(Feder, 1982)
- In this case, the ratio of marginal factor productivity in export sector to that in non-exports sector is expected to be higher than 1, and δ will be positive with a value greater than zero
- For some countries, of course, the lack of exposure to international competition due to simple export structures can make the ratio less than one, and δ will turn out negative
- When export externalities do not exist, however, δ will be zero, which means marginal factor productivities of exports sector equal those of non-exports sector, and exports sector cannot have positive impacts on non-exports sector

- Estimating export externalities to see how fisheries affect food security

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \qquad (4)$$

$$\beta_0 \equiv \left(\frac{\partial N}{\partial t} + \frac{\partial X}{\partial t}\right)\frac{1}{Y} = \frac{\partial Y}{\partial t}\frac{1}{Y}$$

$$\beta_1 \equiv \frac{I}{Y}, \beta_2 \equiv \frac{\dot{L}}{L}, \beta_3 \equiv \left(\frac{\delta}{1+\delta} - \theta\right)\left(\frac{\dot{X}}{X}\frac{X}{Y}\right), \beta_4 \equiv \theta\left(\frac{\dot{X}}{X}\right)$$

- Formula (4) shows an estimation of export externalities
- economic growth rate (y) consists of the growth rate of total factor productivity
- β_0 : the growth rate of total factor productivity
- β_1 : the contribution to production of marginal capital increase
- β_2 : the contribution to production of marginal labor increase
- β_3 : export externalities
- β_4 : export growth

- Estimating export externalities to see how fisheries affect food security

How fisheries affect food security, represented by PoU, will be examined for each group

[Model to evaluate how fisheries affect food security(PoU)]

$$FS_{PoU} = [GDP1, FEX, \quad FW, LF, IS] \qquad (5)$$

- FS : Food security
- PoU : Prevalence of undernourishment
- GDP1 : GDP per capita($)
- FEX : the proportion fish export to GDP in agriculture, forestry and fisheries
- FW : the share of agriculture, forestry and fisheries in GDP
- LF : labor productivity in agriculture, forestry and fisheries
- SI : the proportion of staple food import (staple food import divided by total export)

This study uses countries panel data ranging from 2001 to 2013 using by FAO, WB data

Total number of observations are 378.

- Estimating export externalities to see how fisheries affect food security

  - **Prevalence of Undernourishment (PoU)**

  - the most utilized variable in food security literature, and it is used to represent the degree of access to food, a critical aspect of food security
  - it is a compound indicator constructed from various surveys on household consumption

    * daily habitual energy consumption or the minimum level of energy required(Wieck et al 2014)

  - appropriate for representing food security when considering the concept of access to food

  - **GDP per capita is important in terms of access to food**

  - Higher GDP per capita is expected to result in a better food security overall

  - **FEX**(The proportion of fish export to GDP produced in agriculture, forestry and fisheries)

  - a higher proportion of fish export means more foreign money earned, which can be used both for importing more staple foods at low costs and for introducing investment goods from abroad conducive to economic growth, eventually helping improve food security

- Estimating export externalities to see how fisheries affect food security

  - **FW**(The share of agriculture, forestry and fisheries in total GDP)

  - indicator of industrial development in a national economy
  - heavily dependent on primary industries will face more obstacles in their efforts for a better food security than countries with less reliance on primary industries will.

  - **SI**(The proportion of staple food import to total export)

  - foreign money gained from export can go to increasing staple food import, which will improve, at least in the short run, food security by raising domestic food availability
  - Nonetheless, if not followed by improved access to food, higher food availability can fail to solve food shortage issues faced by the underprivileged

  - LF(Labor productivity in agriculture, forestry and fisheries)

  - reflects the expectation that a higher labor productivity will lead to a better food security.

- Estimating export externalities to see how fisheries affect food security

- Hypothesis
  - For countries exhibiting positive export externalities, fish export can help improve food security because they have national systems through which export can drive non-export sector growth

- First step
  - A panel analysis will be carried out on the subject countries as a whole to estimate the degree of contribution to economic growth rate of factor input increase

- Second step
  - The same model from the first step will be used to estimate export externalities of individual subject countries through time series analyses for each subject country

- Third step
  - Divide the subject countries, based on the results of the previous steps, into a group with positive export externalities and the other group without them

- Result of estimating export externalities(First step)

Gross fixed capital formation

externality

$$\frac{Y}{Y} = \underset{(0.6842)}{1.53^{**}} + \underset{(0.0222)}{0.08^{***}}\left(\frac{I}{Y}\right) + \underset{(0.1721)}{0.51^{**}}\left(\frac{L}{L}\right) + \underset{(0.0005)}{0.002^{**}}\left(\frac{X}{X}\right)\left(\frac{X}{Y}\right) + \underset{(0.0192)}{0.04^{**}}\frac{X}{X} \quad (5)$$

GDP growth

Labor

Export growth

- The studied countries have relied more on labor inputs than on export and capital inputs for economic growth

- Result of estimating export externalities of individual subject countries through time series analyses for each(Second step)

- Countries with export externalities : 6 countries
  (Bangladesh, Benin, El Salvador, Guatemala, Guinea, Mauritania)

- Countries without export externalities : 21 countries

- Divide the subject countries into two groups and FE model analysis (third step)

<Table> Group-by-group FE model analysis based on externalities

dependent variable(FS_{PoU})	countries with externalities	countries without externalities
GDP per capita (GDP1)	-0.00218*	-0.00134**
the proportion of fish export(FEX)	-0.02609	0.439857***
the share of agriculture, forestry and fisheries(FW)	0.289253**	0.21313**
labor productivity in agriculture, forestry and fisheries(LF)	0.003172	-0.00148***
the proportion of staple food import(SI)	-33.5124***	9.338874**
constant	10.47468***	18.74931***
sigma_u	5.504406	9.723899
sigma_e	2.036077	3.094382
rho	0.879642	0.908045
R-sq	within = 0.4693 between = 0.8824 overall = 0.0062	within = 0.3389 between = 0.2264 overall = 0.2496

- The existence of export externalities, a main point of discussion in this paper, was used as a variable which represents conditions of a given country's national industrial system

- The concept of externalities provides a clearer understanding of the murky relationship between fisheries and food security

- Circumstances in which a given under-developed country find itself can determine the relative utility in reducing poverty (or more specifically undernourishment) of either exporting fish or preserving fish for domestic use

- This paper is about how fisheries can improve food security in developing countries, which requires selecting and utilizing variables that can fully represent fisheries sector. However, the paper was not able to construct and use fisheries-specific variables because most global data regarding food security is on agriculture.

THANK YOU

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