Impact of Fishery Regulatory Innovation on Income and Nutrition of Smallholder Households in Plateau State, Nigeria

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The issues of nutrition insecurity and deficiencies of micronutrients consumption among households of rural communities in developing countries is widespread and constitute serious public health problem. This study evaluated the nutrition impact of participants and non-participants of an innovation of government regulated (RENLAF) and unregulated (URENLAF) fisheries in Plateau State, Nigeria. We examine Profit index and nutrition security status of captured fisheries on data collected from observations made at Catch Assessment Survey (CAS) and a seven- day- food consumption recall. Also through questionnaire from 80 fishers' randomly selected at four lakes (URENLAF) and 30 other fishers purposively selected from regulated Pandam Lakes. RENLAF Participation has significantly positive effects: higher net farm income by N 187,431.28 per month, consumption levels increase by 26%, 79%, 31% and 46% for calorie, vitamin A, iron and zinc. Socioeconomic characteristics such as income, females involved in sales and fishing gears owned and educational status of main female were positive and significantly affects nutrition. Hippopotamus and high cost of gears constraints fishing and transformation for higher impacts required educated fishers, extension education, gear limit, and setting more RENLAF sites from the existing URENLAF sites by redefinition of property rights. Keywords: micronutrients, fishing, Nigeria, nutrition, income

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1. Introduction

In most developing countries smallholder farming is becoming commercialized, and agribusiness are increasingly affecting economic and social development. Also, issues of nutrition insecurity and deficiencies of micronutrients consumption among households of rural communities are widespread and constitute serious public health problem. Over 70% of Sub- Saharan African population lives in rural areas and draws its livelihoods mainly from smallholder production systems centered on agriculture, forestry and fisheries. Making then frequently compelled to exploit their surrounding for short-term survival, and make up the group most regularly exposed to natural resources degradation (WB, 2002). This deterioration is raising significant concern for Global captured fishery, mainly because an estimated one billion people, mostly in low-income countries, depend on fish as their primary sources of income, calorie, and micronutrients.

An estimated 25% of African's continent population are victims of Vitamin A deficiency (VAD). Iron deficiency anemia affects 2 billion people of the world population, but in developing countries it is frequently exacerbated by malaria and worm infections which is responsible for premature death, infectious and impaired physical and cognitive development. The three major nutrient deficiencies, Vitamin A, Iron and Zinc are accordingly, the array of afflictions ranging from stunted growth, reduced intelligence and cognitive abilities, reduced social ability, reduced leadership and assertiveness, reduced activity and energy, reduced muscle growth and strength and proper health are directly implicated (Encyclopedia, 2008).

The quality and diversity of food consumed will be enhanced by fishing household will therefore improve the consumption of basic energy and micro nutrients necessary for normal development. This therefore means that nutrition and health are basic needs and understanding their intended and unintended effect in the regulatory program is very important especially when the focus is on vulnerable members of the population. Agricultural technologies and related innovations are seen widely to contribute to sustainable food, reducing malnutrition and nutrition security (Godfray et al. 2010; Herforth et al. 2012). These include all forms of technical and institutional innovations/technologies that may cause positive nutrition and health effects, even if it is not their primary intention. Therefore, the need to encourage agricultural policies and programs to become "nutrition-sensitive" (BMGF 2012; USAID 2011), or more specifically, to make "agriculture work for nutrition" (FAO 2012).

The Plateau State Government in the last fourteen years (2004) adopted a captured fisheries management mechanism at Pandam Wildlife Park lakes – **close season, limited entry and mesh size limit**. The net income and nutrition impacts were compared with the other natural lakes in the state which are not regulated and managed as open access or as a common property. Therefore, government's regulated fishery (here forth referred to as regulated fishery-RENLAF) and non- government regulated fishery (here forth referred to as unregulated fishery-URENLAF) will be compared.

In this paper, we address this research gap and analyze the impacts of participation in natural resource management innovation (RENLAF) on fishing household nutrition, using detailed survey data specifically collected for this purpose. Our research will contribute to the literature in the following ways. *First*, we add a new perspective to the existing body of literature on captured fishery impacts which most analyses have considered only how people will be affected by the loss of protein derived from fish. *Second*, we contribute conceptually to the scare agriculture-nutrition linkages in captured fishery. Based on detailed food consumption data, we compare nutritional indicators between fishing household's participants and non-participants of regulated fishery. In addition to estimation of net farm income and calorie intakes, we analyze levels of micronutrient consumption as proxy of nutritional quality. We also addressed issues of selection bias with an instrumental variable. This is because the study uses observational data and the innovation was not randomly assigned as observed differences in outcome variables may be due to the RENLAF innovation, as well as other systematic differences between RENLAF and URENLAF fishing households.

2. **Captured fishery household survey**

Primary Data were employed and collected using a semi- structured questionnaire and focus group interview that was carefully designed and pretested as well as, a catch assessment logbook. The daily fishing observations of selected fishers were carried out through a Catch Assessment Survey (CAS) and the CAS were done to capture the lean months (June-September) and peak months (November-February) of URENLAF fishing in the study area, while the CAS for RENLAF fishing were conducted for two weeks each from third week of May to second week of November, 2015. We also carried out a 7-day recall survey on RENLAF fishers of Pandam Lakes and URENLAF sites, well-known unregulated fishing sites were purposively selected; Shimankar, Polmakat, Deben, and Janta natural Lakes. Total daily fishing observations of one thousand five hundred and forty in four weeks from one hundred and ten fishers were made (1540 observations: 4wks: 110 samples). In total, our data set comprises observations from 80 URENLAF and 30 RE NLAF households. These households were visited, and household heads along female responsible for cooking food were interviewed face to-face. The data collected include general household characteristics, details on captured fishing; daily catch weights, price, the type and numbers of gears and marketing, other farm and non-farm economic activities, food and non-food consumption, and others institutional variables.

3. Three impact pathways stress

We have assumption and hypothesize that nutrition impacts of RENLAF participation is mainly through three closely related pathways. The *first* pathway is through possible changes in household income. This is because higher incomes from more fish sales improve the economic access to food and this is expected to result in higher calorie consumption, especially for previously undernourished households who may now have more fish to sale and purchase other foodstuff. Furthermore, higher incomes may contribute to better dietary quality and higher demand for more nutritious foods, such as vegetables, fruits, and animal products (Babatunde and Qaim, 2010). As such increase in the demand would also result in improved micronutrient consumption. The *second* pathway may be through altered production choices at the farm level and thus changes in the availability of fish on commercial scale. There was observed that participation in RENLAF is associated with higher price stability; hence they reduce market risk and provide incentives for fishers to specialize as was observed elsewhere (Michelson et al., 2012). This may lead to more fish consumption at the household level and thus improve dietary quality. Even if fishers harvest or captured fish primarily for sale, certain portions are likely to be kept for home consumption. The *third* pathway is related to possible changes in gender roles and intra-household food choices decision- making. A possible shift from male to female control of fish sales and revenue may also have nutrition implications. Female-controlled sales/income is often more beneficial for household nutrition, because women tend to spend more than men on food, health, and dietary quality (Hoddinott and Haddad, 1995). Hence, RENLAF participation may have a negative partial effect on nutrition through this pathway.

4. Analytical techniques

To analyze net impacts of RENLAF participation on farm household nutrition, we regress the nutrition indicators such calories, vitamin A, Iron and Zinc on a RENLAF participation dummy as treatment variable and a set of control variables. However, since households' selection into RENLAF, the treatment variable is endogenous. This may cause selection bias in estimation. RENLAF fishers may systematically differ from URENLAF, so that observed differences in outcome variables cannot be interpreted as net impacts of RENLAF participation. Some of these differences may be due to observed factors that one can control for in a simple regression framework. Other differences may be due to unobserved factors, control of which requires an instrumental variable (IV) approach. Finding an instrument that is exogenous, correlated with RENLAF participation, but not directly correlated with the nutrition outcome variables is difficult. We tried different possible variables and eventually identified "the number of RENLAF fishers among the five nearest neighbors" as a valid instrument. Fishers cannot choose who their neighbors were in the villages around the lake, so that our instrument can be considered exogenous. The assumption here is that fishers may observe what others are doing and are influenced by their social network when making innovation adoption decisions. But not necessarily interact on nutrition, health, or other socially relevant issues.

We identify the unbiased impact of fisher’s RENLAF participation on nutrition, the estimated treatment- effect models as follows:

$$NI = a_0 + a_t REN + a_2 X_1 + e_t \quad (1)$$

$$REN = p_1 FRN + p_2 X2 + e_2 \quad (2)$$

Where, *NI* is the nutrition indicator of interest, REN dummy for participation, and X_1 is a vector of control variables that are expected to influence household nutrition. *FRN* is the number of RENLAF fishers among the five nearest neighbors, and e_1 and e_2 are random error terms. a_1 represents the treatment effect. We also estimate separate models for calorie, vitamin A, iron, and zinc consumption and test the hypotheses on three impact pathways empirically, we develop a simultaneous equations as follows:

$$NI = a_0 + a_x INC + a_2 5INC + a_3 SR + a_4 X_2 + e_3 \quad (3)$$

$$INC = p_0 + p_1 REN + P_2 X_3 + e_4 \quad (4)$$

$$NFG = o_0 + C_1 REN + a_2 X_4 + e_5 \quad (5)$$

$$REN = 9_0 + \hat{}FRN + q_2 X_6 + e_6 \quad (6)$$

Where, household income (INC), the number of fishing gears owned (NFG) that we use as a measure of specialization, the gender of the household member who make the sales (SR), and a vector of other control variables (X2), including household size, education, and other socioeconomic factors. Following the discussion above, INC, NFG, and SR are influenced by RENLAF participation, represented by the REN dummy, and additional covariates (X3 to X5). This is modeled in equation (6), where FRN is explained by the number of RENLAF fishers among the five nearest neighbors, which was used as a valid instrument above, and a vector of other control variables (X6). Control variables used as part of the vector X_1 include education, gender, and age of the household head, as well as education of the main female in the household. We also control for household size, land area owned, and the value of non-land assets (e.g., machinery and irrigation equipment). To avoid endogeneity issues, we use lagged asset values referring to the situation before households had started to supply supermarkets. Possible issues of endogeneity are also the reason why we do not include current household income.

4. Method of estimation of household nutrition

The impacts of RENLAF participation on household nutrition analysis requires comparison with URENLAF non-participants and identification of suitable nutrition indicators and outcome variables. These approaches captured household nutrition behavior and dietary quality. We collected detailed information on household 7-day food consumption recall survey interview was carried out with the household senior female member responsible for food choices and preparation. This member at the sites were mostly a senior female who often responded together with the household head. Details on food quantities consumed from own production, purchases, transfers, and gifts were collected for over 42 food items common to the people. These data were used to calculate daily calorie availability in each household as well as consumption levels of certain micronutrients.

Our major emphasis was on **vitamin A, Iron, and zinc,** because deficiencies in these micronutrients are widespread and constitute serious public health problems in many developing countries (Stein et al., 2008). In the evaluation of calorie and micronutrient consumption levels, surveyed food quantities were corrected for non-edible portions. Edible portions were converted to calorie and nutrient levels using food composition tables for West African foods (FAO, 2010). In a few cases where individual food items could not be found, other international food composition tables were consulted (FAO, 2012; USDA, 2005). We make values comparable across households, by dividing the number of adult equivalents (AE), taking into account household size, demographic structure and levels of physical activity. One AE is equal to a moderately active adult male. In these calculations, it is assumed that food within the household is distributed according to individual calorie and nutrient requirements (IOM, 2000; FAO, WHO, UNU, 2001). Zinc and iron losses during cooking were accounted for and issues of bioavailability were also considered. These bioavailability of zinc and iron depends on the composition of meals and human body absorption is influenced by enhancing and inhibiting factors (IZiNCG, 2004; WHO and FAO, 2004).

The information on the exact local meals composition and assumptions based on the literature and knowledge followed local food habits of Plateau State locals. For iron, WHO and FAO (2004) provide a bioavailability range of 5-15%; we took average iron bioavailability of 7%, while, we adopted the unrefined and cereal-based diets with low zinc bioavailability of 15%. We then compare amounts consumed with standard levels of requirements. For calories, a daily intake of 3000kcal is recommended for a moderately active male adult (FAO, WHO, UNU, 2001). Moreover, it is recommended that a safe minimum daily intake should not fall below 80% of the calorie requirement. Based on this, we use a minimum intake of 2400 kcal per AE and categorize households below this threshold as undernourished. Following WHO and FAO (2004), we use daily estimated average requirements (EAR) per AE of 625μg of retinol equivalent (RE) for vitamin A, 18 mg for iron, and 15 mg for zinc.

5. Results and discussions

5.1 Indicators of household net farm income

The costs, returns and profitability indexes RENLAF and URENLAF fishers were calculated as indicated on Table 1: The daily prevailing average wage rate at URENLAF was ₦1300, while RENLAF wage rate was ₦1400. The monthly estimates of revenues shows that net farm income ₦108, 017.01 and ₦152, 194.46 for URENLAF and RENLAF fisheries respectively. The revenues of fishers were estimated from the total output (catch) of individuals realized during the period of Catch Assessment Survey. The monthly estimates of revenues were ₦108, 017.01 and ₦152, 194.46 for URENLAF and RENLAF fisheries respectively. The Profit Index for fishers at RENLAF was 6.51, while the Profit Index for combined URENLAF fishers was 4.53. This result means that every naira invested in fishing business at the RENLAF is expected to bring a six Naira return, while a return of four Naira Three kobo was expected for fishers at the URENLAF. This result is unexpected and may be because RENLAF fishers spend more on fishing gears in view of the fact that gears were more specialize than the URENLAF fishers. The statistical test of significance presented in Table 2, shows both enterprises were profitable, however, RENLAF was more profitable than the URENLAF fishers. This is a very important parameter for investment decision as fishers will wish to know the profit that they can possibly generate from their limited financial resource.

Table 1: *Net Farm Income of RENLAF and URENLAF*

	Items	RENLAF	Percentage	URENLAF	Percentage
A	**Returns**				
i.	Catch (Kg)	505.93		281.42	
ii.	Sales (₦)	278,261.50		126,639.00	
B	**Cost**				
i.	Labour (hr)	8200	**29.9**	2860	**52.24**
ii.	Gillnet	9,176.60	31.50	2320.83	18.88
iii.	Malia trap	3,980	6.64	1000	14.43
iv.	Gura trap	2.776.60	4.56	171.90	0.68
v.	Hook line	4,220	18.43	904.167	08.49
vi.	Repair/maintenance	470	0.77	44.58	0.55
vii.	Depreciation	5,041.90	8.28	318.12	5.71
C	**Total cost**	**33,395.10**	**100**	**7619.59**	**100**
D	**Net Farm Income**	**217,396.29**		**29,965.01**	
E	**Profitability Index**	**6.51**		**3.90**	

Table 2: Test of Significance for Revenues URENLAF and RENLAF Fishers

URENLAF ESTIMATES	REVENUES (₦)	TOTAL COST (N)	**RENLAF ESTIMATES**	REVENUES (₦)	TOTAL COST (N)
Maximum	1313280	120225	Maximum	1497600	120225
Minimum	113760	131280	Minimum	199680	22340
Mean	586222.46	51433.23	Mean	714015.80	56641.90
Std Dev	251951.26	22213.35	Std. Dev.	290672.339	26545.75
Coeff. Variation	0.430	0.432	Coefficient Of Variation	0.41	0.47
Profit	108,017.01		Profit	152,194.46	
Std. Error Mean	28169.007		Std. Error	53069.27	
T- Ratio Value	19.007*		T- Ratio	12.288*	

5.2 Nutrition indicators by fishing method

Results for the main variables of interest are summarized in Table 3. There are also confirmation of impact pathway.

Table 3: Summary statistics of farm and household variables

Variables	Mean	Std. dev.
Number of gears owned	23.06	(2.90)
Reported increase diet with vegetable (%)	53.24	(28.98)
Participation in regulated fishing (dummy)	22.14	(41.57)
Monthly household income (N)	152,194.46	(737.83)
Off-fishing exist income (dummy)	0.70	(0.46)
Credit access (dummy)	0.17	(0.38)
Fishers among 5 nearest neighbors (number)	0.97	(1.38)
Age of household head(years)	51.75	(13.54)
Education of household head (years)	9.59	(3.69)
Education of main female (years)	0.97	(3.01)
Female control sale revenue (dummy)	0.73	(0.45)
Number of observations	110	

The nutrition indicators for the sample of combine households and separately for RENLAF and URENLAF. On an average, households consume 3248.02kcal, 1274.68 μg of vitamin A, 16.85mg of Iron, and 20.05mg of zinc per day per AE. While, the RENLAF households consume 3348.27 kcal of energy, 1209.10 μg of Vitamin A, 19.17 mg of Iron and 23.53mg of Zinc also, the URENLAF on the average consume 932.37 kcal of energy, 153.53 μg of Vitamin A, 14.62 mg of iron and 14.12 mg of zinc. These consumption levels shows increase of 26%, 79%, 31% and 46% for calorie, vitamin A, iron and zinc respectively.

For calorie and vitamin A, the prevalence of deficiency is in a similar magnitude; while the prevalence of iron deficiency was much higher with an estimated 54%. The comparison shows that RENLAF have higher levels of calorie and micronutrient consumption than URENLAF. Likewise, the prevalence of deficiency was higher among URENLAF fishers. This could suggest a possibility of nutrition impacts of RENLAF participation. But, the increase iron and zinc were significant and the comparison on Table 4 did not control for any confounding factors. We therefore went further to run a more rigorous assessment using simultaneous equations econometric approaches.

Table 4. RENLAF and URENLAF calorie, Vitamin A, Iron and Zinc mean consumption

Nutrition indicators	Full sample		RENLAF		URENLAF	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Calorie consumption (kcal/day/AE)	3248.02	(1091.9)	3348.27	(1206.2)	932.37	(1044.7)
Prevalence of energy deficiency (%)	20.83	(40.7)	14.82	(19.3)	21.41	(31.1)
Vitamin A consumption (^g RE/day/AE)	1274.68	(926.3)	1209.10	(925.4)	153.53	(943.1)
Prevalence of vitamin A deficiency (%)	16.41	(37.1)	12.12	(15.0)	17.06	(27.7)
Iron consumption (mg/day/AE)	17.75	(7.2)	19.17	(7.4)	14.62	(6.1)
Prevalence of iron deficiency (%)	64.32	(48.0)	21.35	(48.7)	54.29	(47.8)
Zinc consumption (mg/day/AE)	20.05	(7.8)	21.78	(9.1)	14.12	(8.5)
Prevalence of zinc deficiency (%)	24.22	(42.9)	15.53	(42.7)	24.42	(43.0)
Number of observations	110		30		80	

Table 5. Factors influencing RENLAF participation (first stage of treatment-effect models)

Variables	Calorie (kcal/day/AE)	Vitamin A (^g/day/AE)	Iron (mg/day/AE)	Zinc (mg/day/AE)
Constant	-2.77**	-1.06	-2.84**	-2.28
	(1.39)	(1.13)	(1.37)	(1.39)
RENLAF fishers among 5 nearest neighbors	0.50*	0.33*	0.49*	0.51*
	(0.06)	(0.09)	(0.06)	(0.06)
Female sale fish (dummy)	0.65*	0.70**	0.70	0.87*
	(0.45)	(0.36)	(0.45)	(0.45)
Age of household head (years)	0.03	-0.01	0.04	0.01
	(0.05)	(0.04)	(0.05)	(0.05)
Education of household head (years)	0.05*	0.03	0.05*	0.05*
	(0.03)	(0.02)	(0.03)	(0.03)
Education of main female (years)	-0.16***	-0.12***	-0.16***	-0.15***
	(0.06)	(0.06)	(0.06)	(0.05)
Household size (AE)	0.10	0.19***	0.04	0.19**
	(0.06)	(0.06)	(0.03)	(0.09)
Number of fishing gears owned	0.05	0.05**	0.05	0.04
	(0.03)	(0.03)	(0.03)	(0.03)
LR chi-squared	120.69*	121.37*	119.26*	122.62*
	110	110	110	110

Note; *, ** and * represent 1%, 5% and 10% respectively**

Results presented on Table 6 suggested that household income has a positive and significant effect on calorie, vitamin A, iron and zinc consumption. Also, the analysis shows number of fishing gears owned influences nutrition positively: an increase in income by 10 percentage unit increases vitamin A consumption by almost 684 μg RE per AE, implying a 9.4% increase over mean consumption levels. This sizeable effect should not surprise given that fish are a very important source of vitamin A in the local context. The main staple food source in Nigeria, are cereals which does not contain vitamin A. therefore most household lack sources of vitamin A due to income constraints.

Table 7. Analysis of pathways of RENLAF participation

	Calorie (kcal/day/AE)	Vitamin A (^g/day/AE)	Iron (mg/day/AE)	Zinc (mg/day/AE)
Monthly household income (₦)	0.501**	0.939***	0.003**	0.004**
	(0.21)	(0.23)	(0.00)	(0.00)
Number of fishing gears owned (%)	26.769***	39.559***	0.147***	0.168***
	(8.20)	(9.35)	(0.05)	(0.06)
Female member control sales (dummy)	-1013.312***	-1346.740***	-8.522***	-7.344***
	(285.98)	(151.24)	(1.27)	(2.09)
Constant	3774.757***	86.549	15.308**	25.227***
	(1235.63)	(1352.08)	(7.40)	(8.59)
monthly household income (₦)				
RENLAF participation (dummy)	361.894***	297.791**	342.556***	368.007***
	(129.95)	(123.62)	(127.76)	(131.64)
Constant	-48.625	-14.868	-19.836	-16.395
	(230.85)	(227.00)	(229.49)	(225.13)
Number of fishing gears				
RENLAF participation (dummy)	30.22**	23.138***	23.144***	17.647**
	(8.89)	(7.21)	(8.43)	(8.90)
Constant	104.841***	102.606***	101.230***	106.068 ***
	(19.55)	(19.28)	(19.72)	(19.55)
Female control sales(dummy)				
RENLAF participation (dummy)	0.324**	0.279***	0.213**	0.213**
	(0.10)	(0.07)	(0.09)	(0.10)
Constant	0.602	0.596	0.365	0.563
	(0.48)	(0.45)	(0.45)	(0.48)
RENLAF participation (dummy)				
RENLAF fishers among 5 nearest neighbors	0.083***	0.075***	0.080***	0.086***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	-2.708*	-1.915	-2.792**	-2.319
	(1.41)	(1.19)	(1.36)	(1.48)
LR chi-squared	507.93***	485.04***	520.12***	517.00***
Number of observations	110	110	110	110

Note; *, ** and * represent 1%, 5% and 10% respectively**

The Table 7 shows how these socio-economic factors affects RENLAF participation and are important determinants of household nutrition. RENLAF encourages small scales commercialization increases monthly household income by 152,194 naira, implying a gain of over 40%. There was also positive on participation to a higher degree of the number of fishing gears a fisher owns. On average, and controlling for other factors, around 30 percentage points higher for RENLAF than for other fishers. Finally, sales participation has a significant effect on gender roles within the household. RENLAF innovation increases the likelihood of females involved in the sales of fish by at least 20 percentage. This result contradict existing literature on agricultural commercialization (Fischer and Qaim, 2012).

6. Conclusion

Research has shown that smallholder farmers do benefit in terms of higher productivity and income, provided that they can be linked to the emerging high-value supply chains. In this study, we have analyzed what participation in a fishery innovation was similar for fishery household nutrition. The analysis adds to the knowledge on fishery impacts; nutrition effects for fishing households have not been studied previously. Second, it contributes conceptually to the discussion on agriculture-nutrition linkages by developing a method to capture nutrition behaviors and dietary quality of fishers.

We have used detailed food recall data to assess nutrition indicators, such as calorie, vitamin A, iron, and zinc consumption levels. These provide reasonable overview of food security and dietary quality at the household level. Controlling for other factors, participation in RENLAF increases calorie, iron, and zinc consumption. We further analyzed impact pathways, using simultaneous equation models.

We have shown that RENLAF participation affects household nutrition mainly via three pathways, namely through (i) income, (ii) small holder commercialization, and (iii) gender roles- female mostly involved in sale of products. Fishers who participate in RENLAF benefit from income gains, and higher incomes improve the economic access to food. The second pathway has a positive nutrition effect as well. RENLAF fishers allow theirs wives to sell fish. Our assumption, was that since women are involved it entails higher quantities of fish and vegetables consumed at the household level. Vegetables are an important source of vitamin A in particular. In contrast, the third pathway has a possible effect on nutrition. Participation contributes to alliance of female - male household members,' this promotes tendencies where male household members are influence to spend more on nutrition and dietary quality. Such influence change in gender roles within the household is not uncommon in the process of agricultural commercialization.

This food system transformation and the growth of small scale commercialization of fishery in developing countries can contribute to economic development and improved nutrition in the small farm sector through definition of role of women should be strengthened to further improve nutritional benefits. Gender mainstreaming of programs that try to link smallholders to markets.

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