論文の内容の要旨

農学国際専攻

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**論文題**

Fish Agri-Food Systems for Improving Diet Quality and Nutrition in Rural Bangladesh

(バングラデシュ農村地域住民の食事の質と栄養の向上に資する農水産物フードシステム)

**Thesis Summary**

**Background**

Micronutrient deficiencies and undernutrition remain serious nutritional concern in Bangladesh, especially among rural women of reproductive age (WRA). Prevalence of overnutrition among the same women group is also increasing. Co-existence of these nutritional problems reflects a monotonous dietary pattern, high in energy but low in a variety of essential nutrients such as vitamins and minerals. Furthermore, inadequate ASF intake has been recognized as one of the most important reasons of poor diet quality and micronutrient inadequacy in Bangladesh, mentioned by FAO and WHO. Agriculture is the main occupation for livelihood of about 80% people in rural Bangladesh and agricultural sector is heavily dominated my male; role of women in agriculture mostly limited to pre and post-harvest processing.

**Objectives**

Considering multiple nutritional problems and poor diet quality of people, and gender inequity, overarching research question (RQ) is to examine:

RQ: *What are the gaps in dietary nutrient intakes among people in rural Bangladesh?*

Specific research questions (RQs) investigated by the doctoral research are:

RQ1: *What are the factors affecting diet quality of reproductive age adolescent girls (13-18 years) and adult women (19-49 years)?*

*RQ2: Whether diet quality of household members is influenced by the type of household engagement with aquaculture and/or horticulture production?*

*RQ3: What is the most commonly consumed and preferred animal source food by the rural household in southern Bangladesh?*

*RQ4: Whether nutrition-sensitive homestead pond polyculture fish production system empower women and increase fish intakes of households?*

**Methods**

The research used a variety of different methods to answer different research questions. RQ1 explored factors associated with diet quality of WRA (13-49 years) from the national rural representative households of Bangladesh Integrated Household Survey (BIHS) 2015, conducted by International Food Policy Research Institute (IFPRI). RQ2 assessed whether diet quality of household members was associated by the type of household engagements with aquaculture and/or horticulture, using the first round of a longitudinal observational study, conducted by Tufts Nutrition Innovation lab, to capture the immediate effects of project interventions just after completion of the project activities. All food items consumed in the preceding 24 h and 7 d by the household and individual, were converted to the nutrient level using derived food composition table, which has been developed particularly for this research, to measure nutrient adequacy in the diet of WRA and other household members. RQ3 investigated what is the most frequently consumed and preferred animal source food (ASF) of the household, and RQ4 examined whether nutrition-sensitive homestead pond polyculture production system empower women and increase fish intakes of households, using qualitative and quantitative data, collected by the author, from the rural community of Southern Bangladesh.

Diet quality of WRA and household members was assessed using nutrient adequacy ratio (NAR) in the diet of 11 key micronutrients (e.g. iron, zinc, calcium, preformed vitamin A, vitamin B12, and folic acid) and energy, that reflect one key dimension of diet quality. Mean Adequacy Ratio (MAR) was measured as an overall diet quality using NAR. MAR is reported on a scale from 0 to 1, in which 0 indicates that the requirements were not met for any of the nutrients, and 1 indicates the requirements for all the nutrients were met.

**Results**

**Chapter 2 (RQ1):** Almost all of the WRA had inadequate dietary intake of calcium, iron, and folic acid (93%-97%) in the preceding 24 h. About two-third of WRA had inadequate dietary intake of vitamin A, riboflavin, and vitamin B12 (67.5%-79.2%). Only about half of WRA (53%) achieved minimum dietary diversity in the preceding 24 h, as recommended; which reflects one key dimension of diet quality. More than one-third of RA adolescent girls (40%) and about one-quarter of adult women (27%) were energy deficient, although median energy intake was higher than recommended intake. Fish and seafood was the most commonly consumed (69.8%) animal source food by the WRA, compared to other animal food sources such as: milk (23.6%), egg (18.3%), and meat (13.4%). Multiple ASFs intake in a single day were rare and only 0.4% of WRA ate all four types of ASFs (fish, meat, egg, and milk) in the preceding 24 h. Diet quality was significantly better among adult women, married WRA, and those had higher education or income.

**Chapter 3 (RQ2):** Better diet quality (mean±SD) was associated with households had both engagements aquaculture and horticulture (0.43±0.23, $p<0.001$), compared to either (0.38±0.20), or neither engagement (0.36±0.20). Level of education and occupation categories of adult household members, and daily household food expenditures were associated with better diet quality of household members. Multiple regression model predicted overall diet quality of household members had both engagements, after controlling all the predictor variables, such as: occupation, education, age, region, gender, daily food expenditures.

**Chapter 4 (RQ3):** Fish was the most commonly consumed (52.2 to 61.5%) and preferred (73.9 to 84.6%) animal source food (ASF) by the majority households, across study groups; although estimated amount (mean±SD) of daily intake was statistically significantly lower among non-aquaculture non-project supported household (105.5±53.3; $p$<0.001), compared to aquaculture project supported and non-supported households (163.6±64.7 and 159.6±53). Fish species selection for household consumption was led by taste, health benefits, availability, and price.

**Chapter 5 (RQ4):** Proportion and frequency of fish harvesting for sale was higher among aquaculture project supported households (twice a year, 22.2%; once a year 51.9%), compared to aquaculture non-project supported households (twice a year, 13.0%; once a year 47.8%). Joint decision making of both (women and men) around fish culture (63.0%), harvesting for sale (51.9%) were more common among aquaculture project supported households. Type of fish to harvest for family consumption were mostly decided by women of project supported households (44.4%).

**Conclusions**

Prevalence of adequate dietary micronutrient intakes were very low for most nutrients, among both groups of women. Inadequate dietary micronutrient intakes were associated with poor diet quality of WRA. Minimum dietary diversity was achieved only by half of WRA. Better diet quality was associated with members of household had both aquaculture and horticulture engagements, than of either or neither engagement. Fish was the most commonly consumed and preferred animal source food across study groups. Estimated amount of daily per capita fish intake was higher among aquaculture project supported households, compared to aquaculture non-project supported and non-aquaculture non-project supported households. Nutrition-sensitive homestead fish production technology targeting women, increased fish intakes of the household and influenced join decision making of both women and men, in terms of fish production technology, harvesting for sale and consumption.