DETERMINING THE ROLE OF WILD-CAUGHT AND AQUACULTURE-BASED INLAND FISHERIES IN MEETING BURMA'S HUMAN NUTRITIONAL NEEDS

Human Nutrition and Human Health Impacts of Aquaculture/Study/16HHI05MS

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ABSTRACT

Fish are an important source of food and nutrients in Burma. The contributions fish make to Burmese food security, however, are not well understood. This report analyzed Burmese consumption and nutrient intake from various fish sources (e.g. marine capture, freshwater capture, aquaculture, and dried/processed) in 2005 and 2010. Differences in consumption across zones of Burma, wealth quintile, and urban vs rural were also identified. The data for these analyzes come from the Integrated Household Living Conditions Assessment survey (IHLCA), which was conducted by the United Nations Development Program (UNDP) to assess Burmese household food consumption across a variety of sources, not just fish. Mean fish consumption (kg per capita) in 2010 was less than in 2005 for nearly all categories of species over all regions, locations, and wealth quintiles. It is likely that these results reflect systematic flaws in the sampling and/or data collection process for the 2005 IHLCA since the same pattern is also observed for all other food groups, during a period when incomes were rising and poverty was falling. Moreover, whilst it might be expected that per capita consumption of some capture fisheries species declined during this period due to over-exploitation or habitat degradation, it is difficult to account for such a uniform pattern of falling consumption, especially given that aquaculture is known to have grown significantly during this same period.

Using IHLCA data, national average fish consumption for 2010 was estimated at 20.72 kg/capita. Inland capture fish are particularly important for consumers in rural areas (who are, on average poorer than those in urban areas), while urban consumers and the wealthy are more likely to eat farmed fish. Results also underline the importance of dried, fermented and other preserved fish products. Although often overlooked in assessments of fish consumption, these products account for the single largest category of fish consumed in Burma. Fish, combining all sources (e.g. marine, freshwater, aquaculture) and forms (e.g. fresh, dried, processed) were also a key nutrient source. Fish significantly contributed to per-day intake of protein (21% of recommended intake for women and 17.5% for men), iron (24.4% for women and 55% for men), calcium (24.4% for both women and men), and vitamin B12 (50% for both women and men). Fish contributions for several nutrients (e.g. selenium, vitamin D) could not be determined due to lack of available data for fish species and nutrient compositions.

The findings of this report highlight the importance of fish to Burmese food and nutrition security. By disaggregating nutrient contributions at the species level, we were able to demonstrate the importance of species diversity and the need for nutrition-sensitive approaches and monitoring trends in household fish consumption among the population and geographical groups described.

INTRODUCTION

Fisheries have long played an important role in Burma's rural economy (U Khin 1948; Reeves & Pokrant 1999), and fish a central role in the national diet (Shway Yoe 1966). Fish consumption from inland areas (both wild capture and aquaculture sources) is estimated to provide 30% of total yearly intake of protein (from both animal and plant sources) (FAO 2003). Fish also provide key contributions to the intake of essential fatty acids and micronutrients of high bioavailability such as vitamin B12, iron, iodine, calcium and vitamin A, which can be difficult to obtain through other local food sources and are vital for human growth and development (Aung et al. 2010, Youn et al. 2014). As Burma's most important animal-source food (Belton et al. 2015), fish therefore represents one of the main sources of micronutrients. These nutritional contributions are critically important given that more than 35% of Burmese children show signs of stunted growth, which is linked with chronic malnutrition (World Food Programme 2017).

Understanding the contributions of fish and fisheries to food and nutrition security in Burma is thus important if food and nutrition security and human well-being are to be ensured. These contributions remain poorly understood however, as do the ways in which these are changing over time. This is partly because Burma's half century of political isolation prior to 2011 resulted in an acute lack of data on all sectors of the economy, including agriculture and fisheries (Haggblade et al. 2013), official production statistics for which are considered unreliable (Fujita 2008, BOBLME 2014). Moreover, the production and consumption of fishery resources are often particularly severely misestimated, due to lack of data or political pressure to meet specified government production targets (Bartley et al. 2015, Beard et al. 2011).

Rapid growth, rising incomes and accelerating urbanization linked to Burma's transition to a globally integrated economy post-2011 mean that demand for fish is set to grow: a trend observed throughout Asia as increasingly affluent consumers increase their expenditure on non-staple foods such as fish, meat and fruits (Reardon et al. 2014). At the same time, Burma's capture fisheries resources are reckoned to be heavily exploited. One recent high-profile stock assessment exercise found that the biomass of stocks in the marine fishery stands at 20% of historical levels (IMR, 2014) and inland fisheries are under increasing pressure (MFP 2016a), while aquaculture's potential has yet to be fully realized (MFP 2016b).

Set against this complex and information-poor background, this report estimates the contributions of fish (disaggregated by source – i.e. inland capture, aquaculture, and marine capture; and product type – fresh, processed) to human nutrition in Burma for the first time. These estimates are made using data from a nationally representative household survey, and several nutrient composition databases. Results indicate that fish consumption plays a highly significant role in the Burmese diet, with fresh fish originating from inland fisheries and dried, fermented and other processed fish from marine and inland capture fisheries of particular importance.

METHODS AND MATERIALS

The Integrated Household Living Conditions Assessment survey (IHLCA), conducted in Burma by the United Nations Development Program (UNDP) in 2005 and 2010, is a nationally representative household survey of 18,660 Burmese households conducted by the Ministry of National Planning and Economic Development and the United Nations Development Programme (IHLCA 2011). The purpose of the IHLCA is to provide statistical data for determining living conditions in Burma. To meet this purpose, the survey collected household food consumption data during two rounds in each of the survey years, corresponding to pre- and post-monsoon paddy harvesting season, which captured some seasonal variability in food consumption. Seven-day recall was used to capture the quantity of foods consumed, including the amount sourced through the market, the household's own production, and other source (e.g. gifts).

Fish and fish products were pre-coded as 37 different items in the IHLCA. Fish fall into 3 categories: species specific (e.g. snakehead, Bombay duck), generic but denoting source (e.g. small marine fish), and generic but not denoting source (e.g. fish paste). For fish categories that are generic and do not denote source (e.g. marine, freshwater, or aquaculture), source and composition were inferred, as far as possible, using available information (e.g. it is likely that most fish paste consumed in coastal state is of marine origin). Trade data show that fish imports to Burma are extremely small, at 6029 t/year (FAO 2015a), so import trade should have little impact on the results.

Many of the IHLCA fish categories are species specific, but some items also cover a variety of generic categories of product (e.g. "other small river fish <= 4 inches", "other dried medium sea fishes"). In these cases, it was necessary to make some assumptions, based on the knowledge of key informants and existing literature, about the most important fish species when conducting nutrient analysis. In particular, the analysis made use of three documents: 1) an assessment of the catch composition from inland fisheries at 14 locations throughout the upper, middle and lower Ayeyarwady and Chindwin River basins (Baran et al. 2017); 2) Unpublished data on the most common most abundant species harvested inshore from three locations in the Gulf of Mottama (Mon State, Eastern Burma), made available by the NGO Network Activities Group; 3) Unpublished data on major species landed from marine fisheries in Rakhine State (Western Burma), made available by the World Conservation Society.

Data from published sources Bogard et al. (2015) and databases (FAO INFOODS INFOODS Global Food Composition Database, Mahidol University ASEAN Food Composition Database, Indian Food Composition Tables 2017, Cost of the diet tool V2 analysis software) were used to obtain estimates of the nutrient composition of the most commonly consumed fish species and fish products. Kilograms of raw whole fish were first adjusted with an edible portion coefficient to exclude parts that are not consumed, e.g. bones. The edible portions were multiplied by the nutrient composition of that species, based on the literature, to estimate nutrient intakes provided by different fish species, and sources of fish (aquaculture, inland capture, etc.) in 2010. Details of the following dietary components were extracted from the literature: Energy, protein, fat, moisture, ash, iron, zinc, calcium, vitamin B12, sodium, iodine, selenium, phosphorous, magnesium, potassium, manganese, copper, vitamin D3, vitamin E, vitamin A, retinol and essential fatty acids. Data was not available for every species/product and nutrient combination. Data on macronutrient composition and iron, zinc, calcium and vitamin B12 content were most complete.

This analysis was conducted at the national and regional level to capture geographical differences in consumption, for rural and urban areas, and by wealth category (as proxied by consumption expenditure per capita) – with households divided into 5 wealth quintiles (quintile 1 representing the poorest 20% of the population, quintile 5 the richest).

IHLCA 2010 is the most recent year of the survey and no recent, comparable datasets exist. Because data for 2005 and 2010 provides a time-series, the intention at the outset of the analysis was to generate estimates of changes in nutrient intakes and production volumes from different fisheries sub-sectors. However, analysis of both data sets indicated that a substantial decline in fish intakes occurred across all species/product groups during this period. Analysis of other non-fish food groups (grains, vegetables, fruits, meat, edible oils) indicated similar declines in consumption. This result is problematic, because the poverty rate in Burma declined significantly over the same period as real incomes rose (World Bank 2015). Declining poverty and rising incomes should be associated with increasing in food consumption, particularly for higher market value non-staple such as fish. Moreover, even in the event that incomes fall, consumers should substitute higher market foods for the staple rice, causing rice consumption to increase. As there is no plausible explanation for why food consumption decreased so sharply across all food groups, the decision was made to exclude

2005 data from nutrient composition analysis. Data from the 2010 IHLCA were considered to be reliable, because reported values for per capita consumption of foods such as fish and rice are within a similar range to those reported in neighboring countries.

Comparison of fish consumption (kg/capita) between 2005 and 2010 is retained for illustrative purposes. Fish species/products, grouped by origin (e.g. aquaculture, inland and marine fisheries; Table 1), were analyzed by region, location (e.g. urban or rural), and wealth quintile. These comparisons were used to identify changes in fisheries production and consumption across Burma between the 2005 – 2010 time-period.

Using the data from the IHLCA 2010, maps were developed to illustrate the contributions of marine and inland capture fisheries and aquaculture to food and nutrition security in Burma. The maps show yearly per-capita consumption of various types of fish by region and identify the relative contributions of aquaculture and inland and marine capture fish to the diet

RESULTS

Fish Consumption in 2005 and 2010

Mean fish consumption (kg per capita) in 2010 was less than in 2005 for nearly all categories of species over all regions, locations, and wealth quintiles. Many of these mean differences in consumption were significantly different (or borderline significantly different) at a 5% level. Exceptions to the decreasing trend (e.g. increases in consumption) were aquaculture species consumption in the East region, all processed fish species consumption in the West region, and processed marine fish species consumption in the West region (Table 2; Table 3; Table 4). However, in cases where there was an increase in mean fish consumption, none of the differences were significant.

Comparing consumption between rural and urban locations for each year, mean fish consumption (kg per capita) in rural locations was generally less than that of urban locations for both 2005 and 2010 (Table 6). Exceptions for both years were freshwater species consumption, all processed fish species consumption, and processed marine fish species consumption, which all had a larger mean fish consumption for rural locations compared to urban locations. However, of all the tests comparing rural and urban mean differences in consumption, only aquaculture species in 2005 was found to be significantly different in rural and urban consumption. Fish consumption also decreased for all wealth quintiles between 2005 and 2010 (Table 5).

As noted above, it is likely that these results reflect systematic flaws in the sampling and/or data collection process for the 2005 round of the survey, given that the same pattern is also observed for all other food groups, during a period when incomes were rising and poverty was falling. Moreover, whilst it might be expected that per capita consumption of some capture fisheries species declined during this period due to over-exploitation or habitat degradation, it is difficult to account for such a uniform pattern of falling consumption, especially given that aquaculture is known to have grown significantly during this period (Belton et al. 2015).

Fish Consumption in 2010

Leaving aside problematic data for 2005, this sub-section summarizes fish consumption (kg/capita/year) patterns for 2010, in terms of geography (area of the country, urban and rural locations) and income (proxied by wealth quintile).

Burma is comprised of six geographical zone: South (Tanintharyi, Mon, Kayin); Lower (Ayeyarwady, Yangon, Bago); West (Rakhine, Chin); Central (Mandalay, Magway); North (Sagaing, Kachin); East (Shan, Kayah). Southern, Lower and Western Burma all have lengthy coastlines,

providing access to marine fisheries, and (in some places) rivers and deltaic environments utilized for lowland wet rice cultivation and freshwater capture fisheries. Aquaculture is heavily concentrated in Lower Burma. These three areas, had the highest estimated levels of fish consumption in the country, ranging from 19.4 to 25.1 kg/capita/year.

The estimated contribution of fish to the diet was smaller in the landlocked Central, North and Eastern areas that make up Upper Burma. These areas, where much of the environment is arid, hilly or mountainous, are distant from the main sources of fish production. Consumption of fish was lowest, although still significant, in Eastern Burma, where average estimated consumption stood at 8.5 kg/capita/year.

Focusing on the composition of fish consumption by source (marine and freshwater capture fisheries and aquaculture), and product type (fresh and processed), it is apparent that dried and other processed products account for the largest share of fish consumption nationally (34%). Among fish consumed in fresh form, freshwater capture fisheries account for the largest share (27% of total consumption), with aquaculture and marine capture fisheries contributing 21% and 18% respectively

Processed fish products (mainly dried or fermented) are comprised of a mix of fish and shrimp from marine and inland capture fisheries. Fish from aquaculture are almost always sold in fresh form. Drying and fermenting have traditionally been used to preserve fish which would otherwise spoil quickly, smoothing seasonal gluts and shortages and facilitating trade over long distances in the absence of ice and refrigeration. Although the amount of processed fish in total consumption seems extremely high, it does fall within approximately the same range reported in some areas of the Lower Mekong River Basin with similar aquatic ecologies (Hortle, 2007).

Consumption of aquaculture fish is lowest in West and South Burma, where marine capture fisheries dominate production. Interestingly, although absolute levels of consumption of fish from aquaculture (5.5 kg/capita/year) are highest in Lower Burma, where the vast majority is produced, its contribution to the diet is greatest in Upper Burma (central, northern and eastern areas), where it accounts for 23-32% of total fish consumption. This indicates the existence of considerable domestic trade in farmed fish, allowing the penetration of fresh fish produced in the delta far into Upper Burma. In fact, Upper Burma accounted for 47% of farmed fish consumption, with 43% occurring in Lower Burma, and just 10% in coastal areas (South and West Burma combined). This result highlights the scale and significance of intra-national trade in aquaculture products and its important implications for food and nutrition security in fish deficit areas of the country.

Fish consumption behaviors vary not only among different areas of the country, but between rural and urban zones, and across income groups. Estimated average annual fish consumption per capita is almost the same in both urban and rural areas, at around 21.11 kg/year (urban) and 20.58 kg/year (rural). This pattern is interesting because urbanization (and the higher incomes with which it is normally associated) is usually found to result in overall increases in fish consumption (c.f. Toufique and Belton 2014).

However, aggregate consumption figures mask important differences in the source of fish consumed. Average consumption per capita of freshwater capture fish is 27% higher in rural areas than urban, probably reflecting the nature of the inland fishery, much of which is dispersed and small-scale, making the assembly of sufficiently large quantities to export to urban areas problematic, with the result that much of the catch is consumed locally. Consumption of fish from marine capture and aquaculture is higher in urban areas than in rural (by 25% and 41% respectively). Dried and processed fish is consumed in almost equal quantities in rural and urban areas.

The apparent propensity of urban dwellers to consume farmed fish in greater quantities than their rural counterparts appears to indicate a high degree of substitutability with inland capture fish. This tendency is significant in terms of likely future demand patterns, given that progressively greater urbanization is likely to be a feature of Burma's geography as the country (which is currently in a stage of 'nascent urbanization', with around 30% of the population living in urban areas) integrates further into the global economy, and transitions away from a national economy dominated by the primary sector (World Bank 2015).

Total annual fish consumption per capita among the wealthiest 20% of the population is more than double that among poorest 20% (28.22kg vs. 7.57kg). Disaggregating further, a similar pattern holds for dried/processed fish (10.05 kg vs. 2.51 kg) and freshwater capture fisheries (9.21 kg vs. 2.36 kg). Consumption of fish from marine capture fisheries is more equitably distributed across income groups, with consumers belonging to the wealthiest quintile eating, on average, less than 50% more than consumers in the poorest quintile (4.28 kg vs. 1.94 vs.). Inequality in consumption between rich and poor is greatest for aquaculture fish, average consumption per capita of which is around 6 times higher among members of the wealthiest quintile than among those in the poorest 20% of the population (4.68 kg versus 0.77 kg). From this observation it can be inferred that the income elasticity of demand for aquaculture fish is higher than that for fish from other sources (i.e. an increase in income will result in a proportionately greater increase in expenditure on farmed fish than on fish from other sources).

These findings have main two implications: First, as the economy grows and incomes rise, demand for farmed fish will increase faster than demand for fish from other sources. Second, the relatively unequal consumption of aquaculture fish across income groups, as compared to fish from other sources, reflects the low diversity and rather undifferentiated nature of Burma's fish farm sector (dominated by a single species, Mrigal), equating to limited range of products and prices. Capture fisheries are characterized by much higher diversity of fish species and thus offer "something for everyone", including the poorest consumers. Consequently, there is scope for the development of a more diversified aquaculture sector that caters to a wider range of consumer demand. This possibility has precedents in many other countries in the region, where aquaculture supplies a wide variety of species including those consumed by low-income population groups (Belton et al. 2018).

Nutrient Intakes from Fish

The literature search found no published nutrient composition tables for Burmese fish samples. To complete the nutrient analysis, the literature and data presented represents the best available species and category match from neighboring countries. The data is varied in source and quality of nutrient profile. This can be seen in missing data for certain nutrients across the species and categories and in turn, has reduced the full nutrient profile that can be reported here. Difference in data source aside, there is wide variation in the provision of micronutrients across the range of fish species and groups.

Nutrient composition and intake data were analyzed solely based on the IHLCA 2010 dataset. The data show that fish (combining all sources and forms) were important contributors of some nutrients (Table 8), significantly to per-day intake (HHS and USDA 2015) of protein (21% of recommended intake for women and 17.5% for men), iron (24.4% for women and 55% for men), calcium (24.4% for both women and men), and vitamin B12 (50% for both women and men). A large portion of the calcium and iron contributions come from dried and processed fish products (Table 12), although freshwater fish and fish products are also an important contributor of calcium (Table 10). Despite the large amount of incomplete nutrient data underrepresenting vitamin B12, significance of the contribution of fish can still be seen from the freshwater and farmed fish and products derived from these species (Table 10; Table 11). Additionally, climbing perch, small river fish, and (estimated) Ngapiyae provided the greatest amount of vitamin A, though due to missing data from the whole

nutrient composition table, total vitamin A contribution from fish is unable to be reported. Overall, nutrient results should be interpreted cautiously, due to the missing data for many of the micronutrients analyzed.

CONCLUSIONS

Using IHLCA data, national average fish consumption for 2010 was estimated at 20.72 kg/capita. It is striking that it stands at well under half the 50.2 kg/capita fish supply reported in the FAO food balance sheet for 2010 (FAO 2015b). The magnitude of this gap seems to imply that Burma's fish consumption as recorded in the FAO food balance sheet, along with the national fish production figures from which this number is calculated, are significantly inflated. This finding underlines the need for improved monitoring in support of better informed fisheries management and policy decisions.

Results show the continued importance of inland capture fisheries as the main source of fish in most of Burma, while aquaculture is relatively under developed in terms of both levels of production and species diversity, being dominated by Indian major carps. Inland capture fish are particularly important for consumers in rural areas (who are, on average poorer than those in urban), while urban consumers and the wealthy are more likely to eat farmed product) This situation is rather unusual, given that in most other countries in the region aquaculture has already surpassed capture fisheries (in particular inland fisheries) as the main source of fish, with farmed fish now often cheaper than wild (see Belton et al. 2018).

This situation signals two opportunities: First, to implement effective inland fisheries management strategies in order to maintain or enhance levels of productivity from what is still a relatively intact fishery. The value (economic and nutritional) of inland fisheries should also be considered when making decisions regarding developments that may affect the sector (e.g. dam construction for hydropower, water management schemes for agriculture); Second, to provide investments and technical support for the development of a more dynamic and diverse aquaculture sector that is able to supply greater quantities of affordable fish, stimulate rural economic growth and promote livelihood opportunities for farms, workers and businesses in supporting value chains.

Results also underline the importance of dried, fermented and other preserved fish products. Although often overlooked in assessments of fish consumption, these account for the single largest category of fish consumed in Burma. These products are often some of the cheapest animal source foods available and are particularly important in inland areas such as the Dry Zone in Central Burma, were there little local production of fresh fish.

Fish is well recognized as a high-quality animal source protein, rich in essential micronutrients of high bioavailability. The unique contribution of fish as an important micronutrient source in Burma is compromised by the lack of nutrient data. Data on nutrient intakes from fish point to its crucial role in the diet in a context where levels of malnutrition remain persistently high, contributing a significant share of protein, dietary iron, calcium and Vitamin B12 requirements. Withstanding under-represented nutrient contribution results, the value of fish providing protein and micronutrients is still demonstrated in this analysis. By disaggregating nutrient contribution at the species level, we are able to demonstrate the importance of species diversity and the need for nutrition-sensitive approaches and monitoring trends in household fish consumption among the population and geographical groups described.

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TABLES AND FIGURES

Table 1. Categorization of commonly consumed fish species

Burmese Name	Common Name	Scientific Name
Freshwater Capture Species		
Ngayut/Ngayant	Striped snakehead	*Channa striata*
Ngakha/Ngakhu	Walking catfish	*Clarias batrachus*
Ngagyee	Stinging catfish	*Heteropneustes fossilis*
Ngapyamya	Climbing perch	*Anabas testudineus*
Ngaton/Ngamyinn	Pangasius/silondia	*Pangasius pangasius/Silona silondia*
Ngathalauk	Hilsa	*Tenualosa ilisha*
Fish meat	Rohu, bronze featherback, Indo-pacific king mackerel	*Labeo rohita, Notopterus notopterus, Scomberomorus guttatus*
Other small river fish		*Puntius chola, Parambasis ranga, Mystus vittatus, Salmostoma sardinella*
Other medium river fish		*Labeo stolizkae, Mystus cavasius, Osteobrama belangeri, Oreochromis niloticus*
Other large river fish		*Catla catla, Wallago attu, Rita rita*
Kakatit	Barramundi	*Lates calcarifer*
Marine Capture Species		
Ngamoke	Silver pomfret	*Pampus argenteus*
Ngashwe	Yellow pike conger	*Congresox talabon*
Ngapokethin	Panna croaker	*Pennahia microcephalus*
Sardine		*Sardinella gibbosa/Dussumeiria elopsoides/Sardinella longiceps/Sardinella melanura/Sardinella albella*
Pazun Kywat	Marine shrimp	*Penaeus monodon/Penaeus merguiensis/Metapenaeus affinis/Parapenaeopsis stylifera*
Pazun Doke	Giant freshwater prawn	*Macrobrachiu rosenbergii*
Squid and like sea fishes	Squid and cuttlefish	*Sepia aculeate/Sepia pharaonic/Uroteuthis duvaucelii/Uroteuthis chinensis/Ancistroncheirus lesueuri*
Other small sea water fish	Anchovy, thyrssa	*Setipinna taty/Stolephorus indicus/Stolephorus commersonii/Cailia ramcarati/Coilia dussumieri, Thryssa setirostri/Thryssa hamiltonii/Thryssa mystax/Thryssa baelama*
Other medium sea water fish	Grey mullet, mango fish, smallhead hairtail, threadfin bream	*Mugil cephlus, Polynemus paradise, Eupleurogrammus muticus, Nemipterus bathybius*
Other large sea water fish	Talang queenfish	*Scomberoides commersonnianu*
Farmed (Aquaculture) Species		
Ngamyitchin	Rohu	*Labeo rohita*

Burmese Name	Common Name	Scientific Name
Ngagyin	Mrigal	*Cirrhinus mrigala*
Dried/Processed Species		
Nga Yantchauk	Dried striped snakehead	*Channa striata*
Other dried small river fish		*Puntius chola, Mystus cavasius*
Other dried medium river fish		*Heteropneustes fossilis, Clarias batrachus*
Ngakunshutu chauk	Mackerel	*Rastrelliger kanagurta*
Other dried small sea water fish		*Septipinna taty/Stolephorus indicus/Stolephorus commersonii/Coilia ramcarati/Coilia dussumieri/Thryssa setirostri/Thryssa hamiltonii/Thryssa mystax/Thryssa baelama*
Other dried medium sea water fish		*Eupleurogrammus muticus*
Dried prawns		Mixed of averaged groups
Shrimp paste		
Fish/shrimp paste		Averaged group of best available matches; Local recipes and samples required
Ngapiyae	Fish sauce (liquid fermented fish)	
Nagpikaung	Salted fish	*Osteobrama belangeri, Scomberoorus guttatus*

Table 2. Consumption in 2005 and 2010 for wild capture freshwater and marine fish product categories, as well as farmed fish

	Consumption in 2005 (in kg)	Consumption in 2010 (in kg)
Freshwater Capture	10.57	6.83
Marine Capture	4.23	3.09
Aquaculture	3.83	3.38

Table 3. Consumption in 2005 and 2010 for each processed fish product category. There were no reported processed fish products from aquaculture.

	Consumption in 2005 (in kg)	Consumption in 2010 (in kg)
Dried/processed Freshwater	4.22	3.00
Dried/processed Marine	5.56	4.42

Table 4. Average regional consumption in Burma in 2005 and 2010. The last row ("Overall") indicates the average consumption for the entire country

Region	Consumption in 2005 (in kg)	Consumption in 2010 (in kg)
South	33.010	25.50
Lower	38.699	26.80
West	25.053	22.29
Central	18.594	13.75
North	23.705	16.53
East	11.747	9.71
Overall	25.135	20.72

Table 5. Consumption by wealth quintile

	Consumption in 2005 (in kg)	Consumption in 2010 (in kg)
Quintile 1	14.638	7.57
Quintile 2	26.288	11.73
Quintile 3	34.349	16.30
Quintile 4	41.935	21.04
Quintile 5	57.435	28.22

Table 6. Consumption by rural vs. urban

	Consumption in 2005 (in kg)	Consumption in 2010 (in kg)
Rural	26.853	21.11
Urban	27.925	20.58

Table 7. List of states within each region

North	Central	West	East	Lower	South
Kachin	Magway	Chin	Shan	Bago	Kayin
Sagaing	Mandalay	Rakhine	Kayah	Ayeyarwady	Mon
				Yangon	Tanintharyi

Table 8. Nutrient contributions from all fish and fish products. Based on 2010 fish consumption data from IHLCA survey. Recommended per day nutrient intake values come from dietary reference intakes (DRIs) for a person 19-50 years of age estimated by the Office of Disease Prevention and Health Promotion (HHS and USDA 2015). RDA refers to the Recommended Dietary Allowance (RDA), which is the average daily level of intake sufficient to meet the nutrient requirements of nearly all healthy people (HHS and USDA 2015). Data on all micronutrients other than Iron, Zinc, Calcium, B12 need to be considered cautiously as there were many species for which nutrient data were not available. As a result, the contribution of fish to micronutrient intakes will be underestimated for these particular nutrients.

Nutrient	Per Day Total Nutrient Contribution	Recommended Per Day Nutrient Intake (Women)	Recommended Per Day Nutrient Intake (Men)	Nutrient Intake from Fish as Share of RDA (Women/Men)
Energy (kcal)	81.5	1900	2550	4.29%/3.20%
Energy (kJ)	241.9			
Protein (g)	9.8	46	56	21.30%/17.5%
Fat (g)	1.7	65	80	2.62%/2.19%
Iron (mg)	4.4	18	8	24.44%/55%
Zinc (mg)	0.7	8	11	8.75%/6.36%
Calcium (mg)	243.3	1000	1000	24.33%
Vitamin B12 (µg)	1.2	2.4	2.4	50%
Sodium (mg)	900.7	2300	2300	39.16%
Iodine (µg)	21.0	700	700	3%
Selenium (µg)	11.9	55	55	21.64%
Magnesium (mg)	16.0	315	410	5.08%
Copper (mg)	4.4	900	900	0.49%
Phosphorus (mg)	106.9	700	700	15.27%
Potassium (mg)	127.6	4700	4700	2.71%
Manganese (mg)	0.0	1.8	2.3	0%
Vitamin D3 (µg)	0.9	600	600	0.15%
Vitamin E (mg)	0.1	15	15	0.67%

Table 9. Nutrient contributions from all marine fish and fish products. Based on 2010 fish consumption data from IHLCA survey. Recommended per day nutrient intake values come from dietary reference intakes (DRIs) for a person 19-50 years of age estimated by the Office of Disease Prevention and Health Promotion (HHS and USDA 2015).

Nutrient	Per Day Total Nutrient Contribution	Recommended Per Day Nutrient Intake (Women)	Recommended Per Day Nutrient Intake (Men)
Energy (kcal)	30.3	1900	2550
Energy (kJ)	87.4		
Protein (g)	3.6	46	56
Fat (g)	0.5	65	80
Iron (mg)	1.7	18	8
Zinc (mg)	0.2	8	11
Calcium (mg)	76.9	1000	1000
Vitamin B12 (µg)	0.2	2.4	2.4
Sodium (mg)	367.5	2300	2300
Iodine (µg)	5.5	700	700
Selenium (µg)	5.5	55	55
Magnesium (mg)	6.6	315	410
Copper (mg)	3.2	900	900
Phosphorus (mg)	56.1	700	700
Potassium (mg)	46.0	4700	4700
Manganese (mg)	0.0	1.8	2.3
Vitamin D3 (µg)	0.2	600	600
Vitamin E (mg)	0.0	15	15

Table 10. Nutrient contributions from all freshwater fish and fish products. Based on 2010 fish consumption data from IHLCA survey. Recommended per day nutrient intake values come from dietary reference intakes (DRIs) for a person 19-50 years of age estimated by the Office of Disease Prevention and Health Promotion (HHS and USDA 2015).

Nutrient	Per Day Total Nutrient Contribution	Recommended Per Day Nutrient Intake (Women)	Recommended Per Day Nutrient Intake (Men)
Energy (kcal)	37.7	1900	2550
Energy (kJ)	98.5		
Protein (g)	4.0	46	56
Fat (g)	0.8	65	80
Iron (mg)	0.4	18	8
Zinc (mg)	0.3	8	11
Calcium (mg)	85.0	1000	1000
Vitamin B12 (µg)	0.7	2.4	2.4
Sodium (mg)	17.6	2300	2300
Iodine (µg)	3.2	700	700
Selenium (µg)	5.4	55	55
Magnesium (mg)	6.0	315	410
Copper (mg)	0.0	900	900
Phosphorus (mg)	28.6	700	700
Potassium (mg)	54.5	4700	4700
Manganese (mg)	0.0	1.8	2.3
Vitamin D3 (µg)	0.6	600	600
Vitamin E (mg)	0.1	15	15

Table 11. Nutrient contributions from all farmed fish and fish products. Based on 2010 fish consumption data from IHLCA survey. Recommended per day nutrient intake values come from dietary reference intakes (DRIs) for a person 19-50 years of age estimated by the Office of Disease Prevention and Health Promotion (HHS and USDA 2015).

Nutrient	Per Day Total Nutrient Contribution	Recommended Per Day Nutrient Intake (Women)	Recommended Per Day Nutrient Intake (Men)
Energy (kcal)	7.0	1900	2550
Energy (kJ)	29.3		
Protein (g)	1.4	46	56
Fat (g)	0.1	65	80
Iron (mg)	0.2	18	8
Zinc (mg)	0.1	8	11
Calcium (mg)	51.8	1000	1000
Vitamin B12 (μg)	0.4	2.4	2.4
Sodium (mg)	1.5	2300	2300
Iodine (μg)	1.3	700	700
Selenium (μg)	1.7	55	55
Magnesium (mg)	2.7	315	410
Copper (mg)	0.0	900	900
Phosphorus (mg)	5.1	700	700
Potassium (mg)	22.0	4700	4700
Manganese (mg)	0.0	1.8	2.3
Vitamin D3 (μg)	0.1	600	600
Vitamin E (mg)	0.0	15	15

Table 12. Nutrient contributions from all dried and processed fish products. Based on 2010 fish consumption data from IHLCA survey. Recommended per day nutrient intake values come from dietary reference intakes (DRIs) for a person 19-50 years of age estimated by the Office of Disease Prevention and Health Promotion (HHS and USDA 2015).

Nutrient	Per Day Total Nutrient Contribution	Recommended Per Day Nutrient Intake (Women)	Recommended Per Day Nutrient Intake (Men)
Energy (kcal)	26.9	1900	2550
Energy (kJ)	112.6		
Protein (g)	4.6	46	56
Fat (g)	0.7	65	80
Iron (mg)	4.0	18	8
Zinc (mg)	0.3	8	11
Calcium (mg)	132.5	1000	1000
Vitamin B12 (μg)	0.3	2.4	2.4
Sodium (mg)	876.4	2300	2300
Iodine (μg)	15.4	700	700
Selenium (μg)	4.2	55	55
Magnesium (mg)	6.8	315	410
Copper (mg)	4.4	900	900
Phosphorus (mg)	64.2	700	700
Potassium (mg)	52.5	4700	4700
Manganese (mg)	0.0	1.8	2.3
Vitamin D3 (μg)	0.2	600	600
Vitamin E (mg)	0.0	15	15

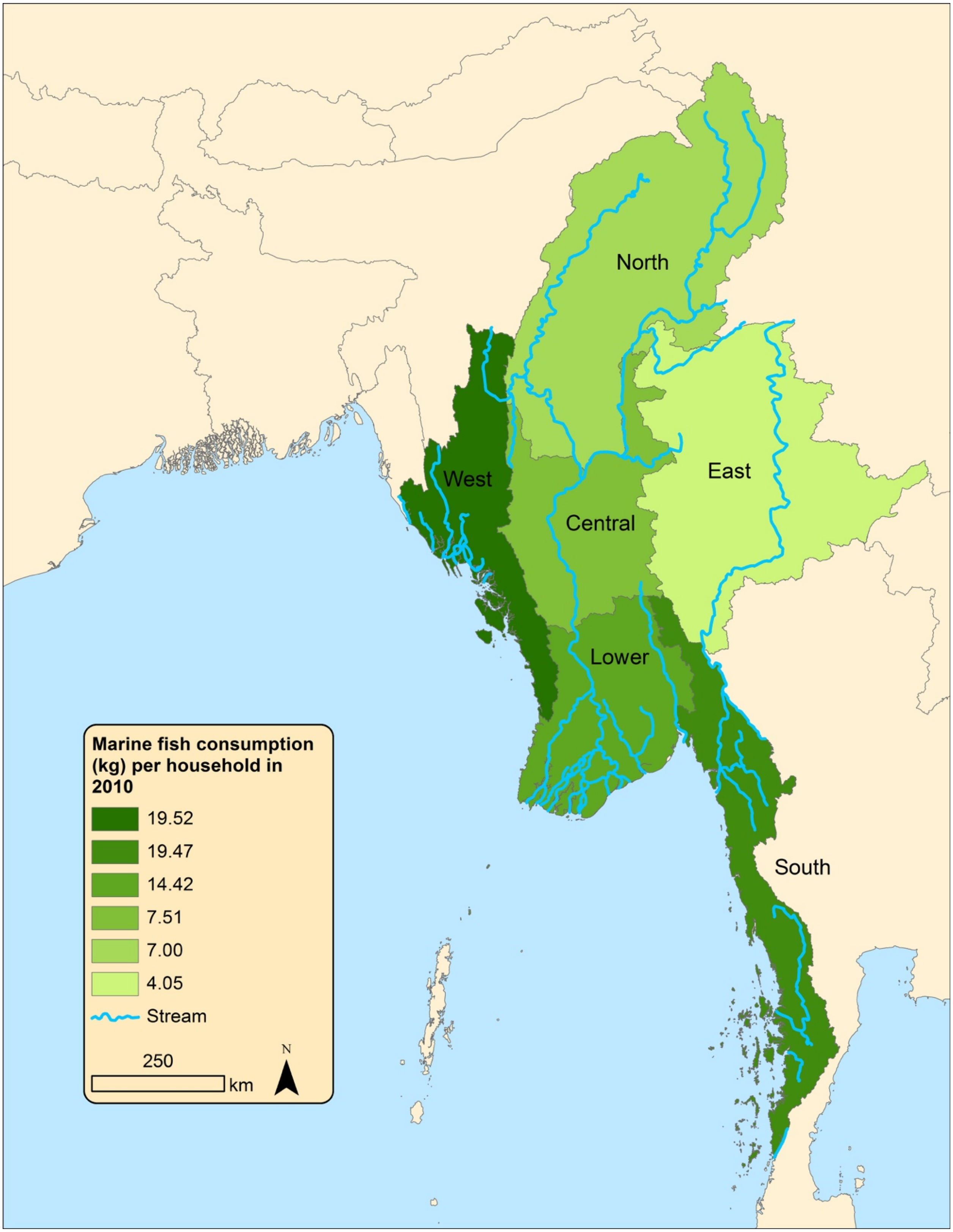

Figure 1. Map illustrating variation, by zone, of marine fish consumption (kg) per household in 2010.

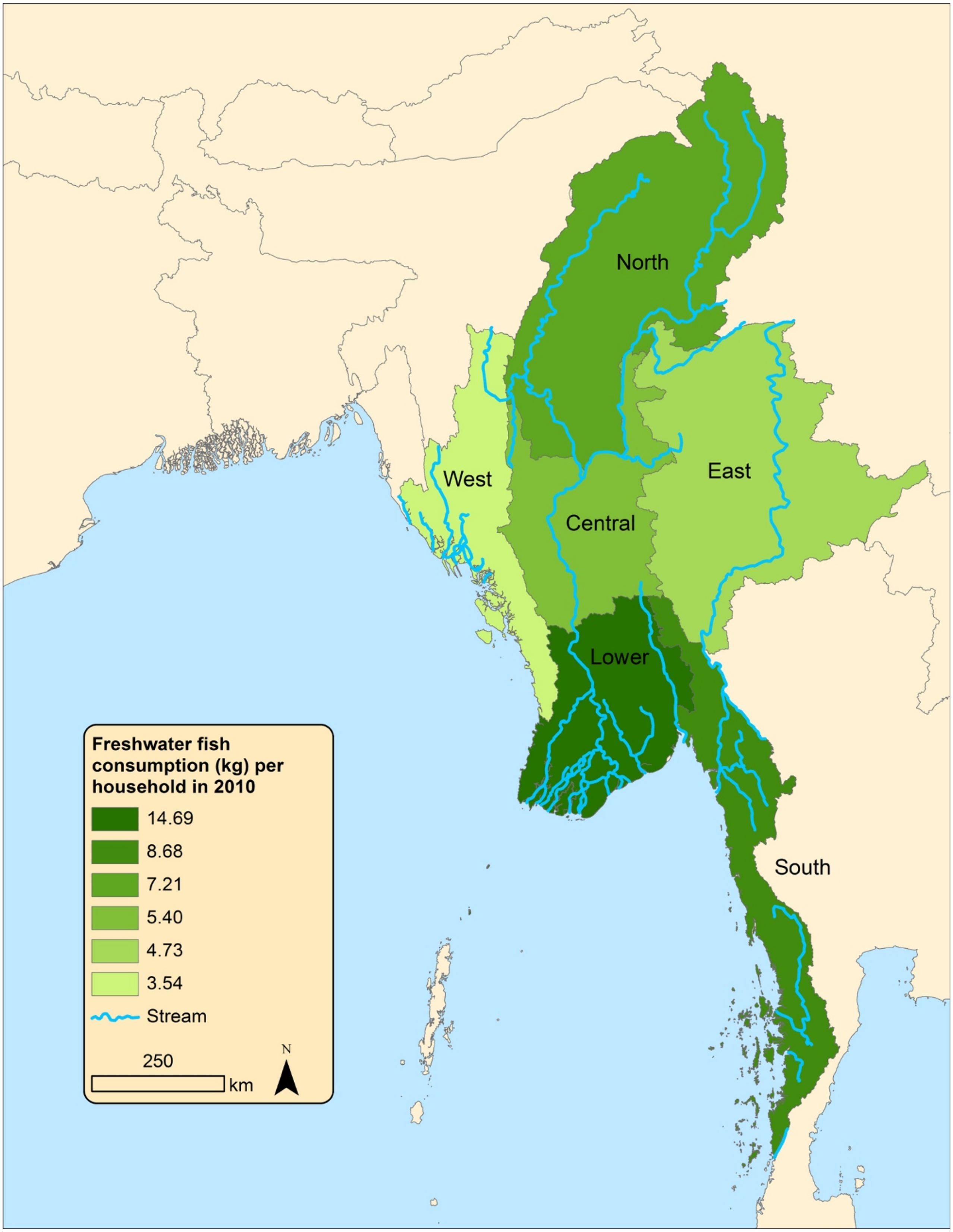

Figure 2. Map illustrating variation, by zone, of freshwater fish consumption (kg) per household in 2010.

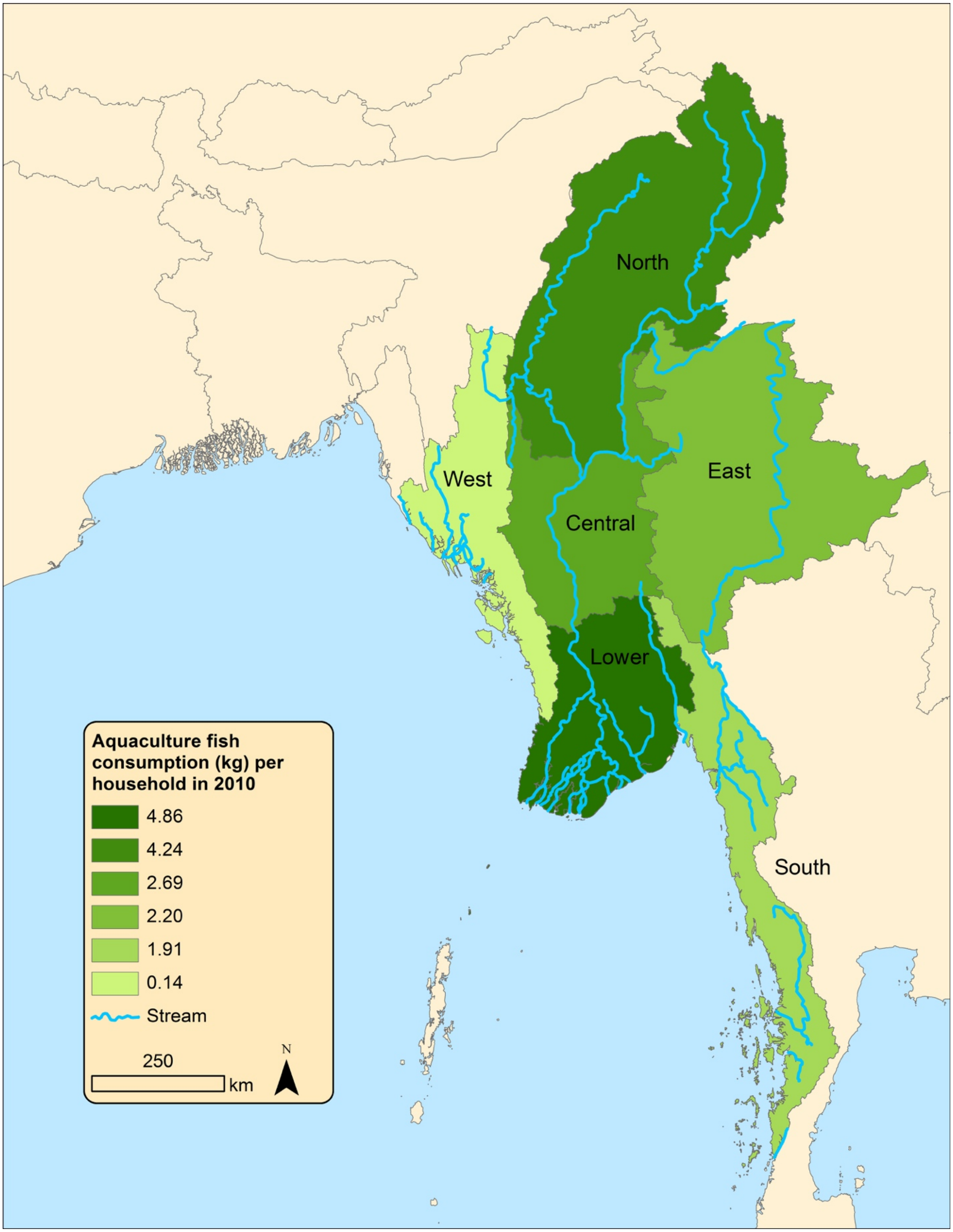

Figure 3. Map illustrating variation, by zone, of farmed (aquaculture) fish consumption (kg) per household in 2010.