Small fish for small children: Dietary intake of small fish to reduce child malnutrition in Uganda

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Summary

In Africa, one out of three children suffer from hidden hunger and are stunted. Malnutrition accounts for almost half of all child deaths across Africa. This project addresses the nutritionally unique, but under-utilized small fish that are micro-nutrient laden, and are capable of combating the triple burden of malnutrition; undernutrition, micronutrient deficiencies and obesity. Small fish are the most abundant wild animal sourced food, ubiquitous in all African coastal waters, rivers and lakes. Small fish species are ecologically resilient and capable of reproducing their own biomass 5 times per year. However, their role in contributing to food and nutritional security is equivocally understood, and in Uganda strict regulations on harvesting and marketing hinder the full utilisation of small fish for human consumption to improve food security and nutrition. This PhD project aims to examine the role of small fish in the diets of children in low-income households in northern Uganda. Further, the project will assess the potentials and barriers to improving the nutrition of school meals by inclusion of small fish as a strategy to reduce child malnutrition.

Research milieu participating in the project

University of Bergen

Department of Geography, Faculty of Social Sciences (DG)

Department of Biological Sciences, Faculty of Mathematics and Natural Sciences (BIO)

Centre for International Health, Faculty of Medicine (CIH)

Institute of Marine Research (IMR)

Department of Seafood, Nutrition and Environmental State

Uganda National Agricultural Research Laboratories (UNARL)

Makerere University (Mak)

Department of Department of Zoology, Entomology and Fisheries Sciences, College of Natural Sciences

Research project affiliation

Small Fish and Food Security: Towards innovative integration of fish in African food systems to improve nutrition (SmallFishFood) http://www.leap-agri.com/ 1M Euro; 2018-22.

Small Fish food and nutrition security from Lake Victoria, East Africa (SmallFishLakeVicEAC), International Fund for Agricultural Development, 2020-2023

Description and relevance of the involved research milieu

The unique role of fish to combat the triple burden of malnutrition; undernutrition, micronutrient deficiency and obesity are the core of the UiB-coordinated H2020 SmallFishFood project carried out by a team from Norway, the Netherlands, Germany,

Ghana, Kenya and Uganda. The Norwegian part of the budget (250.000 EUR funded by NFR) is largely used for the necessary but costly nutrient analyses, precluding PhD funding. The project addresses the value chain (fishing, processing and marketing, including nutrition and safety). The consumption end of the chain is less known, let alone its role in preventing malnutrition in school children, which this PhD project intends to focus on.

The SmallFishFood project provides a strong framework for a PhD candidate, who will benefit from a supervisory team from geography, medicine, nutrition science and fisheries biology. DG will host the PhD candidate in collaboration with an interdisciplinary team (***** indicates SmallFishFood researcher).

Main supervisor: Prof. Ragnhild Overå***** (DG) (gender, households, fish markets).
Co-supervisors: Prof. Jeppe Kolding***** (BIO) (inland fisheries, fisheries governance, food security) and Ass. Prof. Peter Andersen***** (DG) (food systems; diets; micronutrients).
Resource group: Senior Scientist Marian Kjellevold***** (IMR) (composition; fish intake, diets); CIH Profs. Anne Hatløy (households, diets), Thorkild Tylleskär (pedriatrics), Ingunn Engebretsen (child health, global nutrition).
In Uganda, data collection will be supported by SmallFishFood partners UNARL and Mak (Researcher Margaret Masette***** (product development., sensory evaluation), Lecturers Godfrey Kubiriza (experimental design), Robinson Odong (stakeholder consultations, policy reviews).

The project's aim

This PhD-project seeks to address the potential for upscaling interventions with small fish products through school meals to combat child malnutrition in selected rural poor households in the north-west of Uganda where access to fish is limited.

Overarching research question:

To what extent and in which ways is small fish included in children's diets in low-income households, and what are the potentials and barriers for enriching school diets with small fish products?

Three research objectives each provide the focus for an article constituting the PhD-thesis:

1. To examine how economic, legislative, environmental and socio-cultural factors affect children's fish access at home and in school, and assess the importance of small fish in their overall diet.
2. To assess the acceptance and consumption of small fish processed into low-cost products (deep fried, smoked, sundried, fermented and milled) among 6-12 year old school children.
3. To examine the available models for distribution and marketing of small fish products to low-income and vulnerable groups for improved nutrition in households and school feeding programmes.

Project description

A third of children in Africa suffer from hunger and malnutrition, accounting for almost half of all child deaths[1]. Fish is the most important source of animal protein in Africa, with an estimated sustainable yield of 20 million tonnes per year[2]. Small indigenous fish species (SIS) are the most ubiquitous in African waters, and are very productive, due to fast growth and maturation. In some cases, legislation acts as a barrier to harvesting small fish. This prevents low-income groups from accessing highly micro-nutrient dense small fish products. While the SIS are relatively cheap and abundant, their food and nutritional importance is less understood and largely undervalued. SIS are affordable to the rural poor, but they are increasingly being used for poultry and aquaculture feeds, ending up on the plates of middle- and high-income groups.

Dried fish are easily stored, mitigating some of the seasonal variations in food security that are common in places away from water bodies. Small fish are rich in protein, fatty acids and micronutrients such as Vitamin A, D and B_{12}, iodine, zinc and calcium. Small fish are eaten whole, and so the consumer benefits from the micro-nutrient dense eyes, bones and viscera, which are discarded in large fish. Mixing pounded dried small fish in porridges, leafy vegetables, and other sauces, or as a taste condiment that accompany staple foods is practiced in many communities. However, there is limited research into consumers' dietary knowledge for such practices, and the role of such local dishes in children's diets is largely undocumented.

This PhD-project focuses on the role of fish in the diets of children growing up in non-fishing rural communities with limited market access to fish in Uganda. Uganda is endowed with freshwater resources comprising of 18% of its surface area. There are over 300 fish species, of which more than 70% are characterised as 'small'. At commercial level, only Nile perch (*Lates niloticus*), Nile tilapia (*Oreochromis niloticus*) and Silver cyprinid (*Rastrineobola argentea,* local name Mukene) are of economic importance. The first two are mostly exported, while the latter yields around 500 000 tonnes, annually of which 70% is utilised in animal feed production or traded regionally. Sundried, smoked, fried or powdered Mukene products are increasingly marketed for human consumption. They can have a shelf life of six months, making distribution possible to communities far away from water bodies. However, strict regulations on the harvesting and marketing of Mukene and other SIS prevent engagement in small fish value chain livelihoods, and hinder the full utilisation of small fish for human consumption to improve food security and nutrition among poor and vulnerable groups such as children and lactating mothers.

Studying how fish is accessed, prepared and served is important for understanding the nutritional status of households. To date, little is known about existing practices of including small fish in children's diets, regarding preparation methods and amounts consumed, including

[1] ACPF (2019) *For Lack of Will: Child Hunger in Africa.* Addis Ababa: African Child Policy Forum (ACPF).

[2] Kolding, J., van Zwieten, P.A.M., Marttin, F., Poulain, F. and Funge-Smith, S. 2019. *Freshwater small pelagic fish and fisheries in the main African great lakes and reservoirs in relation to food security and nutrition*. FAO Fisheries and Aquaculture Technical paper 642. 110 pp. FAO, Rome

whether and how they have access to dietary intake of small fish in other food consumption arenas such as schools.

Failure to access adequate nutrient puts the children's life-long physical and cognitive development at risk[3]. The proposed cross-disciplinary PhD-project will generate baseline information necessary to inform health policies on the nutritional potential of processed small fish products and their inclusion in children's diets at home and in schools.

Methodology

This project will assess the acceptance and consumption of processed small fish products among children in low-income households in the districts of Gulu and Arua (370 and 530 kilometres from Lake Victoria, respectively). Non-fishing rural communities, some of them hosting refugee camps, will be ideal locations for studying the access, availability and consumption of small fish products. Approximately 200 households and 10 schools providing meals will participate in the proposed study. Mixed qualitative and quantitative methods will be used for studying the level of acceptance, availability and consumption trends.

Methods to meet objective 1: Surveys will map household members' education, incomes and other resources. Food preparation, dietary patterns and child feeding will be studied using interviews, observation and quantitative recording of the food items consumed using a Food Frequency Questionnaire (FFQ), including seasonal variation of intake. Seasonality of fisheries, regulations of small fish exploitation, market availability of small fish products and local culinary preferences will be examined.

Methods to meet objective 2: Surveys will be performed to map the use of small fish in school feeding programmes. In schools where small fish products are tested, equal numbers of female and male pupils will be randomly selected and offered the different products for sensory evaluation. Observation, interviews and questionnaires will be used to assess product acceptance.

Methods to meet objective 3: The marketability of new types of low-cost small fish products will be assessed through key informant interviews and focus group discussions with market leaders, handlers, processors and traders to obtain information on the small fish value chain. Small affordable single-use packs will be utilized to prevent contamination and food-borne diseases. Through SmallFishFood the PhD-project will benefit from data on nutrient content, food safety issues generated from laboratory analyses of fish samples (incl. processed fish frequently mixed in weaning foods) from local fish markets. The assessment of the suitability of the products in school meals (objective 2) will provide the basis for evaluating the practicability of upscaling their utilisation in school feeding programmes.

[33] HLPE, 2014. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Which global societal challenges does the project address?

Malnutrition threatens to destroy a generation of children in Africa. More than one third of all young children are stunted. The damage caused by stunting is irreversible. Half of children under five and one quarter of child-bearing-age women are anemic. Lack of school meals is among the reasons for high dropout rates, and even when they are provided, they are nutritionally inadequate, largely composed of carbohydrates and vegetables. It is estimated that nearly half of all child deaths between 2013 and 2015 were associated with undernutrition.

This proposed PhD-project addresses several of the Sustainable Development Goals (SDGs), in particular SDG2 Zero hunger, SDG3 Good health, SDG5 Gender equality, SDG10 Reduced inequalities, as well as SDG14 Life below water. From a global equity and health perspective, priorities in fisheries and health policies are required to ensure that seasonally abundant fish resources are utilized to their full potential for human consumption. The affordability and nutrition density of small fish make them particularly relevant for improving food and nutrition security among the poor and vulnerable groups such as children.

How does the project relate to the supervisors' research activities?

Overå has 30 years experience studying gender dynamics, poverty and fish markets in Africa. She is PI in SmallFishFood WP2 Fish processing and marketing. She participates in SmallFishLakeVicEAC on making small fish products available to consumers in Uganda.

Kolding has studies inland fisheries in Africa for 35 years and has recently published two FAO technical papers on small fish in relation to food security and nutrition[4] [5]. He is SmallFishFood project leader and participates in SmallFishLakeVicEAC on biological and legislative factors influencing SIS harvesting in Lake Victoria.

Andersen has worked on food security, micronutrients and minor crops in Africa and Asia for 30 years. He participates in SmallFishFood WP3 Nutrition and food security on influence of seasonality on dietary patterns.

Kjellevold's expertise is in food composition data, dietary intake assessment and health effects of consuming fish with special focus on micronutrients. She is PI of SmallFishFood WP3, and leads the "Nutrition and Food Safety" theme in the FAO EAF Nansen Program.

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[4] Kolding, J., van Zwieten, P.A.M., Marttin, F., Poulain, F. and Funge-Smith, S. 2019. *Freshwater small pelagic fish and fisheries in the main African great lakes and reservoirs in relation to food security and nutrition*. FAO Fisheries and Aquaculture Technical paper 642. 110 pp. FAO, Rome

[5] Kolding, J., van Zwieten, P.A.M., Marttin, F. and Poulain, F. 2016. *Fisheries in the Drylands of Sub-Saharan Africa – "Fish come with the rains". Building resilience for fisheries-dependent livelihoods to enhance food security and nutrition in the Drylands*. FAO Fisheries and Aquaculture Circular, FIPI/FIRF/C1118, 52 pp. FAO, Rome

Hatløy holds a PhD in food and nutrition security. She has been working in Africa for more than 30 years, working with nutrition, food security and living conditions,

Engebretsen is active in global health research, in particular child health. Her quantitative methodological focus involves trials, surveys and cohorts; she also does qualitative research.

Tylleskär is a paediatrician and professor in International Health. His focus is on child health, nutrition, HIV and health informatics.

Masette works on fish product development, food safety and school meals. She is a researcher in SmallFishFood and SmallFishLakeVicEAC, and works with Kubiriza and Odong on data collection and analysis.

Have the research milieu collaborated previously?

As described above, the majority of the supervisors are already collaborating in the ongoing SmallFishFood project. Overå and Kolding's research collaboration on African inland fisheries dates back to 1998. In SmallFishFood, Kolding's research on small fish harvesting is a crucial parameter for the research on small fish processing, marketing, food safety nutrition and consumer access on which Overå, Kjellevold, Andersen and Masette are working closely together in Ghana, Kenya and Uganda. The SmallFishFood project has recruited five master students (geography, medicine, fisheries biology) and DG, BIO, CIH and IMR collaborate in their supervision.

DG and CIH have cooperated through research cooperation, co-supervision of PhD students, participation in teaching interdisciplinary courses at CIH, DR Congo and BSRS 2020 (PhD course Global food systems). Several of the partners have previously cooperated on developing and submitting research project proposals. Engebretsen has participated in both of the SPIRE-funded SmallFishFood workshops organized at UiB in 2016 and 2018, and collaborates with Tylleskär on global health issues, including in Uganda.

How does the project contribute to strengthening the strategic area 'Global societal challenges' at UiB?

UiB works specifically to promote interdisciplinary research on migration, health and inequality, as key themes within its strategic initiative on global challenges. This proposal focuses directly on the latter two of these strategic priorities. Also, the UN's Sustainable Development Goals addresses directly both inequality and health.

Access to healthcare and health risks are among the most significant differentiating factors in the world today. Failing health and health services are often both a result, and a cause, of inequality. In addition, the project indirectly addresses two other strategic areas of UiB and the SDGs, namely those of renewable energy and life under water. By focussing on small fish, which are preserved by sun drying – thus using renewable energy - and low in the tropic food web – thus promoting sustainable and balanced use of the aquatic resources – the project proposal, being embedded in the ongoing SmallFishFood consortium, covers nearly all strategic priorities at UiB, and is truly transdisciplinary.

To address these issues, the SmallFishFood researcher team contributed to Day Zero in the 2020 SDG-conference at UiB with the session ‘Bringing small fish on board the SDGs for global food security’. The project also seeks to bring the global societal challenge of food security ‘on board’ UiBs marine strategic area. We strongly believe that cross-disciplinary research can contributing to bridging the different strategic areas at UiB.

This proposed PhD-project can make a valuable contribution though showing how valuable fish resources can be utilized to reduce malnutrition among populations that are among the most food insecure globally.

Plan for publication and dissemination for the project

The PhD candidate will be the lead author of the three scientific publications in international peer reviewed journals, as mentioned above in the section on the aim of the project. We expect that the findings will also contribute to several journal articles summarizing the SmallFishFood project. In addition, we aim to contribute to policy papers from FAO such as the two technical reports mentioned by Prof. Jeppe Kolding above, and similar dissemination platforms, for example through collaboration with our associated partner WorldFish. These policy oriented reports have a global readership including the African countries, but can also serve as an important communication channel to stakeholders in the political and administrative spheres. We find this is important since the fisheries policies largely are ignorant or even hostile to the utilization of small fish species, and health policies do not sufficiently take into account the potential health benefits of small fish products for reducing malnutrition.