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Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

Annual technical report

April 2024

WorldFish Penang, Malaysia

In partnership with



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA): Annual technical report

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About Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

WorldFish has partnered with the Norwegian Agency for Development Cooperation (Norad) on a 5-year project to develop low-cost and highly nutritious aquatic feeds based on novel ingredients. The project, known as Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA), will run from 2022 to 2027 with Norad funding the initiative through a NOK 80 million (approximately USD 8 million) grant. The project aims to enable 5000 smallholder aquatic food producers in Kenya, Nigeria and Zambia to test and use these feeds and ingredients, which will increase their income and improve their nation's food security as well as reduce waste and pollution. An estimated 30 and 40 percent of aquatic food producers engaged in the project will be women and youths, respectively.

Acknowledgments

The Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) project is funded by the Norwegian Agency for Development Cooperation (Norad) (Agreement SAF-21/0004). This work was undertaken as part of the CGIAR Initiative on Aquatic Foods. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

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Disclaimer

This report must be read, and the results considered, in conjunction with the climate and environmental analysis report as well as the country outcomes report for Kenya, Nigeria and Zambia under the FASA project.

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Executive summary

Introduction

This annual progress report captures highlights of the implementation of the FASA project covering the period from January to December 2023 under the five-year grant agreement with Norad (2022–2027). This report provides information on project background, implementation progress, project expenditure, physical progress by component and output, communication activities, project implementation constraints, innovative approaches or achievements as well as priorities for the coming year.

The Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) project aims to develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in three African countries to test and adopt these ingredients and feeds.

The FASA project has three main expected outcomes including i) enhanced capacity of at least two stakeholders' groups in the three target countries to integrate best practices toward a more sustainable feed sector and improve their capacity and to adopt new knowledge on nutrient requirements of multiple improved strains of tilapia and African catfish ii) quality of at least 15 local ingredients has been improved through various processing techniques and the ingredients are used by stakeholders in the three target countries including local millers and farmers, to produce at least 27 improved cost-efficient feed formulations to improve aquaculture productivity and resilience, and iii) 5000 farmers directly or indirectly linked to the project access, test, and use novel fish feeds and feed solutions using the knowledge and innovations developed by the project, with support of a range of strategic scaling partners and other stakeholders

Project expenditures

FASA project had spent NOK 11,092,910 of the NOK 80,000,000 budget approved by the Norwegian Agency for Development Cooperation (Norad), leaving a balance of NOK 68,907,089 by the end of December 2023. The expenditures included personnel, travel, consultants, equipment, project-related costs, consultant, indirect operating cost and CGIAR consortium cost.

Project output and key activities

Project start up activities

In 2023, two sub grant agreements and two contract agreements has been signed with new project partners, including the scaling partner of IITA, NRDC and consulting firms from NAGI Enterprise and Includovate. The hiring process has been completed with the hiring of scaling experts from IITA, interns at WorldFish Headquarters and two consulting firms from Includovate to work on Gender and social inclusion and and NAGI enterprise to work on climate change and environmental analysis.

Cross-cutting/regular activities

In 2023, the cross cutting/ regular activities in the FASA project included the procurement activities, annual project meetings, monthly internal WorldFish meetings, regular project meetings with partners and monitoring and evaluation activities such as data updates on the MEL platform with the assistance of WorldFish's monitoring, evaluation and learning (MEL) specialist, routinely collected data to monitor the progress of project activities and results, after which the data was documented in the MEL database. The major achievement in this activities included the conduct of annual project workshop held on November 2023 in Nigeria. Workshop participants included WorldFish representatives, FASA partners, consultants and stakeholders.

Communication activities

In addition to project start-up and cross cutting activities, FASA's communication activities for 2023 included completed the FASA's communication strategy, developed and updated the project's webpage on a regular basis, conducted a fish-for thought event to introduce the FASA project, produced four blog posts, produced two social media updates and published project newsletters. Overall, the communication activities has been successfully accomplished and progressing well.

Project Outcome/output activities

Output 1.1: New knowledge on the type, price and seasonality of local ingredients used in animal (fish) feeds produced in the three focal countries and made available within and outside the focal countries.

Scoping assessment

The major accomplishment of this outputs included the completion of scoping assessments which has been conducted by the WorldFish Zambia in Zambia and CORAF in Nigeria. The assessment has identified novel local feed ingredients from diverse locations of Zambia and Nigeria. The ingredients were collected and shipped to WorldFish HQ in Malaysia for proximate analysis and to be used in the digestibility experiment, as well as to SLU Sweden for biochemical analysis.

Output 1.2: Viable opportunities and pathways for women and youths integrated into the fish feed sectors in the three focal countries and made widely available, with a focus on feeds derived from (novel) local ingredients.

Includovate has been selected as a consulting firm to lead the work on gender equality and social inclusion (GESI) in the FASA project. There are two specific objectives: (1) conduct gender and social assessments to develop sustainable feeds and (2) investigate opportunities to increase GESI within the evolving feed ecosystem. The research questions has been designed to reveal gendered and socially diverse needs, risks and opportunities associated with novel feed ingredients.

Output 1.3: Strategies and opportunities to increase environmental sustainability and climate resilience in the fish feed landscape in the three focal countries identified and made widely available, with a focus on feeds derived from (novel) local ingredients.

NAGI Enterprise was selected as the consulting firm to carry out the activities under output 1.3. The specific goals of the climate and environmental analysis and LCA component of the project including i) an assessment of climate and environment on fish feed ii) an examination of data weaknesses for the LCA, among other outcomes and iii) the development of an outcomes report with risk analysis and an environmental management plan for the LCA.

Output 1.4: New knowledge on market trends and the commercial viability of feeds derived from (novel) local ingredients produced in the three focal countries and made widely available

IITA has been designated as a new partner that will conduct scaling activities in the project. The Market Intelligence and Scaling Team (MIST) will be responsible to manage and carry out the activities under this output . MIST objective is to provide crucial market intelligence and develop strategies to scale locally sourced fish feed and to use solutions developed by the project to achieve sustainable and inclusive use at scale. As a new addition to the project the team has spent its initial efforts on subcontracting, recruitment and planning the work.

Output 1.5: New knowledge and data on the nutrient requirements for improved strains of tilapia and African catfish produced, validated and made widely available.

In Zambia the fish nutrient experiment has been conducted by the WorldFish Zambia team. The initial nutrient requirement aimed to determine the lysine requirement for the SUZ and Genetic Improvement Program (GIP) strains of three-spotted tilapia (*O. andersonii*). Five experimental diets that included varying levels of lysine has been formulated and used in the experiment. In Nigeria, CORAF has started the two experiments on the methionine and lysine requirements for the improved strain of tilapia and African catfish.

Output 2.1: New data and knowledge on local ingredients generated and used to formulate novel fish feeds and made widely available.

In WorldFish HQ Malaysia, the digestibility experiment, originally planned for 2023, was postponed to 2024 because of the delay in receiving the ingredients from the country partners and a technical problem with the experiment facility. However, WorldFish HQ has received ingredients 11 ingredients from Zambia and has conducted a proximate analysis of the ingredients. Data obtained from the analysis was compiled into a database and the ingredients were then used to manufacture the diet for using in the tilapia digestibility experiment.

In Sweden, the SLU has also obtained 11 feed ingredients from Zambia and has conducted biochemistry analysis on the ingredients.

Implementation constraints

There were some challenges faced by the implementing partners during the project activities implementation included problem in acquiring an import permit to ship feed ingredients from project countries to Malaysia because of the complex application procedures and strict regulatory requirements. Besides that there were some challenges in the initial administration, contracting finance process as well as field data collection which sometime delay the activities progress and deliverable.

Conclusion

Overall, all component outputs implemented in 2023 are actively progressing and catching up with the project work plan. The scoping assessments Nigeria and Zambia have been completed while assessment in Kenya is underway and will be completed in 2024. The kick-off meeting has been completed while annual project workshop, online workshop with stakeholders, as well as the in-person stakeholder workshop are all ongoing. All partners and PhD student who will undertake the project output have been identified and hired. The experiment of fish nutrient requirement in Zambia, Nigeria and Kenya are ongoing and progressing well. The scaling activities, gender inclusion analysis, climate change and environment analysis are underway and continuing undertaken. Thus, with proper planning and regular communication with each partner, the objective of the project could be achieved.

Section A

Background

Project title: Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA).

Project goals: Develop low-cost, highly nutritious fish feeds based on novel ingredients, and enable 5000 smallholder fish farmers in three African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security, and reduced waste and pollution.

Project objectives: Develop and increase access to local, sustainable ingredients and formulate novel fish feeds from Sub-Saharan Africa countries (Zambia, Nigeria and Kenya), done in a socially and environmentally responsible manner that responds to sustainability and climate change, as well as gender and social inclusion issues.

Project outcomes/outputs

The project has three main expected outcomes, and each outcome has several outputs to be delivered:

Outcome 1: Enhanced capacity of at least two stakeholder groups in the three target countries to integrate best practices toward a more sustainable feed sector and to improve their capacity and to adopt new knowledge on the nutrient requirements of multiple improved strains of tilapia and African catfish.

Output 1.1: New knowledge on the type, price and seasonality of local ingredients used in animal (fish) feeds produced in the three focal countries and made available within and outside them.

Output 1.2: Viable opportunities and pathways for women and youths to be more integrated into the fish feed sectors identified in three focal countries and made widely available, with a focus on feeds derived from (novel) local ingredients.

Output 1.3: Strategies and opportunities to increase environmental sustainability and climate resilience in the fish feed landscape of the three focal countries identified and made widely available, with a focus on feeds derived from (novel) local ingredients.

Output 1.4: New knowledge on market trends and the commercial viability of feeds derived from (novel) local ingredients produced in the three focal countries and made widely available.

Output 1.5: New knowledge and data on the nutrient requirements of improved strains of tilapia and African catfish produced, validated and made widely available.

Outcome 2: The quality of at least 15 local ingredients has been improved through various processing techniques, and the ingredients are used by stakeholders in the three target countries, including local millers and farmers, to produce at least 27 improved cost-efficient feed formulations to improve aquaculture productivity and resilience.

Output 2.1: New data and knowledge on local ingredients generated, used in the formulation of novel fish feeds and made widely available.

Output 2.2: Databases and digital solutions developed for use by farmers to formulate and adapt new local feeds on a “real-time” basis.

Output 2.3: Improved knowledge and capacity of millers, farmers and other stakeholders to use novel ingredients to create the most affordable, highest quality fish feeds that take into account context specific circumstances and needs.

Outcome 3: A total of 5000 farmers directly or indirectly linked to the project access, test and use novel fish feeds and feed solutions using the knowledge and innovations developed by the project, with support of a range of strategic scaling partners and other stakeholders.

Output 3.1: Integrated knowledge for enabling the scaling environment (including exploring barriers and bottlenecks to scaling) strategies for scaling up the use of novel feeds and feed management approaches in the three target countries co-developed with stakeholders and used to guide the selection of country scaling strategies.

Output 3.2: Strategic partnerships for scaling the use of the project’s innovations and knowledge built and made operational with a range of partners in the focal countries.

Output 3.3: Strategic capacity development and public awareness campaigns delivered to widely disseminate knowledge, innovations and tools developed by the project.

Section B

Implementation progress

Project expenditures

Total budget	Year 2023
Funds received (NOK)	80,000,000
Expenditures (NOK)	11,092,911
Balance (NOK)	68,907,089

As of December 2023, the FASA project had spent NOK 11,092,910 of the NOK 80,000,000 budget approved by the Norwegian Agency for Development Cooperation (Norad), leaving a balance of NOK 68,907,089. The expenditures were as follows:

- Personnel costs (NOK 4,460,326)
- Travel (NOK 722,217)
- Consultants (NOK 1,483,085)
- Communications and publications (NOK 158,976)
- Training and workshops (NOK 948,532)
- Purchased equipment (NOK 132,620)
- Specific project-related costs (NOK 629,603)
- Operating costs (NOK 613,048)
- Partner 1 – Swedish University of Agricultural Sciences (SLU) (NOK 117,091)
- Partner 2 – West and Central African Council for Agricultural Research and Development (CORAF) (NOK 91,091)
- Partner 3 – National Agricultural Research System (NARS) / Natural Resources Development College (NRDC) (NOK 59,600)
- Partner 4 – International Centre of Insect Physiology and Ecology (ICIPE) (NOK 602,532)
- Partner 5 – International Institute of Tropical Agriculture (IITA) (NOK 145,207)
- Indirect operating costs (NOK 711,475)
- CGIAR consortium costs (NOK 217,508).

Details are presented in the annual financial report of the FASA project (Appendix 1).

Project start-up activities

The start-up activities for the FASA project in 2023 included (i) negotiating, preparing and signing project agreements with key partners, (ii) recruiting new staff, (iii) developing a hiring plan for the project and (iv) recruiting two PhD students (one each from Nigeria and Zambia) and 10 MSc students (Kenya).

Negotiate, prepare and sign project agreements with key partners

WorldFish continued the conversation with the project's partners, including the subgrant agreement. From January to December 2023, two subgrant agreements and two contract agreements were signed with project partners, including the NRDC on May 29, 2023, the scaling partner of IITA on August 14, 2023, the selected consulting firm, NAGI Enterprise, on January 17, 2023, and Includovate on February 2, 2023. All subagreements and contracts are listed in Appendix 2.

Recruit new staff

With support from its human resources department, WorldFish continued to hire experts in 2023 to fulfill the project's staffing plan. The process included hiring scaling experts from IITA, interns at WorldFish Headquarters and two PhD students from Nigeria and Zambia. The hiring of Nigerian PhD student was completed in November 2023, while the hiring of the PhD student from Zambia was completed in early 2024.

In Kenya, the ICIPE has employed Dr. Menaga Meenakshisundaram as a postdoctoral fellow. Prof. Meenakshisundaram joined the ICIPE on November 28, 2023, to take up her new position and has settled down to kick-start her research activities in the FASA project.

Develop a hiring plan

WorldFish’s hiring plan for the FASA project has been updated to include the two PhD students in Nigeria and Zambia, climate change consultants from Includovate, gender inclusion consultants from NAGI Enterprise and interns at WorldFish. The hiring plan was aligned with the human resources policies of WorldFish and One CGIAR.

Recruit two PhD students and 10 MSc students

The project leader from WorldFish and the SLU, with coordination from WorldFish’s human resource department, conducted interviews with several potential candidates to select a suitable person to fill the PhD position at the SLU. Mr. Arnold Irabor was chosen for Nigeria’s PhD student post, and his contract with WorldFish was signed in November 2023. Meanwhile, the recruitment process for Zambia’s PhD student was expected to be completed in early 2024. Documents of the PhD candidate from Nigeria for admission into the PhD program at the SLU are currently being examined. Regular meetings are held with the PhD candidate from Nigeria.

In Kenya, the ICIPE has recruited two master’s students—Ms. Judy Wambui Kaguthi and Mr. John Mutiso Muia—to undertake the MSc program in aquaculture and fisheries management. The hiring process for other MSc students in Kenya is still ongoing and was expected to be completed in 2024.

Conduct project start-up workshops

In Kenya, the ICIPE organized a start-up online meeting on January 18, 2023. Twenty-eight people attended the meeting, including representatives from WorldFish, the Kenya Marine and Fisheries Research Institute (KMFRI), the Kamuthanga Fish Farm in Machakos, Kenya, Victory Farms Ltd in Kenya (private sector), national universities (e.g. University of Eldoret), the Jabali Fish Farm (Jabali Fisheries Traders), beach management units from county governments, the Kenya Bureau of Standards, and selected fish farms.

In Sweden, the SLU collaborated with WorldFish Headquarters to organize a daylong webinar on the Swedish launch of the FASA project on March 7, 2023. This event had the additional support of the SLU’s [Global Office](#) and [Aquaculture Platform](#), both of which played vital roles in its organization.

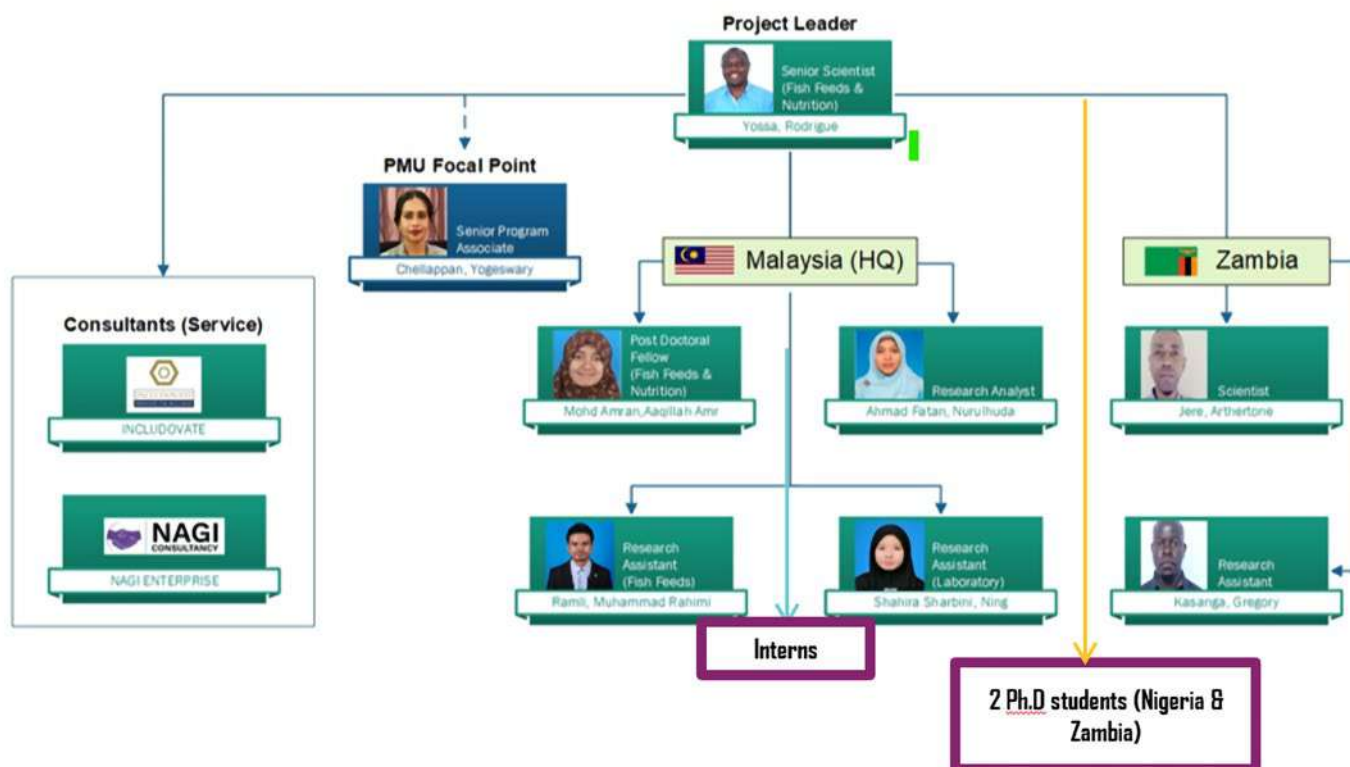


Figure 1. WorldFish–FASA project organizational chart.

The event featured speakers from the SLU, WorldFish and Stockholm University, all of whom possess extensive experience working in the Global South, and they were invited to share their insights on the significance of the FASA project. The webinar, which had a [detailed agenda](#), attracted 54 participants from diverse regions, including Asia, Europe and Africa, representing a wide range of stakeholders, including academia/universities, nonprofit organizations, and aquaculture and aquafeed industries, as well as ministries of animal production.

The webinar facilitated a robust exchange of knowledge and ideas among participants. Through presentations, discussions and interactive sessions, participants gained valuable insights into the FASA project. One of the most significant achievements of the workshop was the initiation of future collaborative projects and partnerships.

Develop a detailed project communications plan, messaging guide and templates

In June 2023, WorldFish's communication team completed and produced a detailed project communications strategy (Appendix 3). The strategy includes activities to achieve FASA's communication objectives, target audiences, key messages and communication tools to achieve successful communication outcomes. FASA's communications strategy adheres both to Norad's guidelines and WorldFish's branding guidelines.

Cross-cutting/regular activities

For the project's first year, FASA's cross-cutting/regular activities included (i) procuring and transferring project materials, (ii) annual project meetings among rotating countries, (iii) monthly internal WorldFish meetings, (iv) regular project phone calls/online meetings, (v) monitoring and evaluation check-ins and data updates on the MEL platform, (vi) an annual outcome monitoring study and (vii) developing an annual project donor report.

Procuring and transferring project materials

WorldFish's procurement team continued to assist with the acquisition of supplies for FASA's activities in Penang and Zambia. The team helped purchase equipment and materials to

upgrade the lab at the NRDC in Zambia and provided support with purchasing ingredients and consumables needed to conduct fish nutrition experiments in Penang and Zambia. The team also helped ship feed ingredients from Zambia to WorldFish Headquarters. The process followed the procurement policies of both WorldFish and One CGIAR.

Annual project meetings

The second annual project workshop was held in Nigeria on November 6–9, 2023. The workshop consisted of a 2-day meeting at the Rockview Hotel in Abuja on November 7–8 and 2 days of field visits to a feed mill and fish farm in Abuja on November 6 and to the Nigerian Institute for Oceanography and Marine Research (NIOMR) in Lagos on November 9. The workshop was also conducted online.

Workshop participants included WorldFish representatives, FASA partners, consultants and stakeholders, including CORAF, the ICIPE, the NRDC, the SLU, Includovate, NAGI Enterprise, IITA, Aller Aqua Zambia Limited, the Agricultural Research Council of Nigeria, and the NIOMR. The Norwegian ambassador to Nigeria officially opened the workshop on the first day, at the Rockview Hotel.

The details of the workshop, including the agenda, presentation, discussions and deliberations, are in the workshop report (Appendix 4). The [workshop report](#) has been uploaded onto the WorldFish website and should be cited as the following:

WorldFish. 2024. Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA). Annual workshop report. WorldFish. Workshop Report.

WorldFish meetings

WorldFish conducted monthly internal project meetings to monitor the project implementation. One of the outcomes was a request for adjustments in the implementation plan.

Regular project phone calls and online meetings

WorldFish maintains close communication with FASA partners and potential beneficiaries of the project. For instance, WorldFish's project leader meets virtually with the SLU, CORAF, ICIPE and IITA on a quarterly basis and communicates weekly with the focal points of the project at those partner institutions. The project leader also meets in-person with WorldFish Headquarters and virtually with WorldFish Zambia on a monthly basis.

MEL check-ins and data updates

FASA's project team, with the assistance of WorldFish's monitoring, evaluation and learning (MEL) specialist, routinely collected data to monitor the progress of project activities and results, after which the data was documented in the MEL database. The database is an important tool for the project that will be used to monitor, evaluate and learn from throughout the project's life cycle. The goal is to ensure that the project's outputs and deliverables outlined in its implementation

workplan are carried out as planned and that the expected results are obtained. Deliverable reports, including the technical report, annual workshop reports and activities report, have been posted to the MEL system for tracking. Changes in the timeline of project activities were also recorded in the system.

Communication activities

In addition to project start-up and outcome 4, FASA's communication activities for 2023 included (i) developing and updating the project's webpage on a regular basis, (ii) fish-for thought events, such as themed lectures and talks, (iii) producing four blog posts per year, (iv) producing two social media updates per month, (v) producing two case studies or success stories per year, (vi) producing one photo story per year and (vii) publishing and circulating project newsletters.

Develop and update the project's webpage

WorldFish's communication team completed the development of FASA's website in September 2023.

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WorldFish

RESEARCH | WHERE WE WORK | RESOURCES | NEWS | ABOUT US

DEVELOPMENT AND SCALING OF SUSTAINABLE FEEDS FOR RESILIENT AQUATIC FOOD SYSTEMS IN SUB-SAHARAN AFRICA (FASA)

Home

WorldFish is managing the project titled "Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)", which goal is to develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in 3 African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security, and reduced waste and pollution. The FASA project will be implemented in will be implemented mainly in Nigeria, Zambia, and Kenya, with additional research activities to be completed in Malaysia and Sweden.

Primary project goal: To develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in 3 African countries to test and adopt these ingredients and

Share [Social Media Icons]

Outcome 1: Enhanced capacity of at least two stakeholder groups in each of the 3 target countries to integrate best practices toward a more sustainable feed sector, and to adopt new knowledge on nutrient requirements of multiple improved strains of tilapia and African catfish.

Outcome 2: Quality of at least 15 local ingredients has been improved through various processing techniques and the ingredients are used by stakeholders in the 3 target countries, including local millers and farmers, to produce 9 novel, cost-efficient feed formulations, to improve aquaculture productivity and resilience.

Outcome 3: 5,000 farmers directly or indirectly linked to the project access, test, and use novel fish feeds and feed solutions using the knowledge and innovations developed by the project, with support of a range of strategic scaling partners and other stakeholders.

Research Area

- Fish Feeds and Nutrition
- Gender and Social Inclusion
- Climate Change and Environmental Assessment

Reports

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) - Annual Workshop Report

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa

PROJECT DETAILS

Jul 2022 - Jun 2027

Nigeria
Kenya
Zambia

CONTACT US

PARTNERS

CORAF | icipe | SLU | IITA

DONORS

Figure 2. FASA's webpage.

Fish-for thought events

The communication team organized a Fish4Thought event in conjunction with the Kenya High Commissioner's visit to WorldFish. The event was held on Wednesday, August 2, 2023, at WorldFish Headquarters. In one of the sessions, the FASA team presented an overview and introduction about the project.

Social media updates

Social media updates were completed each month in 2023, as per the implementation plan. They include promotional blasts on X (formerly Twitter), Facebook and LinkedIn:

X:

<https://twitter.com/WorldFishCenter/status/1632652628617199619?s=20>

<https://twitter.com/WorldFishCenter/status/1630491893304811520?s=20>

<https://twitter.com/WorldFishCenter/status/1599591951283748864?s=20>

<https://twitter.com/WorldFishCenter/status/1633649044206796801?s=20>

<https://twitter.com/WorldFishCenter/status/1659106933419245568?s=20>

<https://twitter.com/WorldFishCenter/status/1656932569261264898?s=20>

<https://twitter.com/WorldFishCenter/status/1664180464695889920?s=20>

<https://twitter.com/WorldFishCenter/status/1695982106042900866?s=20>

Facebook:

<https://www.facebook.com/worldfishcenter/photos/a.111238691762/10160851261906763/>

<https://www.facebook.com/worldfishcenter/photos/a.111238691762/10160838397011763/>

<https://www.facebook.com/worldfishcenter/posts/pfbid0265fperEKVv9mbf9QMBEYrHF8RQibQ5aAZGvu9AW2PDgphjHDZHFQPDxzqQaCipl>

<https://www.facebook.com/worldfishcenter/photos/a.111238691762/10160856957431763>

<https://www.facebook.com/worldfishcenter/photos/a.111238691762/10161011977751763/>

<https://www.facebook.com/worldfishcenter/posts/pfbid0FQw9aNTmC7oa4J2TqTUvZijBzmBEXWGoxuaSbokqTqYRRwYeVHxTu2TPeBtxEWjMI>

<https://www.facebook.com/worldfishcenter/posts/pfbid02hViuTrRTCpYdENm4SSRa5xvmnmaSvAcTXounim7CNJ5PFiHWOgCd3DFPuy4HhqMql>

<https://www.facebook.com/worldfishcenter/posts/pfbid02cQ97FGv7f1J5xv2DJrqqg3DbPjjYjuWKFMKptdTH9jQhxXzqtgc6WtW8Jfec3i5dl>

Blog posts

The following four blogs were published on the FASA project website:

1. [In the Spotlight: Nurulhuda Ahmad Fatan](#)
2. [Engaging local partners to develop sustainable feeds in Zambia](#)
3. [WorldFish engages local partners to produce affordable feeds](#)
4. [WorldFish's research draws interest at Zambia's 95th Agriculture and Commercial Show](#)

LinkedIn:

<https://www.linkedin.com/feed/update/urn:li:activity:7038448240475738113>

<https://www.linkedin.com/feed/update/urn:li:activity:7036273889282318336>

<https://www.linkedin.com/feed/update/urn:li:activity:7005380291032735744>

<https://www.linkedin.com/feed/update/urn:li:activity:7039444774596087808>

<https://www.linkedin.com/feed/update/urn:li:activity:7064902589762437120>

https://www.linkedin.com/posts/worldfish_aquaticfoods-foodsystems-foodpolicy-activity7130857341490532352jbn5?utm_source=share&utm_medium=member_desktop

Newsletters

Project promotions were featured in the following newsletters:

WorldFish newsletters:

<https://mailchi.mp/cgiar/international-campaign-2022-earth-overshoot-day-1194767>

<https://mailchi.mp/cgiar/quarterly-dive-q32022>

Annual newsletters:

[https://mailchi.mp/cgiar/international-campaign-nourishing-livelihoods-with-aquatic-foods-1194931?e=\[UNIQID\]](https://mailchi.mp/cgiar/international-campaign-nourishing-livelihoods-with-aquatic-foods-1194931?e=[UNIQID])

<https://twitter.com/WorldFishCenter/status/1691005825869901825?s=20>

<https://www.facebook.com/worldfishcenter/posts/pfbid032jgVRzWGFyy1eV4F3A4H6ktxSQoYMLyFVSBsq77hkGE43htSLFBv2yzjS383krTq>

Hot of the Press newsletter:

<https://mailchi.mp/cgiar/updated-hot-off-the-press-may-2023-1194919>

Project outcomes

Outcome 1: The capacity of at least two stakeholder groups in the three target countries to integrate best practices toward a more sustainable feed sector and to improve their capacity to adopt new knowledge on the nutrient requirements of multiple improved strains of tilapia and African catfish.

Output 1.1: New knowledge on the type, price and seasonality of local ingredients used in animal (fish) feeds produced in the three focal countries and made available within and outside the focal countries.

WorldFish

Scoping assessment

At WorldFish Zambia, major outputs from this component included the completion of a scoping assessment, which was conducted from March 18

to May 22, 2023, in five districts in six provinces: Eastern, North-Western, Southern, Luapula, Northern and Lusaka. All of the collected data was compiled and analyzed. The report is currently being prepared and will be completed in 2024.

The objective of the assessment was to map and collect relevant information on the type, price and seasonality of local novel fish feed ingredients in targeted areas of Zambia. Additionally, the assessment aimed to provide more information on the availability and general value chain of local feed ingredients in the country and to determine how the fish feed value chain affects the aquaculture industry.

Prior to the survey and data collection, a research document and research protocol that outlines the objectives, methodology and procedures for the assessment was developed to serve as a roadmap

for the study design. The project leader approved the research protocol, and the document has since aided in obtaining ethical approval from participants for collecting data and samples of novel feed ingredients.

The assessment identified and collected 11 novel feed ingredients from various parts of Zambia (Table 1): siavonga kapenta (*Limnothrissa miodon*), crayfish (*Cherax Quadricarinatus*), kakeya (assorted small fish), vinkubala caterpillar, tukanja caterpillar, chisense (*Potamothrissa acutirostris*), sunflower cake meal (*Helianthus annuus*), velvet bean meal (*Mucuna pruriens*), velvet bean seed (*Mucuna Pruriens*), tea waste (*Camellia sinensis*) and chikanda (*Disa robusta*).

These samples were shipped to WorldFish's Feed and Nutrition Laboratory in Malaysia for the digestibility study and to the Swedish University of Agricultural Sciences for biochemical analyses.

ICIPE

Scoping assessment

In Kenya, the ICIPE conducted a desktop literature review. The review was able to uncover only two important studies on fish feed ingredients that are well documented: Munguti et al. (2006) and Munguti et al. (2012). The first study reported on potential feedstuffs for Nile tilapia (*Oreochromis niloticus*) production in Kenya and revealed the proximate composition of four more of animal origin: freshwater shrimp meal, broiler hydrolyzed

feathermeal, indigenous chicken hydrolyzed feathermeal, and omena (*Rastrineobola argentea*). It also found 13 different plant parts and by-products (Arrow root leaves, banana peels, banana stem, banana leaves, boiled tea leaves residue, cassava leaves, Leucaena leaves, papaya peel, papaya leaves, pyrethrum whole, sweet potato leaves, water fern and water hyacinth) and four seed meals (cottonseed cake, mango seed embryo, papaya seed meal and sunflower seed cake).

The findings showed that animal-derived feed has a higher protein content than plant by-products. Nonetheless, the costs of these animal-derived feed components are often significant, making them difficult to be cost-effective for semi-intensive tilapia production systems. Leaves such as tea residue (*Camellia sinensis*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), papaya (*Papaya carica*) and hydrolyzed feathermeal have significant potential as feedstuffs for tilapia grown in semi-intensive pond culture, which is heavily reliant on protein and crude fiber. Before large-scale application, however, further research is needed to assess the amino acid composition, digestibility and antinutritional aspects of these feedstuffs, as well as potential competition from other uses, especially human.

The second study discovered that feed ingredients of animal origin contain much more crude protein than those of plant origin. Freshwater prawn (*Caridina nilotica*) had the highest crude protein

District	Collection date	Source	Local name	Scientific Name
Siavonga	March 19, 2023	Animal	Siavonga kapenta	<i>Limnothrissa Miodon</i>
Monze	March 21, 2023	Animal	Red crayfish	<i>Cherax Quadricarinatus</i>
Zambezi	March 28, 2023	Animal	Kakeya fish	
Zambezi	March 28, 2023	Animal	Mumbwedidi	<i>Gonimbrasia Zambesina</i>
Kasama	April 19, 2023	Animal	Ifishimu	<i>Gonimbrasia Belina</i>
Chiengwe	April 24, 2023	Animal	Chisense	<i>Potamothrissa Acutirostris</i>
Zambezi	March 28, 2023	Plant	Sunflower cake meal	<i>Helianthus Annuus</i>
Mbala	April 13, 2023	Plant	Velvet bean meal	<i>Mucuna Pruriens</i>
Mbala	April 13, 2023	Plant	Velvet bean seed	<i>Mucuna Pruriens</i>
Kawambwa	April 22, 2023	Plant	Tea waste (red dust)	<i>Camellia Sinensis</i>
Mansa	April 27, 2023	Plant	Chikanda powder	<i>Disa Robusta N.E.Br.</i>

Table 1. List of feed ingredients in the scoping assessment for Zambia.

content (635 g/kg of dry matter base). Freshwater prawn, blood meal, meat, and bone meal were the most promising sources of animal-based protein based on feed ingredient availability, potential competition with other human uses, crude protein and crude fiber content, and the feasibility of removing antinutritional factors. Cotton (*Gossypium* spp.) and sunflower (*Helianthus annuus*) seed cakes were the best sources of processed plant protein. Gallant soldier (*Gali-songa parviflora*) leaves, sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*) and papaya (*Papaya carica*) leaves were identified as plant-based feeds that held high potential for small-scale fish aquaculture, whether processed or raw.

In preparation for the scoping assessment, the project made field visits to fish farms (with cage, pond and recirculation aquaculture systems) and fish feed manufacturers in Central and Western Kenya to identify potential areas for project implementation.

Based on the in-person stakeholder survey, a harmonized protocol for a countrywide baseline survey has been developed in accordance with the criteria of the survey questionnaires used in Zambia and Nigeria. The protocol has been approved and was used as guide in the assessment. A nationwide survey was conducted in March 2024 to collect data in eight Kenyan counties representing the western and coastal regions. The ICIPE team intended to interview at least 750 people, and the survey was supervised by the ICIPE's Social Sciences and Impact Assessment Unit in collaboration with the postdoctoral fellow.

CORAF

Scoping assessment

In Nigeria, CORAF has completed the scoping assessment on new knowledge of the type, price and seasonality of local ingredients used in animal (fish) feeds produced in the country. The report was expected to be completed in early 2024.

Prior to the assessment, a research protocol, approved by the project leader, was developed, and the Health Research Ethics Committee of College of Medicine at the University of Lagos provided ethical approval for the baseline surveys.

In the assessment, 920 responses were gathered from 46 locations, averaging 20 respondents

per location. At least five respondents from each location were interviewed in 22 states in Nigeria and the Federal Capital Territory. Various major ingredients were assessed across the country's zones, including groundnut cake in North Central, soybean in North East, maize in North West, cassava and rice bran in South East, cassava in South, and cassava and maize in South West.

A total of 16 different local ingredients were identified, and 10 kg of each ingredient were collected across the country. The ingredients were dried, milled and packaged and then will be sent to Malaysia and Sweden for analyses. The ingredients collected are as follows:

1. African locust bean polishing (waste)
2. Baobab meal
3. Cowpea (white)
4. Cowpea (brown)
5. Bambara nut bran
6. Local brewer waste
7. Shea nut cake
8. Clupeidea fish (*Pellonula leonensis*)
9. Clupeidea fish (*Sierrathrissa leonensis*)
10. Black soldier fly larvae
11. Chaya leaves
12. Plantain peels
13. Yam peels
14. Roselle seed meal
15. Tiger nut waste
16. Ground nut oil.

Output 1.2: Viable opportunities and pathways for women and youths integrated into the fish feed sectors in the three focal countries and made widely available, with a focus on feeds derived from (novel) local ingredients.

Includovate

Includovate was selected as a consulting firm to carry out the gender and social assessment in output 1.2. The consultant will develop and conduct mixed methods gender and social

assessments in Nigeria, Zambia and Kenya, applying a context-sensitive approach and developing sex disaggregated data.

Gender equality and social inclusion assessment

The primary purpose of the assessment is to lead the work on gender equality and social inclusion (GESI) in the FASA project. There are two specific objectives: (1) conduct gender and social assessments to develop sustainable feeds and (2) investigate opportunities to increase GESI within the evolving feed ecosystem. The research questions were designed to reveal the gendered and socially diverse needs, risks and opportunities associated with novel feed ingredients. To comprehend GESI, the project used the ADS 205 framework, which focused on laws, policies, cultural beliefs, gender roles, resource access and decision-making. The assessment used a mixed research approach and included 28 key informant interviews and 420 survey responses from the three focal countries.

These assessments will enable WorldFish to identify risks and ensure that women, youths and other marginalized groups are prioritized throughout implementation and that they have the same access to project opportunities as non-marginalized groups. The assessments identified the extent to which laws, policies, regulations and institutional practices contain explicit or implicit gender biases. Explicit biases include explicit provisions that treat males and females differently, and laws and regulations that criminalize and/or restrict individuals based on their gender identity or expression. Implicit biases include the impacts of laws, policies, regulations and practices on men and women because of different social arrangements and economic behavior. The assessment examined locally accepted quality of life goals and aspirations, perceptions of gender identity and expression, and ideas that impact participation in project activities.

The assessment examined the gendered division of labor between men and women across paid and unpaid work (caregiving and household tasks) and community service to identify potential constraints to participation in development projects. They also mapped the productive assets and resources (land, housing, equipment, income, social benefits, public

services and technology) and differences in access to information. The assessment examined the ability of men and women to decide, influence and exercise control over productive and financial resources, and their decision-making capacity in agricultural cooperatives.

The KIIs in the assessment found that the respondents had little knowledge of the formal laws, policies and regulations governing fisheries in each of the three focal countries. The household survey did not ask about policies and laws, but it did ask questions about institutions working in local communities to remove gender and youth barriers. The findings show that there may not be many such organizations in their communities, or respondents do not know about those that do exist, especially when it comes to removing barriers that women face in their communities. Kenya stands out with the highest level of awareness, followed by Zambia and Nigeria. In all three countries, however, far more respondents either did not know or did not believe that such organizations exist.

In conclusion, FASA's GESI assessment sheds light on intricate gender dynamics within rural fishing communities of Nigeria, Zambia and Kenya. The research highlights profound cultural norms and beliefs that perpetuate gender inequalities, especially concerning women's access to technology and opportunities in the fishing industry. Although theoretical acceptance of shared responsibilities exists, these beliefs often do not translate into practical applications within households because of the fear of community disapproval, particularly among men. The study illuminates various aspects of gender roles, decision-making patterns, and access to resources and information. It reveals a strong preference for shared decision-making, emphasizing collaboration in household and community matters. However, significant gender disparities persist, especially in Nigeria, necessitating targeted interventions. The research underscores the importance of empowering women economically, engaging youths and enhancing communication skills to bridge these gaps.

Gender and inclusive development action plan

Fish feeds are critical for aquaculture. Returns are limited, though, because of high production costs for small-scale aquaculturists. To address this, it is

important to explore alternative affordable and nutritious fish feeds. However, introducing new ingredients could inadvertently impact other aspects of small-scale aquaculture, especially for women, altering their control over assets.

To this end, FASA's gender and inclusive development action plan (GIDAP) aims to integrate gender and social inclusivity into all project aspects, ensuring no harm comes to women or excluded groups. The GIDAP is structured based on the eight GESI recommendations, which align with the scope and duration of the project. This plan delineates the integration of gender and inclusive development considerations into all pertinent FASA technical products and services, encompassing aspects of design, implementation, and monitoring and evaluation. Derived from the findings of the GESI analysis, the GIDAP incorporates essential insights and defines a series of priority interventions aimed at overcoming significant challenges related to GESI within fish feed and fisheries management across Nigeria, Zambia and Kenya.

These insights fuel the following eight consolidated GESI recommendations that shape the GIDAP:

1. Propose amendments in policies, laws and regulations to explicitly address gender disparities, ensuring equal opportunities and rights for all participants in the fisheries sector.
2. Improve the quality of what women feed their fish by engaging with women's groups to raise awareness about the importance of diversifying feed ingredients and by providing them with the necessary skills to improve their fish feeds.
3. Encourage equal access to resources for women and marginalized communities, including economic assets, vital services, financial support, education, information, technology, capacity building and market opportunities.
4. Increase the visibility of women and other disadvantaged groups through participation and decision-making.
5. Strengthen extension services to provide tailored support to women and youths in overcoming barriers to fish feed innovation.

6. Introduce time-saving technologies and mechanization for producing fish feeds, and work with men to promote positive masculinity and unpaid domestic workload contribution.
7. Help male-run businesses and financial inclusion businesses reach more women and youths.
8. Implement a monitoring and evaluation system to assess the progress and effectiveness of the action plan.

These recommendations align with Norad's thematic priorities, connecting with ADS 205 domains and emphasizing inclusivity, empowerment and equal opportunities for women and youths.

The interventions will be carried out in collaboration with stakeholders through socialization and understanding initiatives, capacity building programs and targeted external communication efforts aimed at key stakeholders in Nigeria, Zambia and Kenya. This inclusive approach will involve engaging various local entities, such as cooperatives and feed millers, women's and youth groups, and local nongovernmental organizations (NGOs) representing disadvantaged and underrepresented communities. Fostering partnerships with these diverse stakeholders will effectively tailor the interventions to address the unique challenges different groups face within the fisheries sector.

Two reports from the project have been published. They should be cited as follows:

Ganguly S, Druza K, Njiriri W and Yossa R. 2023. Gender equality and social inclusion (GESI) assessment: Zambia, Nigeria and Kenya. Penang, Malaysia: WorldFish. Program Report: 2023-60.

Ganguly S, Druza K, Njiriri W and Yossa R. 2023. Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa: Gender and Inclusive Development Action Plan (GIDAP) outcome report. Penang, Malaysia: WorldFish. Program Report: 2023-61.

The publication of the journal papers is currently ongoing, with completion expected in 2024.

Output 1.3: Strategies and opportunities to increase environmental sustainability and climate resilience in the fish feed landscape in the three focal countries identified and made widely available, with a focus on feeds derived from (novel) local ingredients.

NAGI Enterprise

NAGI Enterprise was selected as the consulting firm to carry out the activities under output 1.3. FASA promotes environmentally friendly and cost-effective technologies and practices, with an emphasis on sustainable fish feed production, to help minimize the impacts of climate changes and lower feed costs for fish farmers. As a result, climate and environmental analysis, as well as life cycle assessment (LCA), are crucial parts of project implementation, and NAGI will apply these approaches.

The specific goals of the climate and environmental analysis and LCA component of the project are as follows:

- an assessment of climate and environment on fish feed
- an examination of data weaknesses for the LCA, among other outcomes
- the development of an outcomes report with risk analysis and an environmental management plan for the LCA.

Component 1: Climate and environmental analysis

The following activities were implemented in Year 1 of the project regarding the climate and environmental analysis component in Kenya, Nigeria and Zambia:

- Develop an annotated report outline for the climate and environmental analysis.
- Review relevant literature on climate and environment in the production and use of novel fish feeds.
- Work with fish farmers, local and commercial fish feed producers, fish feed transporters and distributors, and other stakeholders in Kenya, Nigeria and Zambia to collect qualitative data through KIIs.

- Collect climate data from secondary sources and perceptions on climate using a household survey questionnaire uploaded onto the KoboCollect app.
- Collect data analysis and datasets in Kenya, Nigeria and Zambia, and store them in Excel.
- Develop a draft climate and environmental analysis report.
- Develop a final and publishable climate and environmental analysis report

Component 2: Life cycle assessment

The following activities were implemented in Year 1 of the project implementation for the LCA in Kenya, Nigeria and Zambia:

- Develop an annotated report outline for the LCA.
- Review relevant literature on fish feed for the LCA.
- Work with fish farmers, local and commercial fish feed producers, fish feed transporters and distributors, and other stakeholders in Kenya, Nigeria and Zambia to collect qualitative data through KIIs.
- Collect LCA data using household survey questionnaires uploaded onto the KoboCollect app.
- Put data analysis and datasets into Excel format for all three countries.
- Develop a draft LCA report.
- Develop a final and publishable LCA report.

Component 3: Outcome report

In addition to the LCA report, one of FASA's climate components was to develop an outcome report to provide a snapshot of the climate and environmental analysis. It synthesizes the risks and opportunities from fish feed analyses carried out in Kenya, Nigeria and Zambia. The report has been completed and submitted to WorldFish for review and approval.

Two reports published under this output and should be cited as follows:

Mubaya C, Ndebele-Murisa MR, Kapute K, Samundengo A and Yossa R. 2023. Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa: Climate change and environmental analysis. Penang, Malaysia: WorldFish. Technical Report: 2023-34.

Ndebele-Murisa MR, Mubaya C, Kapute K, Samundengo A and Yossa R. 2023. Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa: Life cycle assessment. Penang, Malaysia: WorldFish. Program Report: 2023-40.

Output 1.4: New knowledge on market trends and the commercial viability of feeds derived from (novel) local ingredients produced in the three focal countries and made widely available

In August 2023, WorldFish and IITA signed an agreement that designated IITA as a new partner that will conduct scaling activities in the project. The Market Intelligence and Scaling Team (MIST) will manage and carry out the activities. MIST aims to provide crucial market intelligence and develop strategies to scale locally sourced fish feed and to use solutions developed by the project to achieve sustainable and inclusive use at scale. MIST is a new addition to the project and has spent its initial efforts on subcontracting, recruitment and planning the work.

Output 1.5: New knowledge and data on the nutrient requirements for improved strains of tilapia and African catfish produced, validated and made widely available.

WorldFish

Renovate the wet lab at the NRDC

In Zambia, the NRDC's fish laboratory in Lusaka was successfully upgraded in July 2023. This involved renovating the facility from using a flow-through system to a recirculating aquaculture system (RAS). This would ensure that the team has a facility to conduct experiments on the nutrient requirements for fish. To do so, vital components had to be purchased and installed. The components of the RAS setup included a mechanical filter, biological filter, sand filter, sump, aeration units, aquarium tanks, reservoir tanks, water pumps, UV lights and heaters. Work done outside the lab included securing the area and installing air blowers to ensure an adequate supply of oxygen to both the fish tanks and biological filters, as well as installing an electrical switchboard to control the water heaters, air blowers and water pumps. The facility has been used to carry out the first nutrient requirement experiment for the improved tilapia.

Investigate the nutrient requirements for improved strains of tilapia

The initial nutrient requirement experiment took place in the lab's new RAS. The aim was to determine the lysine requirement for the SUZ and Genetic Improvement Program (GIP) strains of three-spotted tilapia (*O. andersonii*). Six diets were formulated, comprising a control diet and five experimental diets that included varying levels of lysine. Preliminary findings indicated that different lysine replacement levels at 0%, 0.2%, 0.4%, 0.6% and 1.2% in the diets of these strains did not affect growth parameters, except for 0.3%. Samples are currently undergoing analysis in the laboratory.

ICIPE

Design a research protocol and secure animal ethical approval

In Kenya, the ICIPE has developed eight research protocols to compare the requirements for amino acids (lysine and methionine), minerals (selenium) and vitamins (E and C) of local and improved strains of Nile tilapia (KMFRI-Sagana strain (F-8)) and African catfish (KMFRI-Sagana strain (F-4)), particularly fingerlings. The project has obtained animal ethics approval from the Institutional Animal Care and Use Committee (IACUC) of the Kenya Agricultural and Livestock Research Organization (KALRO)-Veterinary Science Research Institute (VSRI) in Muguga North, in compliance with all applicable regulations and guidelines, under the reference code KALRO-VSRI/IACUC028/16032022.

All of the research topics that the MSc, PhD and postdoctoral fellows were to undertake will be reviewed and approved individually by the National Council for Science Technology and Innovation (NACOSTI) in Kenya and the students' respective universities. This approval will provide additional permission for them to collect samples from the field, process them, and identify and conduct experimental research in the lab. Four tilapia and three catfish experiments in Kenya have not yet started. Installing a RAS at the ICIPE campus and some KMFRI centers are ongoing. Upon completion, FASA will recruit at least five or six MSc students to do research on catfish and tilapia in 2024.

CORAF

Design research protocol

A research protocol for the tilapia and catfish experiments has been designed, and WorldFish has approved it.

Conduct catfish and tilapia experiments

In Nigeria, CORAF has started the two experiments on the methionine and lysine requirements for the improved strain of tilapia and African catfish. The hybrid strains of *O. niloticus* crossed with *O. mossambicus* were compared with the known level for the *O. niloticus* strain and that of the hybrid *Heterobranchus bidorsalis* cross with *C. gariepinus* (Heteroclarias) and local strains of *C. gariepinus*. The two experiments were conducted simultaneously at the fish nutrition laboratory of the NIOMR on Victoria Island in Lagos, using a completely randomized factorial 2 x 6 experimental design.

Outcome 2: The quality of at least 15 local ingredients has been improved through various processing techniques, and the ingredients are used by stakeholders in the three target countries, including local millers and farmers, to produce nine novel, cost-efficient feed formulations to improve aquaculture productivity and resilience.

Output 2.1: New data and knowledge on local ingredients generated and used to formulate novel fish feeds and made widely available.

WorldFish

Conduct a digestibility experiment of ingredient samples collected for output 1.1

In Malaysia, the digestibility experiment, originally planned for 2023, was postponed to 2024 because of a delay in receiving the ingredients from the country partners and a technical problem with the experiment facility. Before conducting the experiment, WorldFish developed a research protocol detailing specific procedures to ensure adherence to scientific standards and ethical guidelines throughout the research process. It outlines the methodology for conducting in vivo digestibility experiments to evaluate the growth performance, tissue histology and overall digestibility of these ingredients in fish diets. Additionally, the protocol includes provisions for sample collection, analysis techniques, statistical methodologies and ethical considerations to ensure rigorous and reliable data collection.

On January 12, 2023, WorldFish's project team attended training on research in animal and human ethics to enhance the team's understanding of ethical considerations and regulations for the care and use of animals for scientific purposes. Following the training, a digestibility experiment protocol was submitted and approved by the Animal and Human Ethics Protocol committee under the approval code USM/IACUC/2023/ (144)(1298).

The proximate analysis of the ingredients, feed, feces and fish is an important component in the digestibility experiment. The analysis was done to determine the nutrient composition of samples, including crude protein, crude lipid, ash, dry matter, energy and fiber. As such, to assess the nutrient composition, the samples will be analyzed in the fish feed and nutrition laboratory at WorldFish Headquarters, as it was built to serve WorldFish scientists and partners in Penang and across Asia, Africa and the Pacific for biochemical analyses.

WorldFish has received 11 ingredients from Zambia (Table 2). All of them were grinded into powder.

Common name/Scientific name	Category	Image
Siavonga kapenta/ <i>Limnothrissa miodan</i>	Animal	
Crayfish/ <i>Cherax quandricarinatus</i>	Animal	
Takeya (assorted small fish)	Animal	
Caterpillar tukanja/ <i>Gonimbrasia zambesina</i>	Animal	
Caterpillar vinkubala/ <i>Gonimbrasia belina</i>	Animal	
Chisense/ <i>Potamothrissa acutirostris</i>	Animal	
Sunflower cake meal/ <i>Helianthus annuus</i>	Plant	
Velvet bean meal/ <i>Mucuna pruriens</i>	Plant	
Velvet bean seed/ <i>Mucuna pruriens</i>	Plant	
Tea waste/ <i>Camellia sinensis</i>	Plant	
Chikanda powder/ <i>Saccharomyces cerevisiae</i>	Plant	

Table 2. Ingredients received from Zambia for the tilapia digestibility experiment.

All of the ingredients from Zambia were analyzed for proximate analysis in WorldFish’s fish feed and nutrition laboratory. Table 3 shows the results of the analysis of some of the ingredients and feed to be used in the digestibility experiment. Data obtained from the analysis was compiled into

a database. The ingredients were then used to manufacture the diet for the tilapia digestibility experiment. Six experimental diets were produced, incorporating five of the 11 ingredients: caterpillar vinkubala, caterpillar tukanja, siavonga kapenta, kakeya and chisense.

Proximate analysis	Dry matter (%)	Ash (%)	Crude protein (%)	Crude fiber (%)	Crude lipid (%)	Gross calorific value (J/g)
Vinkubala	86.5	8.7	62.5	10.5	7.83	19,700
Tukanja	89.6	11.9	54.4	10.8	13.8	22,800
Siavonga kapenta	89.8	34.4	48.3	0.14	7.90	13,400
Kakeya	86.5	13.7	55.3	1.28	23.4	21,900
Chisense	88.3	21.8	58.1	0.05	8.9	18,400
Crayfish	88.7	25.5	45.8	11.0	4.62	14,700
Chikanda	86.0	10.4	2.28	8.63	0.22	15,520
Sunflower cake meal	84.9	14.6	20.3	29.3	14.3	20,670
Tea waste	87.6	23.2	15.7	16.3	1.52	16,700
Velvet bean meal	88.0	13.8	22.9	5.08	4.69	17,790
Velvet bean seed	90.1	13.1	24.6	6.21	4.04	17,600

Table 3. Proximate analysis of raw ingredients collected from Zambia.

Proximate analysis	Dry matter (%)	Ash (%)	Crude protein (%)	Crude fiber (%)	Crude lipid (%)	Gross calorific value (J/g)
Diet A (Reference)	90.3	7.04	43.5	1.54	4.11	18,500
Diet B (Caterpillar vinkubala)	91.50	7,30	36.8	4.40	4.02	18,820
Diet C (Caterpillar tukanja)	93.2	6.48	47.6	3.93	6.10	19,850
Diet D (Siavonga kapenta)	92.6	15.7	44.8	0.39	4.99	19,010
Diet E (Kakeya)	90.8	9.88	47.2	1.16	8.83	21,270
Diet F (Chisense)	92.1	11.3	49.4	1.12	5.05	20,080

Table 4. Proximate analysis of feed produced for the digestibility experiment

WorldFish began importing ingredients from Nigeria and established communication with Malaysia’s government importation authorities. There were some issues with the procedure, and the discussion to rectify the issue is still underway. The ingredients from Nigeria were expected to be received in 2024.

The following is the list of 16 ingredients selected from the scoping assessment:

1. African locust bean (*Parkia biglobosa*)
2. African baobab leaf meal (*Adansonia digitata*)
3. White cowpea (*Vigna unguiculata*)
4. Brown cowpea (*Vigna unguiculata*)
5. Bambara nut (*Vigna subterranea*)
6. Brewery (*Sorghum bicolor*) waste

7. Roselle seed meal (after extracting oil) (*Hibiscus sabdariffa*)
8. Tiger nut (*Cyperus esculentus*) waste
9. White yam (*Dioscoria rotundata*)
10. Shea nut (*Vitellaria paradoxa*) seed cake
11. Clupeidea fish (*Pellonula leonensis*)
12. Clupeidea fish (*Sierrathrissa leonensis*)
13. Mudskipper (*Periophthalmus argentilineatus*)
14. Black soldier fly (*Hermetia illucens*) larvae
15. Chaya (*Cnidoscolus aconitifolius*) leaves
16. Plantain (*Musa sapientum*).

Swedish University of Agricultural Sciences (SLU)

Conduct a biochemistry analysis of ingredient samples collected for output 1.1

In Sweden, the SLU obtained a permit from the Swedish Board of Agriculture to import 11 feed ingredients from Zambia: siavonga kapenta (*Limnothrissa miodon*), crayfish (*Cherax Quadricarinatus*), kakeya (assorted small fish), vinkubala caterpillar, tukanja caterpillar, chisense (*Potamothrissa acutirostris*), sunflower cake meal (*Helianthus annuus*), velvet bean meal (*Mucuna pruriens*), velvet bean seed (*Mucuna Pruriens*), tea waste (*Camellia sinensis*) and chikanda (*Disa robusta*). The ingredients were being analyzed for their proximate composition.

Implementation constraints

WorldFish

In Malaysia, WorldFish faced challenges when acquiring import permits for feed ingredients shipped from project countries to Malaysia because of the complex application procedures, strict regulatory requirements and uncertainty in the approval process for the permits. All of this has delayed the import process. However, WorldFish has been addressing these difficulties through an ongoing coordination with regulatory authorities and government agencies to streamline the processes in Malaysia.

ICIPE

No major challenges were observed.

CORAF

CORAF's bank experienced challenges with receiving international fund transfers, so WorldFish had to send the funds multiple times before they could receive them. This situation delayed the implementation of the scoping work on the ground by a few weeks.

SLU

No major challenges were observed.

IITA

Initial administration of contracting and finance took some time, but in the end it went smoothly. Still, technical staffing was challenging, as scaling and market intelligence expertise on sustainable local fish feed is quite limited. To address the staffing gaps, MIST started working with aquaculture ecosystem partners in Kenya, Nigeria and Zambia.

Includovate

The approved budget for the gender and social inclusion aspect of the study proved slightly insufficient to cover the comprehensive scope of the research across all targeted provinces in the three countries involved in the project. This prompted Includovate to adjust the project's timeline and sampling strategy to align with the budget. To mitigate these challenges, however, the ICIPE provided additional financial support to collect data in Kenya, which allowed for a slightly expanded sample size in that region.

NAGI Enterprise

NAGI has listed constraints related to collecting and analyzing the climate change and environmental data and to the LCA data.

Although the research team worked diligently to collect the data for Year 1 of the project, and largely achieved the desired outcomes, there were some limitations to the work. Researchers had to travel long distances because the farmers were sparsely populated in some of the areas in Zambia, which made it difficult to meet daily targets. In addition, the district fisheries offices did not have an updated list of registered farmers, so identifying the farmers was cumbersome as was the absence of farm owners to provide accurate information in the field in several cases. In Nigeria, the major challenges encountered while collecting data were the inaccessibility of some communities

because of poor road networks, a limited number of respondents in some communities due to other engagements during the field visits, and an unwillingness to be interviewed because of lack of confidence in government interventions. Despite these challenges, however, the team managed to

collect representative samples, suggesting that the collected data was not compromised in the end.

It is important to note that data for the LCA and climate change assessments were collected simultaneously in all three countries.

Gaps	Limitations	Challenges
Primary data		
Quantitative data was missing for the LCA, including energy and water use, purchased and processed raw materials, waste, transportation and so forth.	This limits the comprehensive performance of the LCA, particularly with calculating emission intensities.	Farmers were generally limited in their knowledge of ingredients and nutritional quantities and therefore the quantities therein. Equally, commercial feed manufacturers were cagey about releasing company records and especially quantitative data.
Qualitative data was missing for the LCA, including energy and water use, purchase and processed raw materials, waste, transportation and so forth.	The scope of current study did not cover the whole country, such as an in-depth study of feed value chain actors.	There was limited time and budget to map stakeholders of the feed industry in each study country. This gap has to be filled for the comprehensive LCA.
Secondary data		
Standardized quantitative data for the LCA, including climate, energy, water use, purchased and processed raw materials, waste, transportation and so forth, was obtained from secondary sources such as literature, LCA tools and databases.	Daily climate records and therefore future climate scenarios and climate impact modeling were not obtained during this study.	Daily observational records are expensive to purchase from national meteorological agencies, and open data (e.g. monthly temperature averages) is limited, often less than 20 years. As such, it cannot be used to ascertain historical trends and as a baseline for future projections.
	Continuous records of natural capita, including land use and land cover changes, agricultural and aquaculture production were not collected.	These records (e.g. vegetation or crop cover measured as Normalized Difference Vegetation Index (NDVI) or through ground measurements or estimates) are expensive and time consuming to obtain but should be considered for a full inventory of changes in the natural asset base and for the LCA and archiving.
	Data from the LCA tools and databases for established emission impacts of materials, such as fuel consumption, was scant and hardly collated during this study.	Most accessible (and free) LCA tools require copious amounts of primary data to work on emission intensities. Additionally, formulations to calculate emissions require specific measurements of primary data, and those that are standardized (e.g. energy use) may not be applicable to a context such as Africa, where the type of energy and units may differ. Using standardized metrics may render the LCA not a rigorous as it needs to be.

Table 5. Challenges during the implementation of the LCA in Year 1.

Innovative approaches and achievements

WorldFish

Not applicable.

ICIPE

In Kenya, an innovative technology has been completed to defat dried full-fatted black soldier fly larvae meal into pressed protein cake and oil as novel ingredients in fish feed. Advanced tools have been developed for a complete nutrient profile of full-fatted and defatted black soldier fly larvae meal, and the results have been generated. Advanced techniques to extract antimicrobial peptides from black soldier fly larvae and validate their efficacy against commonly known pathogens of fish have been developed.

CORAF

Not applicable.

SLU

Not applicable.

IITA

The scaling approach that the project used is Scaling Readiness, which is a new emerging paradigm on scaling science-based innovative solutions in low- and middle-income countries. It has achieved significant success in early use by CGIAR science-based innovation systems. Specifically, it is one of the rare scientific measurement systems specializing in the impact at scale potential of innovative solutions in low- and middle-income countries

Sartas M, Schut M, Proietti C, Thiele G and Leeuwis C. 2020. Scaling Readiness: Science and practice of an approach to enhance impact of research for development. *Agricultural Systems* 183:102874. doi: 10.1016/j.agsy.2020.102874

It has been used to document and analyze more than 700 innovative solutions across the Global South, including but not limited to the following: the [CGIAR Results Dashboard](#) of the CGIAR Global Innovation Management System, the [CGIAR RTB Global Program](#) and [CGIAR Best 50 innovations in its 50 years of work](#).

[Scaling Readiness](#) has been accessed broadly, and [more than 50 trainers](#) have been trained on it.

Includovate

Not applicable.

NAGI

Not applicable.

Priorities for the coming year

WorldFish

In Malaysia, the priority for the coming year is to conduct three digestibility experiments consecutively, each using five ingredients from all of the ingredients collected from country partners as per the implementation plan for 2024. At least one ingredient database and three manuscripts will be submitted and published by the second quarter of Year 3. Three research manuscripts on the digestibility experiments from WorldFish Headquarters, along with other research papers from each of the project countries, will be prepared and submitted by the second quarter of Year 3, acknowledging Norad's support. A database will be developed based on the data obtained from the ingredients, feeds, and fish performance analysis.

In Zambia, the priority for 2024 is to conduct an experiment on nutrient requirements to determine the optimal levels of methionine, vitamin C, calcium and phosphorus necessary for the growth of improved strains of tilapia.

ICIPE

In Kenya, the priority for the upcoming year will include the following:

- Complete the countrywide scoping studies on the type, price and seasonality of local fish ingredients.
- Collect gender selected ingredients for shipment to WorldFish Headquarters and the SLU for further processing.
- Recruit MSc students to investigate the nutrient requirements of the improved Nile tilapia (*O. niloticus*) and African catfish strains in Kenya under different aquaculture production systems.
- Apply for permits from NACOSTI in Kenya and from the respective universities where the students are enrolled to obtain permission for them to undertake their respective research experiments both in the field and in the laboratory.
- Develop project reports and manuscripts and publish research findings in internationally peer reviewed journals.

CORAF

Not applicable.

SLU

In Sweden, the priority for the upcoming year will include the following:

- Participate in FASA's annual workshop, to be held in Zambia.
- Complete the admission of two PhDs (one each from Zambia and Nigeria) and plan and execute their theses. Conduct a biochemical analyses of the feed ingredients that WorldFish will deliver.

IITA

In the coming year, MIST will focus on completing the country-specific market assessments and scaling strategies.

Specifically, it will deliver the following:

- Subactivity 1.4.1.1: Conduct a literature review of relevant policy, research and country documents.
 - a. Finalize the review.
- Subactivity 1.4.1.2.i: Design market assessments for each country.
 - a. Prepare data collection instruments.
 - b. Receive feedback on the instruments.
 - c. Finalize the instruments.
- Subactivity 1.4.1.2.ii: Design market assessments for each country.
 - a. Receive the list of information sources.
 - b. Update the list of information sources.
 - c. Finalize the list of information sources.
 - d. Plan the data collection.
- Subactivity 1.4.1.3: Collect data and conduct analysis.
 - a. Administer the instruments.
 - b. Enter the data into the database.
 - c. Analyze the data.
- Subactivity 1.4.1.4: Prepare and publish reports.
 - a. Combine the literature findings and results.
 - b. Draft market study reports.
 - c. Receive feedback on the market study reports.
 - d. Finalize market studies.
 - e. Help the production team prepare the formatted reports.
- Subactivity 3.1.1.2.i: Collect data and conduct analysis, including online stakeholder workshops (one workshop per country at the end of Year 1, and one recap workshop at the end of Year 4, for a total of four workshops).
 - a. Prepare data collection instruments.
 - b. Receive feedback on the instruments.
 - c. Finalize the instruments.
 - d. Administer the instruments.
 - e. Analyze the results.
- Subactivity 3.1.1.2.ii: Collect data and conduct an analysis, including online stakeholder workshops (one workshop per country at the end of Year 1, and one recap workshop at the end of Year 4, for a total of four workshops).
 - a. Receive the list of stakeholders.
 - b. Update the list of stakeholders.
 - c. Finalize the list of stakeholders.
 - d. Send invitations to stakeholders.
 - e. Send the results (from previous activities) to stakeholders.
- Subactivity 3.1.1.3: Prepare and publish the reports.
 - a. Combine the annotated outline (output of 2023) and results from 3.1.1.2.a.
 - b. Draft the scaling assessment reports.
 - c. Receive feedback on the scaling assessment reports.
 - d. Finalize the scaling assessment reports.
 - e. Help the production team prepare the formatted reports.

Includovate

In 2024, Includovate's primary objective is to execute the GIDAP, developed in 2023 to inform the GESI assessment. To achieve this overarching goal, specific objectives have been outlined as follows:

- Capacity building for implementing partners: Strengthening the capabilities of the implementing partners is a key focus. This involves providing capacity building sessions, learning opportunities and resources to enhance their skills and knowledge in the context of GESI.

- Capacity building for key stakeholders: Beyond implementing partners, we recognize the importance of fostering collaboration with other key stakeholders involved in the FASA project (including NARS, extension workers, feed millers and other relevant actors) across the three countries. Therefore, our second objective is to conduct capacity building initiatives tailored to the GESI needs of these stakeholders.
- Assessment of knowledge and attitude changes: To gauge the impact of our capacity-building efforts, we plan to conduct pre- and post-training knowledge, attitude and practice surveys. These assessments will enable us to quantify the changes in knowledge and attitude among participants, providing valuable insights into the effectiveness of our capacity-building sessions.

International public goods

The following is a list of publications, in press, submitted or in preparation.

WorldFish

Not applicable.

ICIPE

Not applicable.

CORAF

Not applicable.

SLU

Not applicable.

IITA

Not applicable.

Includovate

Ganguly S, Druzca K, Njiriri W and Yossa R. 2023. Gender equality and social inclusion (GESI) assessment: Zambia, Nigeria and Kenya. Penang, Malaysia: WorldFish. Program Report: 2023-60.

Ganguly S, Druzca K, Njiriri W and Yossa R. 2023. Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa: Gender and Inclusive Development Action Plan (GIDAP) outcome report. Penang, Malaysia: WorldFish. Program Report: 2023-61.

NAGI

Not applicable.

Nutrition and health

This section contains the project's contribution to nutrition and health SLO (if applicable).

WorldFish

Not applicable.

CORAF

Not applicable.

ICIPE

Not applicable.

SLU

Not applicable.

NAGI

- Nutrition in aquaculture systems is essential to the economical production of a healthy and high quality product. This research is appropriately designed to address the study objectives given the need to understand firsthand stakeholders' perceptions and experiences regarding climate and environmental changes as well as historical and current issues concerning fish feed and nutrition.
- The use of novel fish feeds has the potential to help meet the nutritional needs of fish, and eventually human nutrition. The project ensured that the nutritional value composition of novel fish feed is tested in all countries where the FASA project is being implemented by collecting existing and available fish feed samples during scoping studies in Year 1 of implementation.
- Furthermore, the research followed conventional standardized methods and guidelines for LCAs using International Standards ISO 14040 and 14044 for LCAs and models, such as the Comprehensive Livestock and Fish Environmental Assessment for Improved Nutrition, and the Secured Environment and Sustainable Development Framework.

Gender issues

WorldFish

Not applicable.

CORAF

Not applicable.

ICIPE

Not applicable.

SLU

Not applicable.

IITA

No specific gender issues were identified in 2023. However, following the research findings that market and scaling are gender specific, the outputs of 2023 were designed in consideration of the gender aspects.

Includovate

FASA has focused completely on gender issues within the project, specifically in developing the GESI assessment and a GIDAP report based on interviews with the fish farmers in the three countries.

NAGI

Although the project has a separate component specifically to address issues of gender, the climate change team of consultants considered the gender aspect in the development of data collection tools. The household survey tool was designed to address any gender issues affecting fish farmers and fish feed producers in the aquaculture sector between other climate change factors and the environment experienced by farmers in the sector. Additionally, the field data collected specified gender. This was coded and can be disaggregated, if need be.

Partnerships

WorldFish

WorldFish has selected IITA as new key partner to work on the scaling activities. Includovate has been selected as a new consultant to work on the gender and social inclusion study, and NAGI has been selected as a new consultant to work on the climate change and environmental assessment study.

ICIPE

Several new partnerships have been developed in the FASA project, including with fish farmers, policymakers, universities, research institutions, private sector partners (feed millers), NGOs, food and nutrition security planners, program implementers and health workers.

CORAF

Not applicable.

SLU

Not applicable.

IITA

Partnerships are at the core of the contributions of MIST and are dealt with in multiple dimensions. The first dimension is internal partnership within the FASA team. Market intelligence and scaling are cross-cutting elements, and studies on market intelligence and scaling can help research and development teams focus their efforts on the largest impact potential. MIST will share the learning it generates systematically with FASA experts and donor structures. It will also organize ad hoc seminars to build the capacity of FASA team to provide scalable market responsive feed innovations. The second partnership dimension is implementation partners. MIST, itself, is a partner of the project and will leverage the power of FASA implementation partners to conduct its activities in field research and stakeholder engagement meetings. The third partnership dimension is partnering with leading private sector and donor organizations. MIST has started working with large emerging aquaculture players in Africa regarding the use of FASA solutions and will have consultations with large impact funds on the blue economy.

Includovate

Includovate has partnerships with three organizations in Kenya, including the ICIPE and KMFRI, which helped provide data enumerators. Includovate also collaborates with CORAF in Nigeria and WorldFish Zambia in Zambia.

NAGI

NAGI's team of consultants collaborates with project partners, including the NIOMR in Nigeria, the ICIPE in Kenya, and WorldFish Zambia in Zambia. It also collaborated with local (in-country) consultants and the cohort of sector players during the first year of implementation. The collaboration helped with collecting and gathering relevant research data for both the climate change and environmental analysis and the LCA.

During data collection, the selection of the sampled population was based on consultations with fisheries departments and registered fish producer associations

as well as project partners in the study countries. In Kenya, the research team worked with the Ministry of Environment, Land and Fisheries, the International Livestock Research Institute and extension services in the study areas. In Nigeria, the team consulted with the Fish Feed Manufacturers Association of Nigeria, the Catfish Farmers Association of Nigeria and the NIOMR, among other relevant organizations. In Zambia, the main collaborators were the Fisheries Department, WorldFish Zambia, agriculture extension and aquaculture association representatives, as well as the University of Zambia and Aller Aqua, in addition to fish feed producers and distributors/ transporters.

Conclusions

WorldFish

In Malaysia, every component output is actively progressing and is catching up on the tentative workplan. Scoping of ingredients is also underway. With proper planning and consistent communication with each partner, the objective of the project could be achieved.

ICIPE

The kick-off meeting, annual project workshop and online workshop with stakeholders, as well as the in-person stakeholder workshop, have been organized. Staff and MSc student recruitment, protocols for scoping studies and nutrient requirements for Nile tilapia and African catfish have been developed for approval by WorldFish.

CORAF

In Nigeria, activities on the scoping assessment to reveal new knowledge on the type, price and seasonality of local ingredients used in animal (fish) feeds produced in Nigeria have been completed. Report writing and publications are in progress. The experiment on the nutrient requirement of improved strains of tilapia and African catfish is currently in progress. The second annual FASA workshop was successfully conducted in November 2023.

SLU

Not applicable.

IITA

In 2023, the project welcomed MIST into its family. MIST will take primary responsibility for market and scaling strategies, support engagement and dissemination efforts and, wherever possible,

build the capabilities of the FASA community and connect private sector partners and complementary donors to the project's efforts.

In 2023, the MIST's activities focused on setting a strong foundation for servicing and catalyzing scaling efforts. In 2024, it will accelerate its efforts to complete the deliverables on market intelligence and scaling and will catch up with the initial project timelines.

Includovate

Not applicable.

NAGI

Research from the 2023 implementation of the climate and environmental analysis concluded the following:

- The report provided a baseline understanding of the connection and integration of climate change and environmental considerations in the life cycles of fish feed.
- The report provided a baseline understanding and solid evidence on which to base the rest of the project in line with factors that either advance or hinder fish feed production and formulation in the context of climate and the environment.
- The report provided a springboard for the LCA report on fish feeds as well as the country outcome reports.

Furthermore, research on specific LCA studies concluded the following:

- The LCA analysis provided a baseline of current LCA data.
- The analysis also highlighted weaknesses in the current data and how FASA can address them going forward.
- The study created connections within the data to generate positive feedback loops among the inputs and outputs of LCA research.
- The major sources of emissions emanate from the first two phases of feed production and manufacturing compared to the transportation or distribution and disposal phases of the feed, which are phases after the factory and/or manufacture of feeds. Therefore, it is recommended that the comprehensive LCA concentrate its efforts here, as they are the "cradle to factory" phases.

Appendix 1. 2023 annual financial report



STATEMENT OF FUNDS STATUS
for the period from 01 July 2022 to 31 December 2023
In NOK

Contract/Project Processing No.	SAF-21/0004
Project Code	AG10578
Project Title	Development And Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)
Project Duration	01/07/2022 - 30/06/2027
Interim Project Leader	Ahmad Fatan, Nurulhuda
Donor	Norwegian Agency for Development Cooperation (NORAD)
Total Grant	NOK 80,000,000

	Amount Invoiced		Date	Amount Received	
	Date	NOK		NOK	USD
	8 Jul 2022	6,501,585.00	27 Jul 2022	6,501,585.00	659,114.25
	1 Dec 2022	3,517,328.00	13 Dec 2022	3,517,328.00	351,679.11
	1 June 2023	3,619,851.00	21 Jun 2023	3,619,851.00	333,762.56
Total		13,638,764.00		13,638,764.00	1,344,555.92
Fund Disbursements				NOK	USD
1 Jul 2022 - 31 Dec 2022				2,066,805.19	209,527.48
1 Jan 2023 - 31 Dec 2023				9,026,105.67	888,014.07
Total Fund Disbursements				11,092,910.86	1,097,541.56
Fund Balance as of 31 December 2023				2,545,853.14	247,014.36

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Kek, Cherry

Interim Head of Finance

Date : Feb 22, 2024 | 6:59 AM EST

Approved by:

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Ahmad Fatan Nurulhuda
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Ahmad Fatan, Nurulhuda

Interim Project Leader

Date : Feb 27, 2024 | 4:47 PM SGT



**FINANCIAL REPORT
FOR THE PERIOD 01/07/2022 TO 31/12/2023
IN NOK**

Contract/Project Processing No.	SAF-21/0004
Project Code	AG10578
Project Title	Development And Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)
Project Duration	01/07/2022 - 30/06/2027
Interim Project Leader	Ahmad Fatan, Nurulhuda
Donor	Norwegian Agency for Development Cooperation (NORAD)
Total Grant	NOK 80,000,000

BUDGET LINE ITEMS	TOTAL BUDGET (I)	BUDGET 1st July 2022 - 31st Dec 2023 (II)	EXPENSES				TOTAL CUMULATIVE EXPENDITURES 1st Jul 2022 - 31 Dec 2023 (III + IV)	BUDGET BALANCE
			PERIOD REPORTING 1st Jul 2022 - 31st Dec 2022	PERIOD REPORTING 1st Jul 2022 - 31st Dec 2022 (III)	PERIOD REPORTING 1st Jan 2023 - 31 Dec 2023	PERIOD REPORTING 1st Jan 2023 - 31 Dec 2023 (IV)		
	NOK	NOK	USD	NOK	USD	NOK	NOK	NOK
1. Personnel Costs	28,875,957	6,816,499	129,142	1,273,873	318,912	3,186,453	4,460,326	24,415,631
2. Travel	4,027,918	1,400,769	848	8,362	71,598	713,855	722,217	3,305,701
3. Consultants	7,007,992	2,047,440	3,116	30,732	139,832	1,452,353	1,483,085	5,524,907
4. Communications and Publications	2,245,000	270,418	111	1,099	15,415	157,877	158,976	2,086,024
5. Training & Workshops	2,117,933	554,729	31,146	307,229	62,433	641,303	948,532	1,169,401
6. Purchase of equipment	131,394	131,394	13,276	130,955	154	1,665	132,620	(1,226)
7. Specific project-related costs	6,438,994	2,574,878	2,947	29,069	59,498	600,533	629,603	5,809,391
8. Operating costs	2,604,291	720,513	11,395	112,400	49,916	500,648	613,048	1,991,242
9. Partner 1 - Swedish University of Agricultural Sciences	4,197,829	695,959	-	-	11,202	117,091	117,091	4,080,738
i. Personnel costs	707,660	156,346	-	-	8,842	92,427	92,427	615,233
ii. Travel	179,600	22,450	-	-	396	4,139	4,139	175,461
iii. Specific project-related costs	608,844	55,227	-	-	-	-	-	608,844
iv. Operating costs	2,471,296	398,263	-	-	1,398	14,613	14,613	2,456,683
v. Purchase of equipment	30,532	30,532	-	-	-	-	-	30,532
vi. Evaluation	-	-	-	-	-	-	-	-
vii. Indirect Operating Costs (5%)	199,897	33,141	-	-	566	5,912	5,912	193,985
10. Partner 2 - West and Central African Council for	4,250,492	1,276,308	-	-	9,074	91,091	91,091	4,159,401
i. Personnel costs	1,742,713	522,814	-	-	-	-	-	1,742,713
ii. Travel	256,996	67,670	-	-	-	-	-	256,996
iii. Specific project-related costs	1,979,777	564,084	-	-	8,652	86,858	86,858	1,892,919
iv. Operating costs	10,911	3,273	-	-	-	-	-	10,911
v. Purchase of equipment	57,691	57,691	-	-	-	-	-	57,691
vi. Evaluation	-	-	-	-	-	-	-	-
vii. Indirect Operating Costs (5%)	202,404	60,777	-	-	422	4,233	4,233	198,171
11. Partner 3 - NARS / Natural Resources Development	538,800	336,750	-	-	5,545	59,600	59,600	479,200
i. Personnel costs	-	-	-	-	-	-	-	-
ii. Travel	-	-	-	-	-	-	-	-
iii. Specific project-related costs	538,800	336,750	-	-	5,545	59,600	59,600	479,200
iv. Operating costs	-	-	-	-	-	-	-	-
v. Purchase of equipment	-	-	-	-	-	-	-	-
vi. Evaluation	-	-	-	-	-	-	-	-
vii. Audit	-	-	-	-	-	-	-	-
12. Partner 4 - International Centre of Insect Physiology	8,169,749	2,822,894	-	-	55,969	602,532	602,532	7,567,217
i. Personnel costs	4,389,065	1,317,582	-	-	42,777	460,514	460,514	3,928,550
ii. Travel	59,268	3,480	-	-	-	-	-	59,268
iii. Specific project-related costs	2,289,080	865,885	-	-	5,046	54,319	54,319	2,234,761
iv. Operating costs	685,174	259,179	-	-	4,995	53,774	53,774	631,400
v. Purchase of equipment	133,622	123,969	-	-	486	5,232	5,232	128,390
vi. Subcontractors & Collaborators	224,504	118,376	-	-	-	-	-	224,504
vii. Indirect Operating Costs (5%)	389,036	134,423	-	-	2,665	28,692	28,692	360,344
13. Partner 5 - International Institute of Tropical Agriculture	2,694,000	952,733	-	-	14,100	145,207	145,207	2,548,793
i. Personnel costs	1,019,975	446,153	-	-	12,142	125,038	125,038	321,115
ii. Travel	-	-	-	-	-	-	-	-
iii. Specific project-related costs	1,160,164	374,249	-	-	-	-	-	1,150,164
iv. Operating costs	-	-	-	-	-	-	-	-
v. Purchase of equipment	-	-	-	-	-	-	-	-
vi. Evaluation / Audit	-	-	-	-	-	-	-	-
vii. Indirect Operating Costs (16.13%)	523,861	132,331	-	-	1,958	20,169	20,169	112,162
14. Indirect operating costs (7%)	5,131,024	416,998	13,439	132,560	56,955	578,915	714,475	4,419,549
15. CGIAR consortium costs (2%)	1,568,627	127,482	4,108	40,526	17,412	176,982	217,508	1,351,119
Total Budget / Expenditure	80,000,000	21,145,764	209,527	2,066,805	888,014	9,026,105	11,092,911	68,907,089

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Interim Head of Finance
Date: Feb 22, 2024 | 6:59 AM EST

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Ahmad Fatan, Nurulhuda
Interim Project Leader
Date: Feb 27, 2024 |

Appendix 2. Subgrant agreements

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AGREEMENT

Between

Natural Resources Development College (NRDC)

And

International Center for Living Aquatic Resources Management (ICLARM)
also known as
WorldFish
Penang, Malaysia

Page 1 of 8

PLA: PLA13084	AG: AG10578	BUS: BU11530
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This AGREEMENT is made on 12 May 2023 between:

- (1) International Center for Living Aquatic Resource Management (ICLARM), also known as and hereinafter referred to as “WorldFish”, and**
- (2) Natural Resources Development College, hereinafter referred to as “NRDC” or the “Partner”**

WorldFish and Natural Resources Development College (NRDC) are hereinafter collectively referred to as the “Parties” and may be individually referred to as the “Party”.

PREAMBLE

WorldFish is managing the project titled “Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)”, which goal is to develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in 3 African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security, and reduced waste and pollution. The FASA project will be implemented in mainly in Nigeria, Zambia, and Kenya, with additional research activities to be completed in Malaysia and Sweden.

NRDC is a public vocational institution under the Ministry of Agriculture in the Republic of Zambia. In the FASA project, NRDC will primarily contribute by hosting and collaborating in the implementation of WorldFish’s research activities.

This Agreement is supplementary to any Memorandum of Understanding (**MOU**) that may exist between the Parties and Articles I to III of the MOU also apply to this Agreement.

ARTICLE I – OBJECTIVES

The purpose of this Agreement is to achieve the following objectives:

- NRDC to host WorldFish activities under the project titled “Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)” in a research facility from 01 May 2023 until 31st of March 2027.
- NRDC to assign a staff, who will be the main contact point for NRDC and be involved and support the implementation of the research activities of WorldFish at NRDC from 2023 to 2027.
- NRDC to provide in-kind contribution (technicians’ time) during the upgrade of the research facility (flow-through system) that was constructed in 2019-2020 by WorldFish at NRDC.
- NRDC to ensure the security of the research facility that will be used.
- WorldFish to invest up to NOK215,520/- in upgrading the NRDC research facility (flow-through system) that was initially constructed in 2019-2020 by WorldFish, and make it a Recirculating Aquaculture System.
- WorldFish to provide a payment of rent to the NRDC.

PLA: PLA13084	AG: AG10578	BUS: BU11530
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- WorldFish to share the results of the findings resulting from the studies conducted at NRDC with the staff and students of NRDC, via seminars, on a yearly basis.
- WorldFish to involve the NRDC contact point in the research activities at NRDC and use that opportunity to build his/her capacities in scientific research.
- WorldFish to invite a representative of NRDC to attend the annual project meetings in Malaysia, Nigeria, Kenya or Zambia, and all actual costs will be covered by WorldFish.

ARTICLE II – TERMS OF REFERENCE

Under the direction of the Project Leader, NRDC will provide the following deliverables/services:

No	Deliverables/ Services	Due Dates
1.	Assign the research facility for the WorldFish research team from May 2023 to April 2027.	30 May 2023
2.	Assign a staff, who will be the main contact point for NRDC, to be involved, and support the implementation of the research activities of WorldFish at NRDC.	Until 30 May 2023
3.	Provide in-kind contribution (technicians' time) during the upgrade of the research facility (flow-through system) that was constructed in 2019- 2022 WorldFish at NRDC.	Until 28 June 2023
4.	Ensure the security of the research facility at NRDC.	Continuing up to 31 March 2027

ARTICLE III – DURATION

This agreement will commence on the date of signature by the Parties, and will continue until 31st of March 2027, unless mutually extended by the Parties in writing.

ARTICLE IV – CONTRACTUAL SUM

WorldFish, subject to funds received from the donors, will pay a total of NOK7,450 monthly (Seven Thousand Four Hundred Fifty Norwegian Kroner only) in accordance with the payment schedule below for the period commencing on the 01 of May 2023 and ending on the 31st of March 2027, as the contractual sum for the payment of rent and activities listed in ARTICLE II. All payments for the rental and activities listed in ARTICLE II above shall be due on the last day of the month on which it becomes due.

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No.	Period Covered	Payment (NOK)
1.	May 2023 to June 2023	NOK14,900
2.	July 2023 to September 2023	NOK22,350
3.	October 2023 to December 2023	NOK22,350
4.	January 2024 to March 2024	NOK22,350
5.	April 2024 to June 2024	NOK22,350
6.	July 2024 to September 2024	NOK22,350
7.	October 2024 to December 2024	NOK22,350
8.	January 2025 to March 2025	NOK22,350
9.	April 2025 to June 2025	NOK22,350
10.	July 2025 to September 2025	NOK22,350
11.	October 2025 to December 2025	NOK22,350
12.	January 2026 to March 2026	NOK22,350
13.	April 2026 to June 2026	NOK22,350
14.	July 2026 to September 2026	NOK22,350
15.	October 2026 to December 2026	NOK22,350
16.	January 2027 to March 2027	NOK22,350

A representative of NRDC will be invited to attend the annual project meetings and all actual costs will be covered by WorldFish. The cost will include airfare, per diem, lodging, local transportation, and visa application fees up to a maximum of NOK135,831/- during the five years of the project. The amount specified in this paragraph shall be in addition to the amounts payable for rental and activities listed in ARTICLE II above.

With the exception of payments in 2023, subsequent payments to you are subject to the approval of WorldFish’s budget each preceding year and the receipt of funds from donors.

In case of partial performance of the work set out herein, WorldFish has the discretion to pay a partial sum corresponding to the work completed or withhold payment for inadequate performance.

No other fees, reimbursements, allowances, or benefits will be paid under this agreement other than those specified herein.

Payment shall be made to the following Bank account:

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Bank Account Holder Name	NRDC Business Centre
Bank Account Number	1166700300144
Bank Name	ZANACO Twin Palm Branch
Bank Branch & Address	Twin Palm Branch, P/B CH 3, 10101 Lusaka Zambia
Branch Code	010073
BIC	ZNCOZMLU
Bank Account Currency	Kwacha

WorldFish shall not be responsible for any losses incurred by the Natural Resources Development College (NRDC) due to currency fluctuations and/or delays, standard and additional bank charges arising from incomplete or inaccurate banking details submitted. The sole responsibility shall be on the Natural Resources Development College (NRDC) directly.

The terms contained in this Article IV may be revised, amended or varied by mutual consent between the Parties and WorldFish shall inform you of any proposed revision, amendment or variation as soon as practicable.

ARTICLE V – INDEMNITY AND LIABILITY

WorldFish will not assume responsibility for any liability arising from or incidental to the Partner’s work specified in Article II herein. The Partner will arrange for his/her own group medical, life, AD&D and professional liability insurance and shall be responsible for any damage, loss, suit, claim and demand whatsoever that may arise from and related to this project. The Partner shall indemnify and keep indemnified at all times WorldFish against such damage, loss, suit, claim and demand. This indemnity shall continue even after the termination of this agreement or after the completion of the project.

ARTICLE VI – POLICIES, PROCEDURES AND GUIDELINES

The Partner is required to comply with WorldFish’s code of conduct, ethics policy, child protection policy, anti-harassment, discrimination and bullying policy, anti-fraud and anti-corruption policy, and any other organizational policies relating to workplace behaviors and processes. WorldFish may terminate the appointment with immediate effect in the event that the partner is in breach of any of the provisions of this letter or if the conduct brings themselves or WorldFish into disrepute.

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ARTICLE VII – INTELLECTUAL PROPERTY

“Intellectual property” means information, ideas, inventions, new fish varieties, innovations, artwork, designs, literary text and any other matter or thing whatsoever that adds a creation of human intervention that may be capable of legal protection or the subject of legal rights.

Intellectual property created in the course of this contract is subject to the CGIAR Policy on the Management of Intellectual Assets.

1. Resulting Intellectual Property Rights

All intellectual property rights arising from the partnership must be treated in the following manner:

- a) If all or a substantive majority of the cost of the collaborative project is borne by WorldFish, then WorldFish reserves the right to own all resulting intellectual property rights resulting from the project but WorldFish grants the Partner a non-exclusive, worldwide, royalty-free, irrevocable license to use, publish and sublicense the resulting intellectual property; if the Partner bears all or a substantive majority of the cost, then vice versa.
- b) If the Partner contributes approximately 50% of the cost, the resulting intellectual property rights shall be jointly owned by both Parties. As such, it shall remain publicly accessible and shall be available to the partners of WorldFish and the Partner and to end-users.
- c) Results of the collaborative research will be jointly published in the public interest as mutually agreed upon.

2. Background Intellectual Property

Either Party may choose to introduce intellectual property that it owns to the other, in the interest of this Agreement. It would thereby grant the other Party a license to use and sublicense the background intellectual property being introduced, wherever this is required to meet the objectives of this Agreement.

3. Intellectual Property Rights Protection

Partners who believe that intellectual property rights protection should be sought by WorldFish in relation to aspects of the collaborative work must discuss this with their WorldFish counterpart. As a general rule, such IP protection shall not be sought unless it is necessary for the further improvement of the intellectual property or to enhance the scale or scope of impact on target beneficiaries, in furtherance of the CGIAR Vision as defined in the CGIAR IA Principles.

4. Publication

Wherever possible, publications should be in Open Access Journals or made available through Open Access Repositories. Similarly, data sets and other outputs of research should be publicly available in line with the obligation of WorldFish to comply with the CGIAR Open Access and Data Management Policy.

ARTICLE VIII – CONFIDENTIAL INFORMATION

Each Party shall hold in confidence all documents disclosed to it by the other Party containing the other Party’s trade secrets and proprietary, secret, confidential and/or other information not generally

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available to the public (Confidential Information). Confidential Information shall only be disclosed to persons assigned by the Parties who are directly involved in the collaboration.

ARTICLE IX – SEVERABILITY

If any provision in this Agreement shall be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

ARTICLE X – TIME

Every effort should be made to ensure that the time-frame laid out herein in Article II is adhered to. Gross disregard of this shall render this Agreement voidable.

ARTICLE XI – AMENDMENTS AND MODIFICATIONS

This Agreement may not be assigned, amended or modified unless mutually agreed upon in writing by the Parties, and the changes shall then form part of this Agreement.

ARTICLE XII – TERMINATION

Either party may terminate this Agreement by giving 30 days notice in writing to the other party stating the reasons for such termination. During this notice period, the Parties shall make reasonable efforts to resolve the reasons for termination stated in the termination notice. Unless the Party giving the termination notice rescinds such notice, this Agreement shall be terminated upon the expiry of the notice period and neither Party shall have any further obligation hereunder, except for such rights and obligations under the following Articles, which will survive termination: Article V – Indemnity and Liability; Article VII – Intellectual Property; Article VIII – Confidential Information; and Article XIII – Dispute Resolution. The affected Party is eligible to claim for payment due and payable until and before the date of the termination. The Parties are obliged to submit to each other all reports, data and manuscripts that are relevant to this Agreement before the termination of the Agreement.

ARTICLE XIII – DISPUTE RESOLUTION

Before recourse to legal action, all attempts must be made to settle the dispute amicably by negotiations between the Parties.

Should amicable negotiations fail, all disputes shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with said Rules. The seat of arbitration shall be Lusaka, the governing law of the contract and the arbitration clause shall be Zambian law and the language of arbitration shall be English.

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ARTICLE XIV – FORCE MAJEURE

If either Party is temporarily unable by reasons of force majeure to meet any of its obligations under this Agreement, and if such Party gives the other Party written notice of the event within thirty (30) days of its occurrence, such obligations of the Party as it is unable to perform by reason of the event shall be suspended for as long as the inability continues. If necessary the Agreement can be cancelled, if Force Majeure prevents performance for an extended period. Neither Party shall be liable to the other Party for any event referred to below or delays arising from such event. The term "Force Majeure" as used herein shall mean Acts of God, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, blockades, insurrection, riots, epidemics, lightening, floods, washouts, civil disturbances, explosions and other similar events not within the control of either Party and which, by the exercise of due diligence, neither Party is able to overcome.

Signed

DocuSigned by:
Simon Carter
1EAF465595E547D...

Simon Carter
Global Financial Controller
Corporate Functions

WorldFish Headquarters (Malaysia)
Jalan Batu Maung,
Batu Maung, 11960 Bayan Lepas,
Penang, Malaysia

Date: May 16, 2023 | 10:09 AM SGT

Witness:

DocuSigned by:
Tan Su Ching
3FA17B858AA6437...

Tan Su Ching
Grants and Contracts Manager

WorldFish Headquarters (Malaysia)
Jalan Batu Maung,
Batu Maung, 11960 Bayan Lepas,
Penang, Malaysia

Date: May 16, 2023 | 1:07 PM SGT

DocuSigned by:
Melon Mulamfu
BE17B7001469465...

Melon Mulamfu
Principal

Natural Resources Development College
(NRDC)
No 7132, Off Great East Road,
Private Bag CH99, Chelstone,
Lusaka, Zambia.

Date: May 24, 2023 | 4:35 PM SGT

Witness:

DocuSigned by:
Elinat Tembo
07870A405EAB403...

Elinat Tembo
Registrar

Natural Resources Development College
(NRDC) No 7132, Off Great East Road
No 7132, Off Great East Road
Private Bag CH99, Chelstone,
Lusaka, Zambia.

Date: May 29, 2023 | 11:19 PM SGT

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SUB-GRANT AGREEMENT

Between the International Center for Living Aquatic Resources Management (ICLARM) also known as WorldFish, headquartered in Penang, Malaysia, and

International Institute of Tropical Agriculture (IITA) headquartered in Ibadan, Nigeria referred to as the “Sub-grantee” in this Agreement.

This Agreement includes this Signature Page and all Annexes attached to this agreement. In the event of any conflict between the contents of Annexes and the terms stated in the Signature Page, the terms in the Signature Page shall prevail.

This Agreement is issued to the Sub-grantee on the expressed condition that project activities and funds will be carried-out and administered in accordance with the terms and conditions as hereby set forth in this agreement and all its attachments.

Implementation Period	Start Date: 28 July 2023	End Date: 30 April 2027	
Implementation Duration	Total of 45 months		
Agreement Period	Agreement Start Date: 28 July 2023	Agreement End Date: 30 May 2027	
Agreement Amount (Currency and amount)	NOK3,771,600/-	Three Million Seven Hundred Seventy-One Thousand and Six Hundred Norwegian Krone	
Cash or In kind contribution (if none insert N/A)	N/A		
Project Title	Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)		
WorldFish Contact Person:	Senior Scientist, Project Leader	Rodrigue Yossa	r.yossa@cgiar.org
Sub-awardee Contact Person	Innovation and Impact Management Scientist	Murat Sartas	m.sartas@cgiar.org

Attachments:

- Annex 1: WorldFish Standard Terms and Conditions
- Annex 2: Project Description
- Annex 3: Reporting Templates
- Annex 4: General Conditions Applicable to Grants from The Norwegian Agency for Development Cooperation
- Annex 5: CGIAR and WorldFish Policies and Procedures
- Annex 6: Project Description, Result Framework, and Implementation Plan

Signed by Authorized Signatories:

For WorldFish

For IITA

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DocuSigned by:

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Name : Simon Carter
Title : Global Financial Controller
 Financial Services
Date : Aug 11, 2023 | 9:32 PM SGT

Name : Dr Kenton Dashiell
Title : Deputy Director General,
 Partnerships for Delivery
Date : Aug 14, 2023 | 11:09 PM SGT

ANNEX 1: WORLD FISH STANDARD TERMS AND CONDITIONS

WorldFish and the Sub-grantee are hereinafter collectively referred to as the “Parties” and may be individually referred to as the “Party”.

ARTICLE I – PERIOD OF AGREEMENT

This Agreement shall be effective for the period specified in the Signature Page. All expenditures made with funds provided under this agreement shall be for allowable project expenditures and actual costs incurred during the period of this agreement.

ARTICLE II – AMOUNT AND PAYMENT

WorldFish, subject to funds received from the donors and successful completion of activities and deliverables by the Sub-grantee, will pay the Sub-grantee up to the amount specified in the Signature Page. WorldFish shall not be liable for reimbursing the Sub-grantee for any costs in excess of what is specifically and explicitly agreed to in this Agreement. No other fees, reimbursements, allowances or benefits will be paid under this agreement other than those specified in this Agreement.

Expenditures must be incurred within the eligibility period and in connection with the project and necessary for its implementation. Expenditures must be for activities that are carried out within the agreement period. They must also be identifiable and verifiable; reasonable, justified and comply with the principle of sound financial management; and comply with national rules (of applicable tax and social legislation).

In case of partial performance of the deliverables set out herein, WorldFish has the discretion to pay a partial sum corresponding to the work completed or to withhold payment for inadequate performance.

The details of this total Agreement Amount, payment schedule and budgetary restrictions are set forth in Annex 2.

Funds will be made available within 60 working days of receipt AND acceptance of deliverables. No funds will be released until technical and financial reports are received and accepted by WorldFish.

Unless otherwise agreed in writing, WorldFish funds will be paid in the currency of Agreement amount and in accordance with the detailed banking instructions provided by the Sub-grantee as part of the Work Plan and Budget in Annex 2.

WorldFish reserves the right to withhold final payment until after the final technical and financial reports are received and accepted by WorldFish.

WorldFish will not be responsible for any losses incurred by the Sub-grantee due to currency fluctuations, standard and additional bank charges arising from incomplete or inaccurate banking details being submitted, or any taxes, duties or fees that may be due. The sole responsibility shall be with the Sub-grantee.

WorldFish reserves the right to withhold payment for any of the following:

- Sub-grantee’s failure to make satisfactory progress towards the project objectives set forth in Annex 2.
- Sub-grantee’s default of or otherwise inability to adhere to the conditions or provisions of this agreement
- Sub-grantee’s inability to submit reliable and/or timely reports or other deliverables as described in this agreement.

Any balance of funds held by the Sub-grantee at the completion or sooner termination of the project shall be returned to WorldFish within 30 days irrespective of a formal demand from WorldFish. Funds must be returned to WorldFish in the currency of the agreement unless a different arrangement is agreed and clearly written in this agreement.

ARTICLE III – INDEMNITY AND LIABILITY

WorldFish will not assume responsibility for any liability arising from or incidental to the Sub-grantee’s work specified in the Agreement. The Sub-grantee will arrange for group medical, life, AD&D and professional liability insurance for themselves and their personnel and shall be responsible for any damage, loss, suit, claim and demand whatsoever that may arise from and be related to this project. The Sub-grantee shall indemnify and keep indemnified at all times WorldFish against such damage, loss, suit, claim and demand. This indemnity shall continue even after the termination

of this agreement or after the completion of the project for a period of 5 years.

ARTICLE IV – POLICIES, PROCEDURES AND GUIDELINES

The Sub-grantee shall strictly adhere to the guidelines and provisions listed in Annex 4 and Annex 5.

The Sub-grantee is required to comply with WorldFish's code of conduct, ethics policy, child protection policy, anti-harassment, discrimination and bullying policy, anti-fraud and anti-corruption policy, and any other organizational policies relating to workplace behaviors and processes. WorldFish may terminate the appointment with immediate effect in the event that the Sub-grantee is in breach of any of the provisions of this letter or if the conduct brings themselves or WorldFish into disrepute.

CGIAR Policy and Principles on the Management of Intellectual Assets: All intellectual assets produced or acquired shall be managed in ways that maximize their global accessibility and/or ensure they lead to the broadest possible impact on target beneficiaries in furtherance of the CGIAR vision. WorldFish implement this principle through Article V below.

CGIAR Open Access & Data Management Policy: Open Access is defined by WorldFish as the ownership, preservation, exploitation and publication of research data collected by Sub-grantees and others which should be managed in a way that increases the visibility, accessibility and impact of the research. WorldFish implements this Policy through its Open Access/Open Data Implementation Plan which will be adopted on approval by the WorldFish Board of Trustees.

WorldFish Policy on Ethics of Research Involving People: WorldFish staff are held accountable towards people (communities, groups, individuals) involved in or affected by our research, and expects our Sub-grantees to adhere to the same high ethical standards.

WorldFish Anti-Fraud and Anti-Corruption Policy: WorldFish will not accept any level of bribery, corruption, money laundering and all types of fraud, whether actual or attempted and will treat any such matter with the utmost of seriousness.

This is whether it is committed by trustees, staff, contractors, consultants or Sub-grantees.

WorldFish Child Protection Policy: WorldFish is committed to creating and maintaining positive environments that protect children from all forms of exploitation and abuse. Sub-grantees shall not engage in any form of child exploitation or engage with anyone who poses an unacceptable risk to children, shall work towards reducing the risks to children that may be associated with WorldFish programs, and will report any concern or suspicion of exploitation and abuse of children and abide to WorldFish Child Protection Policy

ARTICLE V – INTELLECTUAL PROPERTY (IP)

“Intellectual property” or “IP” means information, ideas, inventions, innovations, art work, designs, literary text and any other matter or thing whatsoever that adds a creation of human intervention that may be capable of legal protection or the subject of legal rights.

Intellectual property created in the course of this agreement is subject to the CGIAR Policy and Principles on the Management of Intellectual Assets as described in Article IV.

1. Resulting Intellectual Property Rights

All intellectual property rights arising from Sub-granting must be treated in the following manner:

- a) If all or a substantive majority of the cost of the collaborative project as described in the Work Plan and budget is borne by WorldFish, then WorldFish reserves the right to own all intellectual property rights resulting from the project but WorldFish grants the Sub-grantee a non-exclusive, worldwide, royalty-free, irrevocable license to use, publish and sublicense the resulting intellectual property for other than commercial reasons.
- b) If the Sub-grantee bears all or a substantive majority of the cost, then the Sub-grantee reserves the right to own all resulting intellectual property rights and grants to WorldFish a non-exclusive, worldwide, royalty-free, irrevocable license to use, publish and sublicense the resulting intellectual property
- c) If WorldFish and the Sub-grantee contribute approximately equally to the costs then the resulting intellectual property rights shall be

jointly owned by both Parties. As such, they shall remain publicly accessible and shall be available to the Sub-grantees of WorldFish and the Sub-grantee and to end-users.

2. Background Intellectual Property

Either Party may choose to introduce intellectual property that it owns to the other, for the purpose of this Agreement. It would thereby grant the other Party a non-exclusive, royalty free license to use and sublicense the background intellectual property being introduced, wherever this is required to meet the objectives of this Agreement.

3. Intellectual Property Rights Protection

Sub-grantees who believe that intellectual property rights protection should be sought by WorldFish in relation to aspects of the collaborative work must discuss this with their WorldFish counterpart. As a general rule, such IP protection shall not be sought unless it is necessary for the further improvement of the intellectual property or to enhance the scale or scope of impact on target beneficiaries, in furtherance of the CGIAR Vision as defined in the CGIAR IA Principles.

4. Publication

Wherever possible, publications should be in Open Access Journals or made available through Open Access Repositories. Similarly, data sets and other outputs of research should be publicly available in line with the obligation of WorldFish to comply with the CGIAR Open Access and Data Management Policy (and the WorldFish Open Access/Open Data Implementation Plan when approved by the WorldFish Board of Trustees. The technical and scientific articles published by IITA as the result of this agreement must be coauthored by WF Project Leader.

ARTICLE VI – CONFIDENTIAL INFORMATION

Each Party shall hold in confidence all documents disclosed to it by the other Party containing the other Party's trade secrets and proprietary, secret, confidential and/or other information not generally available to the public (Confidential Information). Confidential information shall only be disclosed to persons assigned by the Parties who are directly involved in the collaboration. Any obligation of confidentiality hereunder shall not apply to information that:

- I. is or becomes public knowledge through no fault of the receiving party, or
- II. was known prior to this Agreement by the receiving party, or
- III. properly and lawfully becomes available to the receiving party from another source without any obligation of secrecy, or
- IV. is independently developed without benefit of disclosure from the receiving party, or
- V. is required to be disclosed through process of law.

ARTICLE VII – PROHIBITION AGAINST TERRORIST FINANCING AND DISCRIMINATION

The Sub-grantee certifies that it has not provided and will not provide material support or resources to any individual or entity that it knows, or has reason to know, is an individual or entity that advocates, plans, sponsors, engages in or has engaged in terrorist activity.

The Sub-grantee agrees to undertake all reasonable efforts to ensure that none of the funds shall be used to provide support to individuals or entities associated with terrorism, as included in the list maintained by the Security Council Committee established pursuant to resolution 1267 (1999). This provision must be included in any subcontracts or sub-agreements entered into under this Agreement.

Funds received from WorldFish shall not be used for payments for which corrupt, fraudulent, collusive, obstructive or coercive practices were engaged in, nor for drug trafficking.

The Sub-grantee will not discriminate against persons with disabilities, and will make every effort to respect the principles of the UN Convention on the Rights of Persons with Disabilities.

ARTICLE VIII – SEVERABILITY

If any provision in this Agreement shall be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

ARTICLE IX – TIME

Every effort should be made to ensure that the time-frame laid out in the Work Plan and Budget at Annex 2 is adhered to. Failure to meet the time-frame set forth in Table 3 and Table 4 of Annex 2 shall be grounds for termination by WorldFish as provided in Article XI.

ARTICLE X – AMENDMENTS AND MODIFICATIONS

This Agreement may not be assigned, amended or modified unless mutually agreed upon in writing by designated signatories of the Parties, and the changes shall then form part of this Agreement.

ARTICLE XI – TERMINATION

Either Party may terminate this Agreement by giving 30 days' notice in writing to the other Party stating the reason(s) for such termination. During this notice period, the Parties shall make reasonable efforts to resolve the reasons for termination stated in the termination notice. Unless the Party giving the termination notice rescinds such notice, this Agreement shall be terminated upon the expiry of the notice period and neither Party shall have any further obligation hereunder, except for such rights and obligations under the following Articles, which will survive termination: Article III – Indemnity and Liability; Article V – Intellectual Property; Article VI – Confidential Information; and Article XII – Dispute Resolution. The affected Party is eligible to claim for payment due and payable until and before the date of the termination. The Parties are obliged to submit to each other all reports, data and manuscripts that are relevant to this Agreement before the termination of the Agreement.

ARTICLE XII – DISPUTE RESOLUTION

Before recourse to legal action, all attempts must be made to settle the dispute amicably by negotiations between the Parties.

Should amicable negotiations fail, all disputes shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with said Rules. The seat of the arbitration shall be Malaysia, the governing law of the contract and the arbitration

clause shall be Malaysian Law and the language of arbitration shall be English.

ARTICLE XIII – FINANCIAL RECORDS, MONITORING AND AUDIT

The Sub-grantee shall maintain books, records, documents and other evidence in accordance with their respective usual accounting procedures to sufficiently substantiate financial data relating to this Agreement. The Sub-grantee shall establish and maintain a reliable accounting system that enables the production of financial reports.

WorldFish and its authorized representatives shall have the right to audit, examine and make copies of or extracts from all the financial and related records (in whatever form they may be kept, whether written, electronic, or other) relating to or pertaining to this agreement. Such records shall include, but are not be limited to, accounting records; sub-agreement files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); all paid vouchers; other reimbursements supported by invoices; ledgers; cancelled checks; deposit slips; journals; payroll documents; timesheets; and correspondence. The Sub-grantee shall, at all times during the term of the agreement and for a period of 7 years after the completion of this agreement, maintain such records, together with such supporting or underlying documents and materials. The Sub-grantee may at any time be requested by WorldFish, whether during or after completion of the agreement, and at the Sub-grantee's own expense, to make such records available for inspection and audit. Costs of any audits conducted by WorldFish will be borne by WorldFish.

WorldFish reserves the right to request separate audited financial statements or reports, which should be paid for using project funds provided by WorldFish.

If an audit identifies any costs that are not in compliance with the donor requirements and considers those costs as ineligible, those costs shall be borne by the Sub-grantee and as applicable, costs shall be reimbursed to WorldFish.

ARTICLE XIV - REPORTING

WorldFish requires the Sub-grantee to submit both interim and final reports. Details of reporting requirements are set forth in Annex 2.

Sub-grantee shall maintain adequate records that clearly support the charges and expenditures incurred under this project. If requested by WorldFish, Sub-grantee may be required to send the supporting documentation to support claims made on the Financial Report. WorldFish may, at its discretion, request modification of any invoice or report when unallowable expenditures are incurred or charged to the project, amend the schedule for reporting requirements, and/or require additional supporting documentation from the Sub-grantee as necessary.

ARTICLE XV – FORCE MAJEURE

If either Party is temporarily unable by reasons of force majeure to meet any of its obligations under this Agreement, and if such Party gives the other Party written notice of the event within thirty (30) days after its occurrence, such obligations of the Party as it is unable to perform by reason of the event shall be suspended for as long as the inability continues. If necessary the Agreement can be cancelled, if Force Majeure prevents performance for an extended period. Neither Party shall be liable to the other Party arising from any event referred to below or delays arising from such event. The term "Force Majeure" as used herein shall mean Acts of God, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, blockades, insurrection, riots, epidemics, lightening, floods, washouts, civil disturbances, explosions and other similar events not within the control of either Party and which, by the exercise of due diligence, neither Party is able to overcome.

ARTICLE XVI - REPRESENTATIONS AND WARRANTIES

The Parties shall be independent parties and nothing herein shall be construed or implied to mean the establishment or existence of a partnership or joint venture between the parties, nor shall any party herein be construed to be employees, agents, or principals of the other party.

By signing this Agreement, all parties certify that the terms of conditions defined in this Agreement are accepted; that the Parties are proper business entities permitted to do business; and that the individuals signing are competent parties authorized to enter into this Agreement on behalf of their respective agencies.

ARTICLE XVI – SPECIAL PROVISIONS

IITA shall notify WorldFish and provide all the relevant supporting details in the event that the exchange rate fluctuations negatively affect the ability to fulfil its obligations/ deliverables under this agreement. WorldFish shall evaluate the notice and may at its discretion propose amendments, variations or modifications to this agreement upon prior approval from the prime donor.

ANNEX 2: PROJECT DESCRIPTION

I. Project Overview

WorldFish is managing the project titled “Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)”, which goal is to develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in 3 African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security, and reduced waste and pollution. The FASA project will be implemented in will be implemented mainly in Nigeria, Zambia, and Kenya, with additional research activities to be completed in Malaysia and Sweden. Full-time postdoctoral researchers and scientists hired by IITA through this agreement will be co-supervised by WF Project Leader.

II. Expected Outputs and Required Activities to be Performed by Sub-grantee

Table 1: Expected Outputs and Required Activities to be Performed by Sub-grantee

Outputs	Activities
Output 1: Participation in annual project meetings and planning a Start-up workshop	<p>Detailed activities:</p> <p>Participate in annual project meetings to report on scaling activities of the previous year and plan the scaling activities of the next year with partners and other stakeholders.</p> <p>Guide and support the project teams during stakeholder’s consultations, the production of booklets and manuals and the extension workshops.</p>
Output 2: New knowledge on market trends and commercial viability of feeds derived from (novel) local ingredients produced in 3 focus countries and made widely available.	<p>Detailed activities:</p> <p>3 market assessments (1 per project country): Conduct literature review of relevant policy, research, and country documents; Design market assessments for each country; Data collection and analysis; and Report preparation and publication.</p>
Output 3: Integrated knowledge for enabling the scaling environment (including exploring barriers and bottlenecks to scaling), and strategies for scaling up the use of novel feeds and feed management approaches in the 3 target countries co-developed with stakeholders and used to guide selection of country scaling strategies	<p>Detailed activities:</p> <p>Annual assessments of enabling and constraining factors for scale-up (1 per project country at the end of years 1, 2, 3, 4): Design scaling assessments for each country (redesign/update for each year as needed); Data collection and analysis, including online stakeholder workshops (1 workshop per country at the end of year 1 and 1 recap workshop at the end of year 4 for a total of 4); and Report preparation and publication.</p> <p>Stakeholder consultations to co-develop scaling strategies: Organise and facilitate 2 stakeholder workshops per country (total of 6); Report preparation and dissemination.</p>

Outputs	Activities
<p>Output 4: Strategic partnerships for scaling the use of the project's innovations and knowledge built and operational with a range of partners in the focus countries (sub-activities to be co-developed with scaling partners and as part of scaling assessments)</p>	<p>Detailed activities: Develop innovation platforms for bringing key scaling stakeholders together; Identify and set up demonstration sites and model farms; Host farmer field days on demo sites and model farms; Build partnerships with cooperatives to test and use novel feeds; Support establishment of new feed services and businesses by young people, farmers, etc; Support small-scale millers to develop new product offerings based on project's innovations; and Build partnerships with NGOs, private sector, and extension service providers to incorporate project's knowledge and innovations into their offerings to aquaculture farmers.</p>
<p>Output 5: Disseminate knowledge through workshops, conferences, and mass media</p>	<p>Detailed activities: Design and conduct context-specific outreach (based on assessments in output 1.5) to target end-users (farmers and millers) to support scale-up; and Develop scaling potential outside of project by identifying additional scaling opportunities.</p>

For exact description of the Expected Outputs and Required Activities to be performed: Kindly refer to the Project Description, Result Framework and Implementation Plan approved by the donor, Norad (Annex 6A,6B and 6C).

III. Outcomes or Results Expected (include Work Plan or Activity Implementation Plan) if needed

- Outcomes or results expected 1: Participate in the project annual meetings.
- Outcomes or results expected 2: 3 of market assessment reports completed.
- Outcomes or results expected 3: 12 scaling assessments completed, and strategies developed; 6 - stakeholder consultations/ 2 workshops completed to validate scaling assessments and strategies.
- Outcomes or results expected 4: 6 demonstration sites/model farms developed and 12 farmer field days hosted; 3000 farmers who visit demonstration sites/model farms and attend farmer field days; 1500 farmers who test novel feeds on their farms; 15 farmers' cooperative in promoting, testing, and using novel feeds; 12 new feed services/feed businesses established by farmers, young people, cooperatives, and other stakeholders; 15 of new millers that change or improve their products based on knowledge and innovations developed by the project; and 9 of NGOs, private sector partners, or extension service providers that incorporate the project's knowledge and innovations into their offerings/ services to farmers (e.g. financial products for farmers who adopt new feeds)
- Outcomes or results expected 5: 10 online workshops to disseminate knowledge; Number of conference presentations; 3 YouTube videos; 1 BMPs; 1 online and printed factsheets; 1 benefits story published; 1 radio programme aired; 1 TV programme aired; 6000 end-users reached through digital and in-person outreach; and 1 policy briefs published and launched.

Activity Implementation Plan:

Activity Implementation Plan: Please refer to Annex 6C

IV. Budget, Reporting and Payment Schedule

1) BUDGET in NOK

Table 2: BUDGET in NOK

Budget Item/ Year	Year 1 (NOK)	Year 2 (NOK)	Year 3 (NOK)	Year 4 (NOK)	Total (NOK)
Personnel Cost	357,251	177,804	215,520	269,400	1,019,975
Specific project-related costs	-	748,498	743,491	735,775	2,227,764
IITA Indirect Cost (16.13 %)	57,625	149,412	154,689	162,135	523,861
Total (NOK)	414,876	1,075,714	1,113,700	1,167,310	3,771,600

The following modifications to the budget require written approval from WorldFish:

- To change the required funding amounts necessary to fulfill the stated project objectives.
- To change or temporarily replace key project staff.
- To reallocate between budget lines items an amount greater than 10% percent of the main budget line.
- To add a line item to the budget.
- To sub-grant or subcontract any portion of this budget to a third party.

2) PAYMENT SCHEDULE

WorldFish, subject to funds received from the donors and accordance with payment terms as per table below, will pay the partner a total of not more than **NOK3,771,600** towards the expected outputs / deliverables as per Annex 2. Fund Transfers may be executed in **Norwegian Krone (NOK)**.

With the exception of the first payment of **NOK145,207 (35% of first year budget) upon acceptance of the Year 1 Work Plan and Budget**, subsequent releases of funds (cost reimbursement) to the Sub-grantee are subject to the following conditions:

1. Technical and financial reports that are due are received and accepted by WorldFish, whichever is the later (please refer to Table 3 - Schedule for Submission of Technical Reports and Table 4 – Schedule for Submission of Financial Reports).
2. Sub-grantee’s approved expenditure reports cover at least 75% of the previous cash transfers from WorldFish.
3. Sufficient supporting evidence must be provided with the financial reports to support the expenditure.

Payment should be made to the below account number:-

Bank Account Holder Name : International Institute of Tropical Agriculture
Bank Name : Barclays Bank Plc
Bank Account Currency : USD
SWIFT BIC : BARCGB22

IBAN : **GB84BARC20000056516000**
Sort Code : **200000**
Branch Address : **Level 16, 1 Churchill Place, Canary Wharf, London, E14 5HP,**
United Kingdom
Bank Account Number : **56516000**

WorldFish shall not be responsible for any losses incurred by the Sub-grantee due to currency fluctuations and/or delays, standard and additional bank charges arising from incomplete or inaccurate banking details submitted. The sole responsibility shall be the Sub-grantee directly.

3) REPORTS

a. Financial Reporting

Sub-grantee shall submit the following reports to WorldFish according to the Table 4 (Schedule for Submission of Financial Report) below:

Financial reporting template is provided for in Annex 3 (MS Excel file). Reports shall be submitted in the currency set out in the Signature Page, i.e., in NOK. The Sub-grantee shall submit proof by the bank of the amount that has been credited in the currency of account for the funds disbursed by WorldFish.

Financial reports shall include at a minimum the following information:

- a. Budget versus actual expenses, with current reporting period data and grant to date data.
- b. Detailed list of expenses that include description, transaction date, amount, expense category, exchange rates used to convert to reporting currency.
- c. Cost Share or matching progress report for period. (if necessary)
- d. WorldFish needs access to all supporting documentation from the sub-grantee to support the transaction list.
- e. Fund balance status – cash received from WorldFish versus expenditures reported to WorldFish

b. Technical Reports

Sub-grantee shall submit the following reports to WorldFish according to the Table 3 (Schedule for Submission of Technical Report) below:

Technical reporting template is provided for in Annex 3 (MS Word file)

c. Other Reports

WorldFish may, at its discretion, require other necessary reports (supporting documents) from Sub-grantee.

d. Reporting Format

Sub-grantee shall submit semi-annual and annual technical reports not later than one month after the reporting period.

Sub-grantee shall submit semi-annual financial report in NOK covering January to June not later than one month after reporting period and annual financial report in NOK covering January to November (actual spending) and for the month of December (estimation).

Sub-grantee shall submit a final financial statement in NOK and a final technical report not later than 4 weeks after completion of the project.

Table 3: Schedule for Submission of Technical Report

No	Reporting Period	Type of Report	Due Date
1.	January 2023 – December 2023	FASA Annual Technical Report 2023Q1-Q4	30 January 2024
2.	January 2024 – June 2024	FASA Mid-Year Technical Report 2024Q1-Q2	30 July 2024
3.	January 2024 – December 2024	FASA Annual Technical Report 2024Q1-Q4	30 January 2025
4.	January 2025 – June 2025	FASA Mid-Year Technical Report 2025Q1-Q2	30 July 2025
5.	January 2025 - December 2025	FASA Annual Technical Report 2025Q1-Q4	30 January 2026
6.	January 2026 – June 2026	FASA Mid-Year Technical Report 2026Q1-Q2	30 July 2026
7.	January 2026 – December 2026	FASA Annual Technical Report 2026Q1-Q4	30 January 2027
8.	January 2027 – April 2027	FASA Mid-Year Technical Report 2027Q1-Q2	30 May 2027
9.	June 2023 – April 2027	FASA Final Technical Report 2023-2027	30 May 2027

Table 4: Schedule for Submission of Financial Report

No	Reporting Period	Type of Report	Due Date
1.	January 2023 – December 2023	FASA Annual Financial Report 2023Q1-Q4	30 December 2023
2.	January 2024 – June 2024	FASA Mid-Year Financial Report 2024Q1-Q2	30 July 2024
3.	January 2024 – December 2024	FASA Annual Financial Report 2024Q1-Q4	30 December 2024
4.	January 2025 – June 2025	FASA Mid-Year Financial Report 2025Q1-Q2	30 July 2025
5.	January 2025 – December 2025	FASA Annual Financial Report 2025Q1-Q4	30 December 2025
6.	January 2026 – June 2026	FASA Mid-Year Financial Report 2026Q1-Q2	30 July 2026
7.	January 2026 – December 2026	FASA Annual Financial Report 2026Q1-Q4	30 December 2026
8.	January 2027 – April 2027	FASA Mid-Year Financial Report 2027Q1-Q2	30 May 2027
9.	June 2023 – April 2027	FASA Final Financial Report 2023-2027	30 May 2027

ANNEX 3: REPORTING TEMPLATE

Financial & Technical reporting template-Please see Annex 3a and 3b for details.

Financial Reporting Template: Annex 3a (attached)

Technical Reporting Template: Annex 3b (attached)

ANNEX 4: PART II: GENERAL CONDITIONS APPLICABLE TO GRANTS FROM THE NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION (ATTACHED).

ANNEX 5: CGIAR AND WORLDFISH POLICIES AND PROCEDURES

In addition to the Policies and Procedures listed in Annex 1 Article IV, the Sub-Grantee shall adhere to the attached WorldFish Procurement Policy for all procurement-related activities (attached).

ANNEX 6: PROJECT DESCRIPTION (ANNEX A), RESULT FRAMEWORK (ANNEX B), AND IMPLEMENTATION PLAN (ANNEX C)

Date 30 January 2023

PLA13008

Includovate Pty Ltd
Attention: Dr. Kristie Druzca
 Level 1, Suite 2, 85,
 87 Charles St,
 Kew VIC 3101, Australia

Email : kristie.druzca@includovate.com
 Email of PIC (Program Manager): mercy.kamau@includovate.com

Dear Dr. Kristie Druzca,

Lead Gender and Social Inclusion Study for the Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA).

WorldFish hereby appoints **Includovate Pty Ltd** (“**Consultant**”) as a **Lead Gender and Social Inclusion Study** for the project stated above and on the terms and conditions contained herein. References to you shall include your personnel, where the context requires. The details of this Consultancy contract are as per the details listed below.

1. General Terms

Consultancy Commencement Date	12 January 2023
Consultancy End Date	30 July 2023
Duration of Contract	Approximately 7 months and 15 days
Contract Commencement Date	16 January 2023
Contract End Date	30 August 2023
Proposed Project Completion Date	30 April 2027
Expected Activities	The consultant will develop and conduct mixed methods gender and social assessments in the 3 project countries (Nigeria, Zambia, and Kenya) using a context-sensitive approach and compiling sex-disaggregated data. These initial assessments will be completed in 6 months and will identify opportunities for the project to advance the gender and social inclusion goals of Norad, WorldFish, and other key stakeholders within the novel feeds landscape, as per the project implementation plan.
Project Leader	Rodrigue Yossa Senior Scientist

2. Deliverables

No.	Due Date	Deliverables
1	Gender Equality and Social Inclusion (GESI) Analysis Report	
a	18 January 2023	Annotated outline
b	20 February 2023	First draft (for input by project team members)
c	23 February 2023	Second draft (for input by project team members and donor)
d	15 March 2023	Final report complete (incorporating inputs from all above)
e	31 March 2023	Expense report for the period up to 10 March 2023
2	Gender and Inclusive Development Action Plan (GIDAP)	
a	28 February 2023	Annotated outline
b	31 March 2023	First draft (for input by project team members)
c	15 April 2023	Second draft (for input by project team members and donor)
d	30 April 2023	Final report complete (incorporating inputs from all above)
3	Publications	
a	15 April 2023	Draft outcome report
b	30 April 2023	Final outcome report
c	31 May 2023	Draft journal article 1

All publications resulting from this Consultancy will be co-authored by the WorldFish Project Leader.

Future Collaboration:

Upon completion of the deliverables described in Year 1, the parties may agree to enter into a collaboration to develop and evaluate the expected work of Includovate Pty Ltd in the FASA project from Y2 to Y5, which would involve the Re-assessment and alignment of gender and social inclusion study assessment work in the FASA project countries and attendance of the annual project workshops. The Tentative Deliverables below may be subject to change, shall not bind the parties hereto, and shall be subject to the execution of separate agreements for the respective years.

Tentative Deliverables (Year 2 to 5)

No	Reporting Period	Type of Report	Due Date
1.	January 2023 – December 2023	FASA_Annual Assessment Report 2023Q1-Q4	30 January 2024
2.	January 2024 – June 2024	FASA_Mid-Year Assessment Report 2024Q1-Q2	30 July 2024
3.	January 2024 – December 2024	FASA_Annual Assessment Report 2024Q1-Q4	30 January 2025
4.	January 2025 – June 2025	FASA_Mid-Year Assessment Report 2025Q1-Q2	30 July 2025
5..	January 2025 – December 2025	FASA_Annual Assessment Report 2025Q1-Q4	30 January 2026
6.	January 2026 – June 2026	FASA_Mid-Year Assessment Report 2026Q1-Q2	30 July 2026
7.	January 2026 – December 2026	FASA_Annual Assessment Report 2026Q1-Q4	30 January 2027
8.	January 2027 – April 2027	FASA_Mid-Year Assessment Report 2027Q1-Q2	30 May 2027
9.	December 2022 – April 2027	FASA_Final Assessment Report 2022-2027	30 May 2027

3. Appointment of Personnel

You shall appoint the following personnel to carry out the Project and deliver the deliverables stated above: -

No.	Name	Qualifications
1.	Mercy Kamau	Associate Program Manager of Includovate Pty Ltd Masters Public Health Brunel University, UK
2.	Kristie Druzca	CEO of Includovate Pty Ltd Ph.D. Social Protection and Inclusion in Nepal, Deakin University, Australia
3.	Sujata Ganguly	South Asia Gender Empowerment and Social Inclusion (GESI) Lead of Includovate Pty Ltd Ph.D. Population Studies International Institute for Population Sciences (IIPS), India
4.	Wanja Njiriri	Gender Technical Lead of Emerald Environmental Ltd Master of Arts Power, Participation and Social Change The University of Sussex, UK
5.	Emmanuel Kodwo Mensah	Associate Researcher of Includovate Pty Ltd Masters Gender Studies Makerere University, Uganda

You shall be solely responsible for the conduct of your personnel and shall indemnify WorldFish against any loss, damage, suit, claim, liabilities, demand, cost, fee or any expense whatsoever that may be asserted by a third party as a result of your personnel's negligence or misconduct.

You shall also be solely responsible for establishing and paying compensation and other benefits to its personnel. You shall be responsible for compliance with all laws relating to your personnel, including but not limited to tax, insurance and social security contributions.

In the event of any change in the named personnel above and subject to WorldFish's approval, you agree to appoint personnel with equivalent or better qualifications as a replacement. Such change in personnel shall not affect your obligations and responsibilities contained in this agreement.

4. Fees and Expenses

You will be paid an all-inclusive service fee of no more than **NOK 562,437** for this consultancy contract. Payment will be made by telegraphic in accordance with the payment schedule below.

Future Collaboration:

Upon completion of the deliverables described in Year 1, the parties may agree to enter into a collaboration to develop and evaluate the expected work of Includovate Pty Ltd in the FASA project from Y2 to Y5, which would involve the Re-assessment and alignment of gender and social inclusion study assessment work in the FASA project countries and attendance of the annual project workshops. The Tentative Budget below may be subject to change, shall not bind the parties hereto, and shall be subject to the execution of separate agreements for the respective years.

Tentative Budget in NOK

Budget Item/ Year	Year 2 (NOK)	Year 3 (NOK)	Year 4 (NOK)	Year 5 (NOK)	Total (NOK)
Personnel Cost	347,067	349,967	352,925	202,385	1,252,343

The terms and amounts contained above are indicative only and shall not bind WorldFish in any way whatsoever. The payments referred to in the tentative budget above are subject to the approval of WorldFish's budget for the respective years, the receipt of funds from donors and the execution of a separate agreement for each respective year.

Payment Schedule

#	Deliverables against which payment is made	Amount (NOK)	Due Date
1	Upon signing of the contract and submission of the planned budget for the spending of the first tranche	224,975	20 January 2023
2	Upon acceptance of deliverables 1 and 2 and full utilization of the initial disbursement of NOK224,975/-	168,731	30 April 2023
3	Upon acceptance of deliverable 3	168,731	30 August 2023

In case of partial performance of the work set out in this contract, WorldFish has the discretion to pay a partial sum corresponding to the work completed or withhold payment for inadequate performance. Payment shall be made to the following Bank account:

Name and address of Bank	Citibank Australia, 2 Park Street Sydney, NSW 2000 Australia
Branch Name	Citibank, N. A. Australia
Account Name	Includovate Pty Ltd
Account Number	491285698
SWIFT Code	CITIAU2X
Bank Account Currency	USD

WorldFish shall not be responsible for any losses incurred by the Recipient due to currency fluctuations and/or delays, standard and additional bank charges arising from incomplete or inaccurate banking details submitted. The sole responsibility shall be the Recipient directly.

Any extension of the service contract is subject to project needs and importance, and subject to the discretion of WorldFish.

5. Allowances and Perquisites

Under this contract you will not be entitled to any allowances, perquisites and benefits other than those stated in this letter.

If, for the purposes of this contract, you are required to travel to Malaysia or any of the project countries to attend the annual project workshop, WorldFish will cover the costs of your flights, accommodation and per diem in accordance with WorldFish travel policies. Funds for the costs specified in this paragraph shall be in addition and not part of the all-inclusive service fee stated in Clause 4 above.

6. Termination

If either party is in material breach of any of its obligations under the contract, the other party can give it written notice that within 14 days of receiving such notice the breach must be remedied (if such breach is capable of remedy). If the breaching party fails to remedy the breach within the 14 days or if the breach is not capable of remedy, the non-breaching party can terminate the contract. The termination will be effective 5 days after the breaching party receives written notice of termination from the non-breaching party.

7. Intellectual Property

You will be provided with a copy of the WorldFish policy on Intellectual Assets which applies to the terms of this agreement and to your work at WorldFish.

Nothing will affect the ownership of any intellectual property that either party had prior to this agreement ("Background Intellectual Property").

Both parties agree to grant non-exclusive, royalty-free licenses to use the Background Intellectual Property which will need to be shared and exchanged to allow the Services to be carried out.

You hereby assign to WorldFish all intellectual property rights (including, without limitation, patents, copyright and related rights) and inventions arising from the services you render for WorldFish. You agree promptly to execute all documents and do all acts as may, in the opinion of WorldFish, be necessary to give effect to this clause.

Intellectual property and Research Data created in the course of this contract is governed by Annex A. Books and publications (paper and electronic) obtained with WorldFish funds will remain the property of WorldFish.

8. Confidential Information and WorldFish Property

You shall not use or disclose to any person either during or at any time after your engagement by WorldFish any confidential information about the business or affairs of WorldFish or any of its business contacts, or about any other confidential matters which may come to your knowledge in the course of providing the Services. For the purposes of this clause, confidential information means any information or matter which is not in the public domain and which relates to the affairs of WorldFish or any of its contacts.

All documents, manuals, hardware and software provided for your use by WorldFish, and any data or documents (including copies) produced, maintained or stored on the WorldFish computer systems or other electronic equipment (including mobile phones if provided by WorldFish), remain the property of WorldFish.

9. Data Protection

You consent to WorldFish holding and processing data relating to you for legal, personnel, administrative and management purposes and in particular to the processing of any "sensitive personal data" as defined in Malaysian Law.

You consent to WorldFish making such information available to other Centers within CGIAR, service providers to WorldFish (such as advisers), regulatory authorities, governmental or quasi-governmental organisations and potential purchasers of WorldFish or any part of its work, for purposes other than marketing.

10. Status

You will be an independent contractor and nothing in this agreement shall render you an employee, worker, agent or partner of WorldFish and you shall not hold yourself out as such.

You will be required to arrange your own group medical, life and AD&D insurance. WorldFish will not assume responsibility for any insurance liability. You will also be responsible for all relevant taxes made in connection with the performance of your services, and any claim brought against you in connection with the provision of the services.

11. Policies, Procedures and Guidelines

You are required to comply with WorldFish’s code of conduct, ethics policy, child protection policy, anti-harassment, discrimination and bullying policy, anti-fraud and anti-corruption policy, and any other organizational policies relating to workplace behaviors and processes. WorldFish may terminate the appointment with immediate effect in the event that you are in breach of any of the provisions of this letter or if your conduct brings yourself or WorldFish into disrepute.

12. Force Majeure

If either you or WorldFish is temporarily unable by reasons of force majeure to meet any of obligations laid out under this employment contract, and if written notice of such event is given to the other party within thirty (30) days’ of its occurrence, the obligations that the affected party is unable to perform by reason of the event shall be suspended for as long as the inability continues. If necessary, the employment contract can be cancelled if Force Majeure prevents performance for an extended period. Neither party shall be liable to the other party for delays arising from such event. The term “Force Majeure” as used herein shall mean Acts of God, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, blockades, insurrection, riots, epidemics, lightening, floods, washouts, civil disturbances, explosions and other similar events not within the control of either Party and which, by the exercise of due diligence, neither party is able to overcome.

13. Choice of Law

Before recourse to legal action, all attempts must be made to settle the dispute amicably by negotiations between the parties.

The laws of Malaysia shall apply and the Parties herein agree to be bound by the court of competent jurisdiction of Malaysia.


If you agree with the terms and conditions of this service contract, please sign in the space below and return a signed duplicate to us.

Yours sincerely,

DocuSigned by:

63A0448F047E4DA...
Syon Myoji
Acting, Corporate Services Director

In agreement to the above terms:

DocuSigned by:

C4516D1D7E6942A...
Kristie Druzca
CEO of Includovate Pty Ltd

Feb 2, 2023 | 1:57 PM SGT

Date

Attachments:

1. Anti-Fraud and Anti-Corruption Policy.
2. Anti-Harassment, Discrimination and Bullying Policy.
3. Anti-Harassment, Discrimination and Bullying policy receipt and acknowledgement form.
4. Child Protection Policy.
5. Child Protection Policy code of conduct form.
6. Child Protection Policy self-declaration and disclosure form.
7. Conflict of Interest declaration form
8. Updated Project Implementation Plan.

ANNEX A: INTELLECTUAL PROPERTY POLICY

1 INTELLECTUAL PROPERTY: DEFINITION

“Intellectual property” means information, ideas, inventions, innovations, art work, data, designs, maps, models, findings, literary texts, new fish varieties and any other matter or thing whatsoever as may be capable of legal protection or the subject of legal rights, as granted by national laws, and may include the following items:

- 1.1 Patents;
- 1.2 Information which is of a kind and which has been communicated in such a way as to give rise to a duty of confidentiality (a trade secret or ‘know how’ are examples of this type of IP);
- 1.3 Copyright vesting in literary works (including computer programs), dramatic works, musical works, artistic works, films, sound recordings, multimedia works, broadcast, published editions and certain types of performance;
- 1.4 Registered trademarks;
- 1.5 Unregistered trademarks used or intended for use in business, plant breeders’ rights or equivalent;
- 1.6 Registered designs and designs capable of being registered;
- 1.7 New fish varieties and the rights of breeders of such varieties;
- 1.8 Layout designs of integrated circuits;
- 1.9 Databases; and other rights resulting from intellectual activity in the industrial, commercial, scientific, literary and artistic fields.

2 RESULTING INTELLECTUAL PROPERTY RIGHTS

- 2.1 All intellectual property rights arising from a partnership with another Partner must be treated in the following manner:
 - a) If all or a substantive majority of the cost of the collaborative project is borne by WorldFish, then WorldFish reserves the right to own all resulting intellectual property rights resulting from the project but WorldFish grants the Partner a non-exclusive, worldwide, royalty-free, irrevocable license to use, publish and sublicense the resulting intellectual property; if the Partner organization bears all or a substantive majority of the cost, then vice versa.
 - b) If the Partner contributes approximately 50% of the cost, the resulting intellectual property rights shall be jointly owned by both Parties. As such, they shall remain publicly accessible and shall be available to the partners of WorldFish and the Partner and to end-users.
 - c) Results of the collaborative research will be jointly published in the public interest as mutually agreed upon.
- 2.2 All intellectual property created by an employee or consultant in the course of their work at WorldFish must be treated in the following manner:
 - a) All intellectual property so generated shall belong solely to WorldFish;
 - b) The ownership and retention of research data and information generated during the consultancy/employment for WorldFish are vested by WorldFish. Prior to completion of the

contract, all data and information gathered as part of the WorldFish activity must be sorted and organized in good order so that it can be used by others in WorldFish for future activities, and is ready for long-term storage. This will include, but not be limited to, research data and notes, field and laboratory notebooks and records, computer files, computer discs and tapes, and all project reports.

- c) Books and publications (paper and electronic) obtained by WorldFish funds will remain the property of WorldFish. Reprints obtained during the consultancy/employment will be left with WorldFish for inclusion in the WorldFish library.

3 BACKGROUND INTELLECTUAL PROPERTY

Either Party may choose to introduce intellectual property that it owns to the other, in the interest of this agreement. It would thereby grant the other Party a license to use and sublicense the background intellectual property being introduced, wherever this is required to meet the objectives of this agreement.

4 INTELLECTUAL PROPERTY RIGHTS PROTECTION

Partners/employees/consultants who believe that intellectual property rights protection should be sought by WorldFish in relation to aspects of the collaborative work must discuss this with their WorldFish counterpart/supervisor. As a general rule, such IP protection shall not be sought unless it is necessary for the further improvement of the intellectual property or to enhance the scale or scope of impact on target beneficiaries, in furtherance of the CGIAR Vision as defined in the CGIAR IA Principles.

5 PUBLICATION

Wherever possible, publications should be in Open Access Journals or made available through Open Access Repositories. Similarly, data sets and other outputs of research should be publicly available in line with the obligation of WorldFish to comply with the CGIAR Open Access and Data Management Policy.

16 January 2023

PLA13007

NAGI Enterprise
Angela Samundengo
 Alick Nkhata Road
 Z2 / 35 Kalingalinga
 Lusaka, Lusaka Province,
 Zambia

Email of PIC: murisa.mzime@gmail.com
 NAGI Email: nagieenterprise@gmail.com

Dear NAGI Enterprise,

Lead Climate Change & Environmental Assessment for the Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA).

WorldFish hereby appoints NAGI Enterprise (“**Consultant**”) as a **Lead Climate Change & Environmental Assessment** for the project stated above and, on the terms, and conditions contained herein. References to you shall include your personnel, where the context requires. The details of this Consultancy contract are as per the details listed below.

1. General Terms

Consultancy Commencement Date	11 January 2023
Consultancy End Date	30 July 2023
Duration of Contract	Approximately 6 months and 15 days
Contract Commencement Date	16 January 2023
Contract End Date	30 August 2023
Proposed Project Completion Date	30 April 2027
Expected Activities	The consultant will identify opportunities for the project to benefit the environment within the novel feeds landscape in the 3 project countries (Nigeria, Zambia and Kenya). The selected organization is expected to employ life cycle assessment (LCA) methods. The initial assessments will be completed in the first 6 months of the project and will find a way for the project to contribute to advance climate change and environment goals of Norad, WorldFish, and other key stakeholders within the novel feeds landscape, as per the FASA project implementation plan.
Project Leader	Rodrigue Yossa

2. Deliverables (Year 1)

No.	Due Date	Deliverables
1	Climate Change and Environmental Analysis Report	
a	16 January 2023	Annotated outline
b	15 February 2023	First draft (for input by project team members)
c	20 February 2023	Second draft (for input by project team members and donor)
d	10 March 2023	Final report complete (incorporating inputs from all above)
e	31 March 2023	Expense report for the period up to 10 March 2023
2	Life Cycle Assessment (LCA)	
a	28 February 2023	Annotated outline
b	30 March 2023	First draft (for input by project team members)
c	15 April 2023	Second draft (for input by project team members and donor)
d	30 April 2023	Final report complete (incorporating inputs from all above)
3	Outcome Report	
a	15 April 2023	Draft outcome report
b	30 April 2023	Final outcome report
c	30 May 2023	Draft journal article 1
d	30 June 2023	Draft journal article 2
e	30 July 2023	Draft journal article 3

All publications resulting from this Consultancy will be co-authored by the WorldFish Project Leader.

Future Collaboration:

Upon completion of the deliverables described in Year 1, the parties may agree to enter into a collaboration to develop and evaluate expected work of NAGI in the FASA project from Y2 to Y5, which would involve the Re-assessment and alignment of climate change and environmental assessment work in the FASA project countries and attendance of the annual project workshops. The Tentative Deliverables below may be subject to change, shall not bind the parties hereto and shall be subject to the execution of separate agreements for the respective years.

Tentative Deliverables (Year 2 to 5)

No	Reporting Period	Type of Report	Due Date
1	January 2023 – December 2023	FASA_Annual Assessment Report 2023Q1-Q4	30 January 2024
2	January 2024 – June 2024	FASA_Mid-Year Assessment Report 2024Q1-Q2	30 July 2024
3	January 2024 – December 2024	FASA_Annual Assessment Report 2024Q1-Q4	30 January 2025
4	January 2025 – June 2025	FASA_Mid-Year Assessment Report 2025Q1-Q2	30 July 2025
5	January 2025 – December 2025	FASA_Annual Assessment Report 2025Q1-Q4	30 January 2026
6	January 2026 – June 2026	FASA_Mid-Year Assessment Report 2026Q1-Q2	30 July 2026
7	January 2026 – December 2026	FASA_Annual Assessment Report 2026Q1-Q4	30 January 2027

8	January 2027 – April 2027	FASA_Mid-Year Assessment Report 2027Q1-Q2	30 May 2027
9	December 2022 – April 2027	FASA_Final Assessment Report 2022-2027	30 May 2027

3. Appointment of Personnel

You shall appoint the following personnel to carry out the Project and deliver the deliverables stated above:-

<u>No.</u>	<u>Name</u>	<u>Qualifications</u>
1.	Mzime R. Ndebele Murisa-Principal Investigator Consultant and Leading activities in Kenya	Program Specialist of START International Ph.D. Biodiversity and Conservation Biology University of the Western Cape, South Africa
2.	Prof. Fanuel Kapute- Leading activities in Zambia	Fisheries & Aquatic Science and Project Evaluation Specialist (Consultant) of NAGI Enterprise Ph.D. Aquaculture and Fisheries Science University of Malawi
3.	Prof. Chipo Mubaya- Leading activities in Nigeria	Social Science Researcher and Associate Professor (Consultant) of NAGI Enterprise Ph.D. Development Studies University of the Free State, South Africa
4.	Angela Samundengo- Overall administrative coordination and communication	Director and Founder of NAGI Enterprise Master of Science Project Management. University of Roehampton, UK

You shall be solely responsible for the conduct of your personnel and shall indemnify WorldFish against any loss, damage, suit, claim, liabilities, demand, cost, fee or any expense whatsoever that may be asserted by a third party as a result of your personnel’s negligence or misconduct.

You shall also be solely responsible for establishing and paying compensation and other benefits to its personnel. You shall be responsible for compliance with all laws relating to your personnel, including but not limited to tax, insurance and social security contributions.

In the event of any change in the named personnel above and subject to WorldFish’s approval, you agree to appoint personnel with equivalent or better qualifications as a replacement. Such change in personnel shall not affect your obligations and responsibilities contained in this agreement.

4. Fees and Expenses

You will be paid an all-inclusive service fee of no more than **NOK 569,268.57** for this consultancy contract. Payment will be made by telegraphic in accordance with the payment schedule below.

Future Collaboration:

Upon completion of the deliverables described in Year 1, the parties may agree to enter into a collaboration to develop and evaluate expected work of NAGI in the FASA project from Y2 to Y5, which would involve the Re-

assessment and alignment of climate change and environmental assessment work in the FASA project countries and attendance of the annual project workshops. The Tentative Budget below may be subject to change, shall not bind the parties hereto and shall be subject to the execution of separate agreements for the respective years.

Tentative Budget in NOK

Budget Item/ Year	Year 2 (NOK)	Year 3 (NOK)	Year 4 (NOK)	Year 5 (NOK)	Total (NOK)
Personnel Cost	351,054.57	351,054.57	351,054.57	197,496.57	1,250,660.28

The terms and amounts contained above are indicative only and shall not bind WorldFish in any way whatsoever. The payments referred to in the tentative budget above are subject to the approval of WorldFish's budget for the respective years, the receipt of funds from donors and the execution of a separate agreement for each respective year.

Payment Schedule

#	Deliverables against which payment is made	Amount (NOK)	Due Date
1	Upon signing of the contract and submission of the planned budget for the spending of the first tranche	395,000	16 January 2023
2	Upon acceptance of deliverables 1 and 2 and full utilization of the initial disbursement of NOK395,000/-	100,000	30 April 2023
3	Upon acceptance of deliverable 3	74,268.57	30 August 2023

In case of partial performance of the work set out in this contract, WorldFish has the discretion to pay a partial sum corresponding to the work completed or withhold payment for inadequate performance. Payment shall be made to the following Bank account:

Name and address of Bank	STANBIC BANK ZAMBIA LIMITED, 1 NAIROBI PALACE CAIRO ROAD LUSAKA ZAMBIA
Branch Name	CAIRO ROAD
Branch Code	040002
Account Name	NAGI ENTERPRISE
Account Number	9130005411037
SWIFT Code	SBICZMLX
Bank Account Currency	USD

WorldFish shall not be responsible for any losses incurred by the Recipient due to currency fluctuations and/or delays, standard and additional bank charges arising from incomplete or inaccurate banking details submitted. The sole responsibility shall be the Recipient directly.

Any extension of the service contract is subject to project needs and importance, and subject to the discretion of WorldFish.

5. Allowances and Perquisites

Under this contract you will not be entitled to any allowances, perquisites and benefits other than those stated in this letter.

If, for the purposes of this contract, you are required to travel to Malaysia or any of the project countries to attend the annual project workshop, WorldFish will cover the costs of your flights, accommodation and per diem in accordance with WorldFish travel policies. Funds for the costs specified in this paragraph shall be in addition and not part of the all-inclusive service fee stated in Clause 4 above.

6. Termination

In case of gross underperformance of the work set out herein or material breach of the obligations under this agreement, WorldFish may terminate this contract with five (05) working days' notice.

Further, either party may terminate this agreement at any time upon fourteen (14) working days' written notice.

Upon termination, all property of WorldFish that is in your possession including any original or duplicate documents must be returned to WorldFish. You undertake to irretrievably delete any information relating to WorldFish stored on any device, electronic or otherwise, and all matters derived from such sources which is in your possession or under your control outside the premises of WorldFish.

7. Intellectual Property

You will be provided with a copy of the WorldFish policy on Intellectual Assets which applies to the terms of this agreement and to your work at WorldFish.

Nothing will affect the ownership of any intellectual property that either party had prior to this agreement ("Background Intellectual Property").

Both parties agree to grant non-exclusive, royalty-free licenses to use the Background Intellectual Property which will need to be shared and exchanged to allow the Services to be carried out.

You hereby assign to WorldFish all intellectual property rights (including, without limitation, patents, copyright and related rights) and inventions arising from the services you render for WorldFish. You agree promptly to execute all documents and do all acts as may, in the opinion of WorldFish, be necessary to give effect to this clause.

Intellectual property and Research Data created in the course of this contract is governed by Annex A. Books and publications (paper and electronic) obtained with WorldFish funds will remain the property of WorldFish.

8. Confidential Information and WorldFish Property

You shall not use or disclose to any person either during or at any time after your engagement by WorldFish any confidential information about the business or affairs of WorldFish or any of its business contacts, or about any other confidential matters which may come to your knowledge in the course of providing the Services. For the purposes of this clause, confidential information means any information or matter which is not in the public domain and which relates to the affairs of WorldFish or any of its contacts.

All documents, manuals, hardware and software provided for your use by WorldFish, and any data or documents (including copies) produced, maintained or stored on the WorldFish computer systems or other electronic equipment (including mobile phones if provided by WorldFish), remain the property of WorldFish.

9. Data Protection

You consent to WorldFish holding and processing data relating to you for legal, personnel, administrative and management purposes and in particular to the processing of any "sensitive personal data" as defined in Malaysian Law.

You consent to WorldFish making such information available to other Centers within CGIAR, service providers to WorldFish (such as advisers), regulatory authorities, governmental or quasi-governmental organisations and potential purchasers of WorldFish or any part of its work, for purposes other than marketing.

10. Status

You will be an independent contractor and nothing in this agreement shall render you an employee, worker, agent or partner of WorldFish and you shall not hold yourself out as such.

You will be required to arrange your own group medical, life and AD&D insurance. WorldFish will not assume responsibility for any insurance liability. You will also be responsible for all relevant taxes made in connection with the performance of your services, and any claim brought against you in connection with the provision of the services.

11. Policies, Procedures and Guidelines

You are required to comply with WorldFish's code of conduct, ethics policy, child protection policy, anti-harassment, discrimination and bullying policy, anti-fraud and anti-corruption policy, and any other organizational policies relating to workplace behaviors and processes. WorldFish may terminate the appointment with immediate effect in the event that you are in breach of any of the provisions of this letter or if your conduct brings yourself or WorldFish into disrepute.

12. Force Majeure

If either you or WorldFish is temporarily unable by reasons of force majeure to meet any of obligations laid out under this employment contract, and if written notice of such event is given to the other party within thirty (30) days' of its occurrence, the obligations that the affected party is unable to perform by reason of the event shall be suspended for as long as the inability continues. If necessary, the employment contract can be cancelled if Force Majeure prevents performance for an extended period. Neither party shall be liable to the other party for delays arising from such event. The term "Force Majeure" as used herein shall mean Acts of God, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, blockades, insurrection, riots, epidemics, lightening, floods, washouts, civil disturbances, explosions and other similar events not within the control of either Party and which, by the exercise of due diligence, neither party is able to overcome.

13. Choice of Law

Before recourse to legal action, all attempts must be made to settle the dispute amicably by negotiations between the parties.

The laws of Malaysia shall apply and the Parties herein agree to be bound by the court of competent jurisdiction of Malaysia.

If you agree with the terms and conditions of this service contract, please sign in the space below and return a signed duplicate to us.

Yours sincerely,

DocuSigned by:

63A0448F047E4DA...
Syon Niyogi
Acting, Corporate Services Director

In agreement to the above terms:

DocuSigned by:

55D83D6C96F34E2...
On behalf of NAGI Enterprise
Angela Samundengo
Director and Founder of NAGI Enterprise

Jan 17, 2023 | 1:04 AM SGT

Date

Attachments:

1. Anti-Fraud and Anti-Corruption Policy.
2. Anti-Harassment, Discrimination and Bullying Policy.
3. Anti-Harassment, Discrimination and Bullying policy receipt and acknowledgement form.
4. Child Protection Policy.
5. Child Protection Policy code of conduct form.
6. Child Protection Policy self-declaration and disclosure form.
7. Conflict of Interest declaration form.
8. Updated implementation plan of the FASA project

ANNEX A: INTELLECTUAL PROPERTY POLICY

1 INTELLECTUAL PROPERTY: DEFINITION

“Intellectual property” means information, ideas, inventions, innovations, art work, data, designs, maps, models, findings, literary texts, new fish varieties and any other matter or thing whatsoever as may be capable of legal protection or the subject of legal rights, as granted by national laws, and may include the following items:

- 1.1 Patents;
- 1.2 Information which is of a kind and which has been communicated in such a way as to give rise to a duty of confidentiality (a trade secret or ‘know how’ are examples of this type of IP);
- 1.3 Copyright vesting in literary works (including computer programs), dramatic works, musical works, artistic works, films, sound recordings, multimedia works, broadcast, published editions and certain types of performance;
- 1.4 Registered trademarks;
- 1.5 Unregistered trademarks used or intended for use in business, plant breeders’ rights or equivalent;
- 1.6 Registered designs and designs capable of being registered;
- 1.7 New fish varieties and the rights of breeders of such varieties;
- 1.8 Layout designs of integrated circuits;
- 1.9 Databases; and other rights resulting from intellectual activity in the industrial, commercial, scientific, literary and artistic fields.

2 RESULTING INTELLECTUAL PROPERTY RIGHTS

- 2.1 All intellectual property rights arising from a partnership with another Partner must be treated in the following manner:
 - a) If all or a substantive majority of the cost of the collaborative project is borne by WorldFish, then WorldFish reserves the right to own all resulting intellectual property rights resulting from the project but WorldFish grants the Partner a non-exclusive, worldwide, royalty-free, irrevocable license to use, publish and sublicense the resulting intellectual property; if the Partner organization bears all or a substantive majority of the cost, then vice versa.
 - b) If the Partner contributes approximately 50% of the cost, the resulting intellectual property rights shall be jointly owned by both Parties. As such, they shall remain publicly accessible and shall be available to the partners of WorldFish and the Partner and to end-users.
 - c) Results of the collaborative research will be jointly published in the public interest as mutually agreed upon.
- 2.2 All intellectual property created by an employee or consultant in the course of their work at WorldFish must be treated in the following manner:
 - a) All intellectual property so generated shall belong solely to WorldFish;
 - b) The ownership and retention of research data and information generated during the consultancy/employment for WorldFish are vested by WorldFish. Prior to completion of the

contract, all data and information gathered as part of the WorldFish activity must be sorted and organized in good order so that it can be used by others in WorldFish for future activities, and is ready for long-term storage. This will include, but not be limited to, research data and notes, field and laboratory notebooks and records, computer files, computer discs and tapes, and all project reports.

- c) Books and publications (paper and electronic) obtained by WorldFish funds will remain the property of WorldFish. Reprints obtained during the consultancy/employment will be left with WorldFish for inclusion in the WorldFish library.

3 BACKGROUND INTELLECTUAL PROPERTY

Either Party may choose to introduce intellectual property that it owns to the other, in the interest of this agreement. It would thereby grant the other Party a license to use and sublicense the background intellectual property being introduced, wherever this is required to meet the objectives of this agreement.

4 INTELLECTUAL PROPERTY RIGHTS PROTECTION

Partners/employees/consultants who believe that intellectual property rights protection should be sought by WorldFish in relation to aspects of the collaborative work must discuss this with their WorldFish counterpart/supervisor. As a general rule, such IP protection shall not be sought unless it is necessary for the further improvement of the intellectual property or to enhance the scale or scope of impact on target beneficiaries, in furtherance of the CGIAR Vision as defined in the CGIAR IA Principles.

5 PUBLICATION

Wherever possible, publications should be in Open Access Journals or made available through Open Access Repositories. Similarly, data sets and other outputs of research should be publicly available in line with the obligation of WorldFish to comply with the CGIAR Open Access and Data Management Policy.

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

Communications Strategy

June 2023





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1. FASA Context

Twenty-two percent of all human dietary protein in sub-Saharan African (SSA) countries is supplied by fish. The aquaculture sector is expanding and is expected to grow across the region by as much as 55 percent by 2030. Development of the aquaculture industry has been prioritized within the national agriculture development plans of more than 20 African countries.

Aquatic animal feed is a key enabler for the sustainability and profitability of aquaculture. According to the [Blue Food Assessment](#), increasing the efficiency of feed to aquatic food weight gain represents the biggest opportunity to improve environmental performance.

Until recently, most smallholder fish farmers engaged chiefly in the production of on-farm feed. For example, in 2005, approximately 70 percent of aquafeed in Nigeria was farm-made and in Kenya, prior to the availability of compounded feeds, most smallholder fish farmers used locally available feedstuffs such as corn meal or rice bran to feed their fish or fish were reared in ponds with manure—with or without supplemental feeds. However, while many smallholder fish farmers in SSA still use on-farm feeds, the upsurge in aquaculture growth over the past decade has led to the emergence of informal small-scale feed millers and formal large-scale aquafeed manufacturers.

SSA countries often depend on imports in addition to domestic production for their supply of quality feed ingredients. In Zambia, for instance, almost all micro-ingredients in feeds, such as fishmeal, premixes and vitamins, are imported. This reliance on imported ingredients is coupled with inconsistent quality of farm-made feeds in SSA related to limited knowledge of in-country ingredients available, the potential processing techniques to improve local ingredients, the formulation of local balanced diets and the use of digital tools to access information on local ingredients.

The **Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) project**, funded by NORAD, will take place over a 5-year period in three African countries – Nigeria, Zambia, and Kenya. In Nigeria, WorldFish will focus on Oyo State and Lagos State where the Nigerian Institute for Oceanography and Marine Research is located while in Zambia, the focus will be on the Northern Provinces and in Kenya, WorldFish will work in Nairobi as well as Nakuru where Egerton University is located.

This project has the following primary goal: to develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in three African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security and reduced waste and pollution. WorldFish estimates that 30 percent of total fish farmers will be women and 40 percent will be youth.

The project is aligned to address Norad's international development priority areas, particularly sustainable food production and Norway's intention to improve nutrition, enhance jobs and value creation, and promote capacity building.

2. Communications Objectives

FASA's communications activities are aimed to achieve the following objectives:

- Demonstrate to stakeholders and wider audiences what and how FASA is making a difference in the well-being of people dependent on aquatic food systems
- Disseminate knowledge and learnings from the project to stakeholders within project countries and outside for possible adaptation and scaling
- Enable project staff and partners to communicate and exchange knowledge with the stakeholders
- Support FASA's project deliverables, such as trainings and policy briefs, to ensure their effective uptake and outcomes
- Ensure that investors and partners view FASA (and WorldFish) as a credible, relevant and results-oriented project (and organization)

To engage FASA's diverse stakeholders effectively, relevant and credible content will be developed and packaged into compelling products, tailored to the needs of the audiences and disseminated through appropriate channels.

3. Target Audiences

Primary audiences

- Donor (NORAD)
- Partners involved in research and delivery (e.g. CORAF, ICIPE)
- Policymakers in project countries
- Local and regional media

Secondary audiences

- Regional associations and agencies, such as ECOWAS, COMESA, and AUDA-NEPAD
- Africa Development Bank and other potential donors/partners
- Wider stakeholders of sustainable development in Africa
- Global aquatic foods and 'blue economy' community

4. Key Messages

The following are key messages of the FASA project that are to be communicated in communication products:

Aquatic foods

- Aquatic foods and aquaculture can be a game-changer for advancing sustainable development and fighting hunger and malnutrition in Africa.
- Sustainable aquaculture is a win-win solution for people and planet – it contributes to income generation, food and nutrition security, family well-being, gender parity, and inclusivity, with a smaller carbon footprint compared to land-based food production.
- Sustainability is a priority in aquaculture development, demanding a circular economy approach, waste reduction and avoidance of environmental pollution.
- Thriving aquaculture value chains offer a large, untapped opportunity in Africa to empower women and youth and bridge inequities.

Aquatic animal feed

- Climate change impacts aquaculture and necessitates environmentally friendly and cost-effective technologies like sustainable fish feeds.
- Developing local, sustainable aquatic animal feed is crucial to overcome challenges in low-income countries, such as high feed costs and reliance on expensive imported resources.
- Efficient feed-to-animal weight conversion offers the biggest opportunity to improve the environmental performance of aquaculture.
- Conventional fish feeds have a high environmental cost, are of poor quality, and are often inaccessible to smallholder fish farmers, especially women and youth.

5. Communications Tools and Tactics

A mix of audience-tailored communication products and channels is crucial for achieving successful communication outcomes and maximizing the impact of communication activities that meets the Results Framework and MEL Plan. WorldFish will use the following tools and tactics to communicate and engage FASA's diverse audiences, with tailored strategies for specific project activities and objectives as needed.

- **Project microsite**

A project microsite or webpage, residing on the WorldFish website, will provide access to all project communications materials and reports and curate related posted news updates and stories. The WorldFish website has some 40,000 unique visitors monthly, equipped to provide adequate visibility to FASA's activities and impact. [Project URL](#)

- **Social media**

WorldFish has some 100,000 followers on its social media channels – Twitter, Facebook, and LinkedIn. WorldFish will promote FASA's events, activities, and outcomes on its social media channels, tagging the relevant partners to engage and promote. Posts will be used to disseminate publications, news updates and other FASA content posted on the website, as well as to push out content in small bites to share knowledge and promote events and activities.

- **E-newsletter**

An annual e-newsletter will be sent out to stakeholders sharing FASA's activities, outcomes, and any publications.

- **Promotional products**

A suite of promotional products to engage different audiences at varied occasions will be developed to succinctly convey FASA's objectives, activities, partners, and countries of work. These include a project brochure or factsheet, a roll-up banner for use in events, and any other products as need arises.

- **Blogs and Stories**

A series of blogs and impact stories will be developed periodically throughout the implementation of FASA to provide insights into the project's activities and outcomes, including 'In the Spotlight' featuring project staff.

- **Events**

Visibility at country, regional, and global events is a powerful medium to engage stakeholders and disseminate the project's knowledge and outcomes. WorldFish will identify strategic events to participate in for FASA and plan with partners to shape the project's participation – abstracts at conferences, exhibits, panel discussions, and for speaking roles.

- **Knowledge exchanges**

Knowledge exchange amongst the communities within the countries and across project countries will be crucial for project implementation, learning, and adaptation. WorldFish will host 'Fish for Thought' events – its branded series of knowledge exchanges to bring FASA's stakeholders together for knowledge exchange.

- **Videos**

Leveraging WorldFish's YouTube channel, videos highlighting FASA's activities will be produced to further communicate and amplify the outcomes of the project.

- **Media**

As opportunity emerges, WorldFish will pitch stories from FASA and its experts to media channels, including radio and television, for coverage, particularly targeting media channels in Africa.

Content Strategy

While using a mix of tools and tactics can help the project reach its audiences, strategizing content is equally important to ensure its uptake and engagement with the program's outputs. WorldFish will disseminate and promote FASA's activities and outputs through a variety of online products, including news updates, stories of impact, infographics, short videos, interviews, and photo stories, disseminated through social media, WorldFish's e-newsletters and at events.

Photo assets from FASA will be accessible through a devoted FASA album on [WorldFish's Flickr](#). Similarly, FASA's videos will be curated on [WorldFish's YouTube handle](#).

6. Being on Brand

FASA's communications will adhere to the following guidelines to ensure they are on brand:

- [NORAD's Branding Guidelines](#)
- [WorldFish Branding Guidelines](#)
- Guide on Funding and Support Acknowledgements for WorldFish publications and other research, knowledge and communication outputs:

Acknowledgment

This work was undertaken in the framework of [*add bilateral project name*]. Funding support for this work was provided by [*add names of all funders in alphabetical order including WorldFish*]. WorldFish is supported by contributors to the CGIAR Trust Fund.

Peer-review clause

This [*paper, book, publication*] has gone through the standard WorldFish science review procedure.

or

This [*paper, book, publication*] has not gone through the standard WorldFish science review procedure.

Disclaimer

The opinions expressed here belong to the authors, and do not necessarily reflect those of [*add names of all funders in alphabetical order*], WorldFish or CGIAR.

- **Note:** All digital statements should be hyperlinked to the WorldFish website (www.worldfishcenter.org) and CGIAR Funders page (www.cgiar.org/funders). The URLs should also be included in all printed material.

All products and activities will be adequately branded, displaying donor logo and partner logos clearly and visibly.

7. Evaluating Performance

The performance of the communication activities will be measured through various qualitative and quantitative indicators, which will be used to continually refine the activities and tactics. The following indicators will be used to assess the performance and efficacy of online communications activities:

- Number of visitors to the FASA project webpage (repeat and new visitors)
- Number of views of blogs, stories, and news updates from FASA
- Number of downloads of publications from FASA
- Digital reach of social media posts

Aside from online indicators, the visibility of FASA's activities will be monitored via the following metrics:

- Number of coverages in media
- Number of events FASA project participated in or was featured
- Number of newsletters/e-blasts sent out

Aside from quantitative indicators, qualitative indicators and incidental feedback will be key to reflecting the sentiment of stakeholders surrounding FASA. These may include but are not limited to recognition from partners and beneficiaries, mentions from influential stakeholders and institutions in the development and agricultural space, development of new partnerships/collaborations, and/or additional funding and expansion of the project activities.



Photo credit: Neil Palmer/WorldFish

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

Annual project workshop report

November 6–9, 2023
Abuja and Lagos, Nigeria

In partnership with



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA): Annual project workshop report

Citation

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About Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

WorldFish has partnered with the Norwegian Agency for Development Cooperation (Norad) on a 5-year project to develop low-cost and highly nutritious aquatic feeds based on novel ingredients. The project, known as Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA), will run from 2022 to 2027 with Norad funding the initiative through a NOK 80 million (approximately USD 8 million) grant. The project aims to enable 5000 smallholder aquatic food producers in Kenya, Nigeria and Zambia to test and use these feeds and ingredients, which will increase their income, improve their nation's food security as well as reduce waste and pollution. An estimated 30 and 40 percent of aquatic food producers engaged in the project will be women and youths, respectively.

Acknowledgments

The Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) project is funded by the Norwegian Agency for Development Cooperation (Norad) (Agreement SAF-21/0004). This work was undertaken as part of the CGIAR Initiative on Aquatic Foods. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

Contact

WorldFish Communications and Marketing Department, Jalan Batu Maung, Batu Maung, 11960 Bayan Lepas, Penang, Malaysia. Email: worldfishcenter@cgiar.org

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Photo credits

Front cover, Neil Palmer/WorldFish; Yogeswary Chellapan, Ning Shahira Sharbini, Nurulhuda Ahmad Fatan Arthertone Jere, Gregory Kasanga/WorldFish.

Disclaimer

This report must be read, and the results considered, in conjunction with the climate and environmental analysis report as well as the country outcomes report for Kenya, Nigeria and Zambia under the FASA project.

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List of abbreviations

BSFL	Black soldier fly larvae
FASA	Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa
ILRI	International Livestock Research Institution
LCA	life cycle assessment

Executive summary

On November 6–9, 2023, the Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA) project held its most recent annual workshop at the Rockview Hotel in Abuja, Nigeria. Two days (November 7–8) were spent at the hotel in between two daylong field visits, one to a feed mill and fish farm in Abuja (November 6) and the other to the Nigerian Institute for Oceanography and Marine Research (NIOMR) in Lagos (November 9).

WorldFish representatives attended the workshop as well as FASA partners, consultants and stakeholders, such as the West and Central African Council for Agricultural Research and Development (CORAF), The International Centre of Insect Physiology and Ecology (ICIPE), The Natural Resources Development College (NRDC), Swedish University of Agricultural Sciences (SLU), Includovate, NAGI Enterprise, The International Institute of Tropical Agriculture (IITA), Aller Aqua Zambia Limited, The Agricultural Research Council of Nigeria (ARCN) and Nigerian Institute for Oceanography and Marine Research (NIOMR). The Norwegian ambassador to Nigeria officially opened the workshop. The objective was to bring together FASA partners to provide updates on the overall activities completed in Year 1 of the project as well as activities planned for Year 2 and tentatively Year 3 (the entire project runs from July 1, 2022, to June 30, 2027). The revised implementation plan for 2024 and tentatively 2025 of the project was the main outcome of the workshop. Through discussions in each presentation section, participants had the opportunity to address questions and update challenges pertaining to the project's activities. In each session, participants also helped generate new ideas and solutions, leading to new insights and approaches to problems.

Several activities were accomplished in the first year of the project. FASA partners completed scoping studies that provided information on the type, price and seasonality of local ingredients used in fish feeds produced in the project's three focal countries: Zambia, Kenya and Nigeria. The laboratory in Zambia was upgraded with a complete recirculating aquaculture system (RAS) for use in experiments on the nutrient requirements of an improved strain of tilapia. A gender and social assessment was done using the Automated Directives Systems 205 (ADS 205) framework, with an emphasis on policies, cultural beliefs, gender roles, resource access and decision-making. Climate change and environmental assessments using life cycle assessment (LCA) methods highlighted the potential of the project to improve environmental benefits within the novel feeds landscape across the three focal countries. Then, workshops on theories of change was held in Zambia, Kenya and Nigeria to investigate the impact of using novel feed ingredients in fish feeds.

In addition to providing updates on implementation activities in Year 1, project partners provided detailed workplans for 2024 and tentatively 2025. Among the activities planned are experiments on the nutrient requirements of improved strains of tilapia and African catfish using locally accessible ingredients. Other activities include conducting a digestibility experiment and biochemical analyses on ingredient samples obtained from each focal country, as well as creating an ingredient database. Finally, the project will submit the agreed upon implementation plan to donor for approval. The plan will be used to carry out the project on the ground in 2024 and tentatively 2025.

1. Introduction

1.1. Objectives

The purpose of the workshop was to bring together project partners to meet in person, provide updates on the project's overall activities implemented from July 2022 to September 2023 and plan activities for the subsequent year.

1.2. Dates and venues

The workshop was held in Abuja and Lagos, Nigeria, on November 6–9, 2023. The agenda of the workshop was as follows:

- November 6: Site visit to the TIDDO Fish Farms Limited and Flourishing Centre Fish and Agro Farms in Abuja.
- November 7-8: Workshop meetings and presentations in Gurara Hall at Rockview Hotels Classic.
- November 9: Site visit to the NIOMR in Lagos

1.3. Participants

A total of 30 people attended the workshop. They consisted of representatives from CORAF, ARCN, NIOMR, the National Institute for Freshwater and Fisheries Research (NIFFR), NRDC, ICIPE, SLU, Includovate, NAGI Enterprise, Aller Aqua Zambia Limited, IITA and WorldFish. A detailed list of attendees is available in Appendix 1.



Plate 1. Workshop participants, including the Norwegian ambassador to Nigeria, His Excellency Svein Bæra.

1.4. Activities

The workshop consisted of presentations at the Rockview Hotel, Abuja and field visits. A detailed agenda of the activities at the Rockview Hotel is included in Appendix 2. Details of the field visit are discussed in section 4.



Plate 2. Workshop participants.

2. Opening

Dr. Rodrigue Yossa, the project leader, welcomed everyone and provided an outline of the activities and program for the workshop. The workshop began with a welcoming speech from Dr. Musa Musa, assistant chief of the ARCN. In his speech, he welcomed all the participants and mentioned how important the FASA project is for WorldFish and its partners—both for the aquaculture sector in Africa and for people relying on farmed fish to make a living. Prerecorded welcome speeches were given by Dr. Essam Mohammed, WorldFish’s director general, Dr. Lamien Nieyidouba from CORAF and Dr. Sunil Siriwardena from WorldFish Nigeria. Mr. Baera then delivered the opening speech, after which Dr. Yossa presented the objective and scope of the workshop.

3. Presentations: Updates on the implementation of Year 1

3.1. Day 1

Presentations were held at the Rockview Hotel. These included updates on the implementation of Year 1 and the perspectives of partners on the implementation. Each presentation provided an update on a specific component of the project in its first year of implementation of the FASA project. Additionally, WorldFish’s finance team provided an update on the project’s finances and financial reporting schedule, followed by an update from the project leader on the technical reporting schedule. Copies of the slides presentations for Day 1 are available in Appendix 3.

3.1.1. FASA in Nigeria

Presentation by Dr. Charity Obeta, CORAF

Overview

Although Nigeria is the largest aquaculture producer in Sub-Saharan Africa, it faces considerable challenges in supplying affordable, high quality feed to sustain fish farming in the country. The expansion of smallholder aquaculture faces limitations such as

the scarcity and unsustainability of feed as well as the substantial economic and environmental costs involved. This is where FASA comes in. The project is a transformative initiative, striving to establish an inclusive, equitable and sustainable aquatic food system in Nigeria in order to pave the way for a more balanced and resilient industry.

Implementation

Scoping studies

Scoping studies were done on the type, price and seasonality of local ingredients for potential use in fish feeds in Nigeria. The focus was on collecting and sharing important data about local ingredients suitable for sustainable fish feeds. The aim was to fill the existing information gap and promote a better, more sustainable way of producing fish feed in Nigeria.

A total of 920 responses were gathered from 46 locations, averaging 20 respondents per location, with 5 at least respondents from each location. These locations spanned 6 distinct regional zones (Figure 1).



Figure 1. Location of the FASA study in Nigeria.

Results

Major ingredients were assessed across the country's zones: groundnut cake in North Central, soybean in North East, maize in North West, cassava and rice bran in South East, cassava in South, and cassava and maize in South West. From 2018 to 2022, cassava prices were highest in South East and increased over time. Rice prices trended upward across the country and were highest in South South, while yam prices, which were highest in South East, also increased.

The survey grouped the ingredients into five uses: (1) animal feeds, (2) animal feeds and human consumption, (3) animal feeds, human consumption and industrial use, (4) animal feeds and industrial use and (5) human consumption only. Findings showed that the largest share of ingredients serves both animal feeds and human consumption (50%), followed by those for animal feeds, human consumption and industry (21%). Some were solely for human consumption (15%) and just a small percentage for animal feeds (11%), while the least amount was used for both animal feeds and industry (3%).

Surveys showed that 20% of the ingredients are produced year-round, though most come during the dry season (51%) followed by the wet season (29%). According to the surveys, 94% of the ingredients are highly accessible in markets.

The following is the distribution of feed mills across the zones:

- North Central: 32% Niger, 28% Plateau, 24% Nasarawa, 12% Federal Capital Territory (FCT), 4% Benue
- North East: 72% Yobe, 20% Bauchi, 8% Taraba
- North West: 46% Kaduna, 40% Kano, 7% Sokoto, 7% Kebbi
- South South: 69% Akwa Ibom, 23% Rivers, 8% Delta
- South East: 71% Enugu, 23% Ebonyi, 6% Abia
- South West: 41% Ondo, 26% Lagos, 18% Ogun, 15% Oyo.

The survey also examined the daily capacity of feed mills based on how long they had been in business. Most feed millers from each zone are capable of producing no more than 4536 kg of feed daily.

FASA collected and packaged the following 16 ingredients and sent them to WorldFish and SLU for analysis and processing:

1. African locust bean (*Parkia biglobosa*)
2. African baobab (*Adansonia digitata*)
3. White cowpea (*Vigna unguiculata*)
4. Brown cowpea (*Vigna unguiculata*)
5. Bambara nut (*Vigna subterranea*)
6. Brewery waste (*Hordeum vulgare*)
7. Roselle seed meal (after extracting oil from the roselle seed)
8. Tiger nut (*Cyperus esculentus*)
9. White yam (*Dioscoria rotundata*)
10. Shea nut seed cake (*Vitellaria paradoxa*)
11. Clupeidea fish (*Pellonula leonensis*)
12. Clupeidea fish (*Sierrathrissa leonensis*)
13. Lantern fish
14. Black soldier fly larvae (BSFL)
15. Chaya leaves
16. Plantain (*Musa sapientum*)

Experiments

Eight experiments will be conducted to investigate the nutrient requirements (methionine, lysine, vitamin C, calcium and phosphorus) for improved strains of tilapia and African catfish using locally available ingredients in Nigeria.

The project received approval of its research and human ethics protocols and rehabilitated an experimental system using Recirculating Aquaculture System (RAS). It also procured fish for the experiments and was acclimatizing the fish at the time of the workshop. Fish feed formulations, sampling and chemical analysis were also planned for the experiments.

3.1.2. FASA in Kenya

Presentation by Dr. Chrysantus Tanga, ICIPE

Implementation

Recruitment

Dr. Menaga Meenakshisundaram (postdoctoral fellow) and Mr. Isaiah Rachami (research assistant) were both recruited as new staff, while Mr. John Muia (MSc), Ms. Judy Kaguthi (MSc) and Mrs. Evalyne Wambui Ndotono (PhD) were recruited as students.

Startup workshops

On January 18, 2023, an online kick-off meeting engaged over 25 participants, setting the groundwork for year 1. Then on February 16–25, 2023, the first face-to-face gathering of stakeholders took place. Among the notable attendees were various fish farms, including the Kamuthanga farm in Machakos, the Kenya Marine and Fisheries Research Institute (KMFRI) in Sagana, and Bukani Aquapark, Hydro Victoria Fish Hatchery and Farm Ltd, and Bunyala Agro Industrial Park in Busia. Additionally, feed millers were represented by entities like Great Lake Feeds and Hatchery Ltd in Siaya County, Captain Feeds and the KMFRI Sangoro Center in Kisumu County, and the Kinyasaga group in Homa Bay County.

Literature review

A literature review was conducted to reveal new insights into Africa's emerging edible insect industry. In Kenya, an analysis of grain allocation revealed an interesting distribution: 62% is designated for animal feed, 23% for human consumption, 12% for industrial purposes and 3% for other uses. To tackle the competition between humans and animals for these grains, a strategic initiative aims to mitigate this rivalry, striving for a more equitable allocation.

References: Tanga, C. M., & Kababu, M. O. (2023).. New insights into the emerging edible insect industry in Africa. *Animal Frontiers* 13(4):26–40. (Impact Factor: 6.762)

Scoping review

A scoping review was conducted on the role of multilateral development organizations and both public and private investments in Kenya's aquaculture sector. It was devoted to (i) designing and constructing climate-smart culture systems, (ii) developing new species to guarantee the supply of high quality products, (iii) developing and scaling low cost and highly nutritious fish feeds based on novel ingredients and (iv) enhancing resilient livelihoods through innovative aquaculture practices and market links to create employment opportunities for youths and women.

References: Munguti, J. M. (2023). Role of multilateral development organizations, public and private investments in aquaculture subsector in Kenya. *Frontiers in Sustainable Food Systems*. (Impact factor: 5.005)

The following are the results from scoping assessments conducted in fish production zones:

- Out of 220 respondents interviewed, most kept tilapia (93.2%) while only a small percentage kept catfish (6.2%).
- Most farmers (70.7%) harvested their fish once a year.
- Some farmers get their fish feed from other farmers (15.2%) and private companies (10.8%), while others produce their own (5.8%).
- About two-thirds of farmers (66%) use compound feeds to feed their fish, while about a quarter (25.8%) reportedly used insect meal .
- Government is the biggest supplier of fingerlings (25.6%) to farmers followed closely by private companies (22.9%) and other farmers (22.4%).
- Most farmers use complete compound feeds (65.5%) and dry supplements (63.2%), while others (10.3%) use wet supplements to feed their fish.
- Farmers strongly agreed (20.6%) and agreed (47.5%) that the use of insect meal in fish production could help lower feed prices and overall production costs.
- The most used protein sources included freshwater shrimp (45.3%), fishmeal (17.9%), dry poultry waste (9.4%), sardines (*omenda*) (6.7%), insects and earthworms (5.8%), legume residues (5.4%), sunflower cake (4.4%), bloodmeal (5.4%), soybean meal (3.1%), cotton seed cake (2.7%) and sesame seed meal (1.3%).
- Common homemade fish feeds are either single ingredients, such as maize bran or household food leftovers, used in feed formulations.
- Half of the respondents (50%) agreed that availability, information and reliability are the main factors in the use of insect-based feeds.
- The top 20 sources of protein are mango seed embryo, water fern, fishmeal, freshwater shrimp, wheat bran, maize bran, rice bran, arrowroot leaves, banana peel, banana stem, banana stem, banana leaves, cottonseed cake, sunflower seed cake, cassava leaves, papaya peel, papaya seed meal, sweet potato leaves, brewery by-product, and tilapia and catfish offal.

The biochemical composition of full-fat BSFL and defatted BSFL includes proximate composition, amino acids and minerals, the finding for BSFL oil was its contains 40% lauric acid and is rich in antimicrobial agents.

Experiments

An experiment was conducted at the National Aquaculture Research Development and Training Center in Sagana on the KMFRI-SAGANA strain (F-8). The aim was to evaluate the use of BSFL as a potential substitute for fishmeal in the production of Nile tilapia (*Oreochromis niloticus*). The experiment included four diets: T0 (Control), T25, T50 and T75. The results revealed that 25% and 50% replacement of fishmeal protein with black soldier fly meal (BSFLM) provides the best growth performance of Nile tilapia. Seven other tilapia experiments are ongoing, as well as seven others for catfish.

3.1.3. FASA in Zambia

Presentation by Dr. Arthertone Jere and Mr. Gregory Kasanga, WorldFish Zambia

Overview

On December 20, 2022, the FASA project was launched in Zambia. The two-hour ceremony, conducted virtually, was graced by the esteemed presence of Dr. Anna Songolo, the permanent secretary of the Ministry of Fisheries and Livestock. A total of 72 people were invited, resulting in robust participation from 59 stakeholders, including key project partners such as the SLU, Includovate, NRDC, Aller Aqua Zambia Limited and NAGI Enterprise. This gathering served as a pivotal moment, setting the stage for collaborative efforts among these stakeholders to successfully execution the project in Zambia.



Figure 2. The scoping study sites.

Implementation

Scoping study

The aim of the scoping study was to provide information on the types, costs and availability of fish feed ingredients and to determine how the fish feed value chain affects the country's aquaculture industry. The study was conducted from March to May 2023. Five districts were chosen in each of six provinces—Eastern, North-Western, Southern, Luapula, Northern and Lusaka (Figure 2). For each district, three camps were visited, 15 per province. In total, across all six provinces, 90 camps were visited.

The scoping study identified three broad categories of ingredients: 70.4% were plant-based, 22.2% were animal-derived and 7.4% were from other sources. A variety of local ingredients in Zambia were considered suitable for aquafeed. Agriculture farmers primarily provided plant ingredients (56%), while processors offered by-products like maize bran and soybean cake (23%). Most farmers (85.2%) did not process their ingredients for feed. Animal-based ingredients were mainly used for human consumption (78.6%) rather than for fish feed. In Lusaka and Southern provinces, there was higher demand for commercial fish feed due to proximity to factories. Human consumption of ingredients (87.8%) was higher than for livestock use (12.2%).

To support the aquaculture feed industry, the findings recommended encouraging private sector participation in the production, supply and distribution of key local ingredients. Eleven dry samples, 6 kg each, were sent for proximate analysis and digestibility studies: *Siavonga Kapenta* (*Limnothrissa miodon*), Crayfish, *Kakeya* (assorted small fish), *Vinkubala* caterpillar, *Tukanja* caterpillar, *Chisense* (*Potamothrissa acutirostris*), sunflower cake meal (*Helianthus annuus*), velvet bean meal (*Mucuna pruriens*), velvet bean seed, tea waste (*Camellia sinensis*) and *chikanda* (*Disa robusta*). Two kilograms of each sample were also sent to the SLU.

Upgrade of NRDC fish laboratory

To conduct experiments on the fish nutrient requirements, the flow-through system at the NRDC laboratory in Lusaka was upgraded to a complete RAS (Plate 3). To do so, vital components had to be purchased and installed.

The components of the RAS setup included a mechanical filter, biological filter, sand filter, sump, aeration units, aquarium tanks, reservoir tanks, water pumps, UV lights and heaters. The work done outside the wet laboratory included securing the area and installing air blowers to ensure an adequate supply oxygen to both the fish tanks and biological filters, as well as installing an electrical switchboard to control the water heaters, air blowers and water pumps.



Plate 3. The new RAS at the NRDC lab in Lusaka.

Nutrient requirement experiment

Among all essential amino acids, lysine is necessary for many bodily functions, especially growth, but it is only found in limited amounts in plant-based ingredients. No previous studies were conducted to estimate the lysine requirement of three-spotted tilapia (*O. andersonii*). However, a study on a comparative estimation of the lysine requirements for the strains of juvenile three-spotted tilapia was conducted at the NRDC. The objective was to estimate the lysine requirement of the SUZ and Genetic improvement program (GIP) strains of *O. andersonii* species. Six diets were produced, consisting of a control diet and five experimental diets with various lysine inclusion levels.

Preliminary results showed that different replacement levels of lysine at 0%, 0.2%, 0.4%, 0.6% and 1.2% in the diet of these strains do not have any effect on growth parameters, except for 0.3%. Samples are still being analyzed at the lab. It is recommended that a similar study be carried out with similar lysine replacement levels on native fish species such as longfin tilapia (*O. machrochir*), Tanganyika tilapia (*O. tanganyicae*) and redbreast tilapia (*Coptodon rendalli*).

3.1.4. FASA in Malaysia

Presentation by Dr. Rodrigue Yossa, Dr. Aaqillah Amr and Ms. Nurulhuda, WorldFish Headquarters

Overview

In Malaysia, the scope of project's work was divided into two parts:

1. Aquaculture work: research, extension and impact assessment.
2. Non-aquaculture work: project management, monitoring, evaluating and learning (MEL) and data management, communication, procurement, finance and accounting.

Implementation

Non aquaculture work

MEL plan

FASA published its MEL plan titled, Monitoring, evaluation and learning (MEL) plan: [Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Africa \(FASA\) project 2022–2027](#). The intent is to continuously update and disseminate information on ongoing projects within the initiative, ensuring transparent communication about data progression and its

updates. In addition, the project will streamline and adapt its plan to make it user-friendly, employing clear language, intuitive design and accessible formats to make it easier to understand and use.

Communication plan

FASA will also provide the scope and objectives of the project within its communication plan. This will include FASA's website, with detailed and comprehensive information about the project, such as progress updates, milestones achieved and deliverables. The website will contain transparent and regular reporting of deliverables to inform stakeholders about the project's progress.

Staffing plan

WorldFish has successfully completed its staffing plan for the project (Figure 3). The plan involves recruiting consultants who specialize in climate change from Includovate and in gender inclusion from NAGI Enterprise. At its headquarters in Malaysia, WorldFish also filled key positions such as a postdoctoral fellow, senior research analyst, two research assistants and two interns. Crucial roles at WorldFish Zambia were also filled, including a scientist and research assistant. The recruitment efforts also included enlisting a PhD student from Nigeria, while the process to recruit another PhD student from Zambia is underway.

Aquaculture work

Digestibility experiment

Research protocols and animal ethics

WorldFish Headquarters successfully developed protocols for research and animal ethics part of the first digestibility experiment. The objective of the experiment was to analyze nutritional content and digestibility, assess the growth and biochemical makeup of Genetically Improved Farmed Tilapia (GIFT) when fed sustainable local ingredients, and evaluate fish health. WorldFish Headquarters received 11 samples from Zambia that included animal-based ingredients (*Vinkubala* caterpillar, *Tukanja* caterpillar, *Siavonga Kapenta*, *Kakeya*, *Chisense* and Crayfish) and plant-based ingredients (velvet bean meal, velvet bean seed, tea waste, sunflower cake meal and *Chikanda*).

Feed production for digestibility experiment

The fish feed and nutrition team at WorldFish Headquarters has manufactured six diets of the first digestibility experiment, including a control diet with no test ingredients and five diets with one ingredient each from animal-based ingredients.

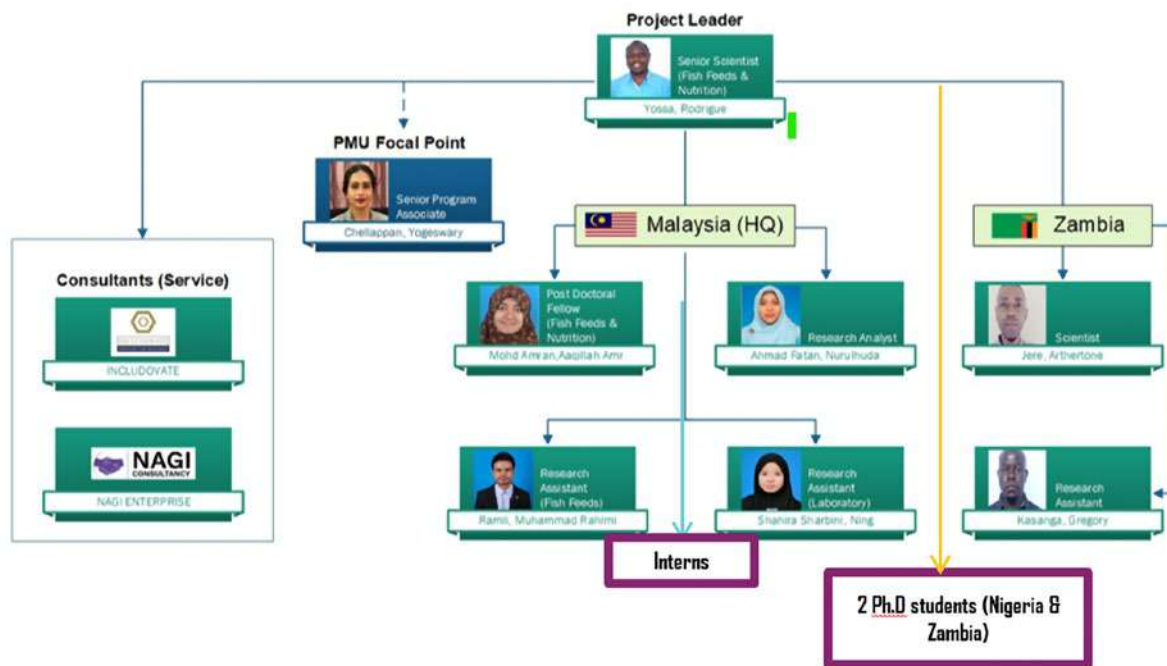


Figure 3. Updated organogram of the WorldFish staffing plan.

Meta-analysis review

The review paper focuses on meta-analyses that examined the effects of substituting fishmeal with insect meal across various fish species. The main goal of the review is to provide a detailed look at recent progress in creating fish feeds with different insect proteins and how they affect three important factors: (1) the apparent digestibility coefficient, (2) fish health as indicated by blood parameters and (3) an economic analysis associated with these alternative feeding practices. The outcomes of the meta-analysis revealed overall positive effects, indicating that including insect meal in fish diets did not display statistically significant adverse effects on fish digestibility, fish health or economic performance.

A cautious approach is recommended toward integrating insect meal into fish diets, one that prioritizes fish health. This entails advocating for a balanced approach. Avoiding excessive fat inclusion is best for partial replacement, while insect meal sourced from the larvae stage is best for total replacement to ensure optimal dietary balance.

Systematic review

The aquaculture industry faces significant challenges from its heavy dependence on

imported ingredients. This prompted an exploration of alternative resources. To address these challenges, a focused effort is underway to develop effective strategies aimed at enhancing the nutritional content of alternative ingredients. The objective of the review is to compile current research focal points, nutritional strategies and management practices that collectively aim to tackle these pressing industry challenges.

According to the results of the review, fingerlings and juveniles are the most studied in the literature, but few studies have been done on broodstock. The review identified different methods like processing, enzymes, probiotics, plant extracts and hormones, all of which are frequently used to boost the nutritional value of alternative ingredients.

By prioritizing alternative energy sources and improving their nutritional value, the industry could take a more efficient, ecofriendly and nutritionally balanced approach to freshwater aquaculture. Exploring broodstock nutrition is recommended.

Establishment of fish feed and nutrition laboratory

On May 25, 2023, WorldFish board member Dr. Baba Yusuf Abubakar officially inaugurated WorldFish's fish feed and nutrition laboratory

in Penang, Malaysia. Ms. Ning Shahira Sharbini, with the help of interns under the supervision of Dr. Rodrigue Yossa, is in charge of the lab. The lab will help WorldFish scientists and partners in Penang and across Asia, Africa and the Pacific in the analysing of proximate composition, including analyzing dry matter, ash, crude protein, crude fat, crude fiber and gross energy. The first analysis successfully examined ingredients received from Zambia, while upcoming analyses will cover minerals such as calcium and phosphorus.

Solid-state fermentation experiment

There is an urgent need to identify and develop new sources of aquaculture feed, particularly those rich in nutritious and palatable protein. As such, it is important to repurpose or transform agricultural wastes into functional forms to be used in animal feed as sustainable alternative ingredients.

The overall objective of this study is to investigate the effect of solid-state fermentation on changes in the nutrient profile, particularly protein and fiber, and the reduction of antinutritional factors in agricultural waste. The aim is to optimize the parameters of the solid-state fermentation to produce functional products by the microorganisms on selected agricultural waste.

Solid-state fermentation activities was conducted at WorldFish Headquarters include a collaboration with the School of Technology Industry at USM Penang. The research protocol on solid-state fermentation for using bacteria, yeast and fungi has been completed, and a preliminary experiment on tea waste using lactic acid bacteria has been conducted. Expected outputs include changes in the nutrient composition of fermented tea waste, such as increased protein and reduced antinutritional factors.

3.1.5. Q&A

Q: Dr. Tanga advised using insect larvae and pupae as an alternative feed ingredient.

A: Dr. Aaqillah agreed, as there are many studies using insects in feed analysis. Recent studies suggest that using larvae is more feasible, as the lipid content is not high.

Q: Dr. Tanga questioned the feasibility of using the fermentation method for small-scale farmers and suggested using different types of bacteria and by-

products for research into fermentation.

A: Nurulhuda explained that fermentation research is useful to small-scale farmers, as they can apply it using a simple bioreactor and tray. Fermentation can also be done using different types of waste, such as yeast, yogurt and tea.

Q: Dr. Tanga suggested comparing expensive options with new alternatives using different types of waste.

A: Nurulhuda took note of his suggestion.

Q: Dr. Baruah commented that tea waste is an interesting alternative in fermentation and that he has done work on fermentation as well. He suggested more discussion on such research.

A: Dr. Yossa added that for years WorldFish has been finding simple ways of using fermentation to increase the nutritional quality of local feed. As for improving ingredients in the antinutritional perspective, there is no single way to remove all antinutritional factors. Fermentation can reduce a few of them and may improve the protein content of the ingredient.

3.1.6. Climate change work

Presentation by Dr. Mzime Ndebele-Murisa, NAGI Enterprise

Overview

The objective of this activity is to identify opportunities for the project to enhance environmental benefits within the novel feeds landscape across the three project countries using life cycle assessment (LCA) methods. This involves not only identifying opportunities to improve the project's environmental contribution but also entails a comprehensive situational analysis of the climate and environmental factors.

The LCA analysis focuses on three areas:

1. finding weaknesses in the currently available data
2. contributing toward an improved and broadened understanding of the carbon footprint of aquaculture fish feed along value chains, wherever and however greenhouse gas emissions arise
3. identifying potential opportunities such as mitigation pathways within the novel fish feed landscape.

Implementation

Despite challenges during data collection in Nigeria, Kenya and Zambia, FASA was able to achieve a representative sample. The project now has a good sense of the industry and value chain processes, and it has successfully compiled and reviewed research reports and articles.

However, quantitative data was inaccessible, as solicitation was seen as intrusive. Travel to some sites was difficult, which delayed the kick off of activities. It was also difficult for the project to meet daily targets, as farmers were located far from one another.

As far as outputs are concerned, FASA was able to complete a climate and environmental assessment report, an LCA report and an outcomes report, which included three draft journal articles. For Year 2, it is recommended that the project update its climate and environmental analysis, conduct a comprehensive LCA based on modeling and increase capacity building.

3.1.7. Gender and social inclusion work

Presentation by Dr. Sujata Ganguly, Includovate

Overview

The objective of this study was twofold: (1) conduct gender and social assessments for developing sustainable feeds and (2) explore opportunities for advancing gender and social inclusion (GESI) within the emerging feed landscape. The research questions aimed to uncover the gendered and socially different needs, risks and opportunities related to novel feed ingredients. To understand GESI, the project used the ADS 205 framework, focusing on laws, policies, cultural beliefs, gender roles, resource access and decision-making. The study involved 28 key informant interviews and 420 survey responses across three countries, employing a mixed research approach.

Implementation

Gendered policy review of fisheries laws

In the gendered policy review across the fisheries sector in Nigeria, Zambia and Kenya, notable patterns emerge. In Nigeria, policies tend to overlook gender dynamics within fishing communities, favoring technical aspects over addressing the distinct needs of men and women.

In Zambia, there are gender-responsive elements, especially in water management policies, but challenges persist in safeguarding women's access and tenure rights. In Kenya, some policies exhibit gender responsiveness, while inconsistencies hinder effective integration.

Across these countries, FASA can capitalize on opportunities to promote gender equality by integrating gender-sensitive approaches, advocating for better representation and adopting transformative strategies in alignment with national policies.

Fish feed ingredients and use

In Nigeria, both genders use maize powder, genetically modified plants (GMPs) and rice bran for fish farming, with slightly lower levels of use among women. Maize powder is popular due to its availability, especially among women, while men also value its affordability and nutrition. Men and women prefer GMPs for their availability and nutrition, and both use rice bran, depending on its availability. Women mostly buy these ingredients, but some process maize powder at home.

In Zambia, chicken manure, feathers and GMPs are all used, more so by women because of their availability. Women often process chicken manure at home and value GMPs for their affordability, mostly from local markets.

In Kenya, men and women use plant leaves and rice bran. Men prefer plant leaves because of their availability and they process them at home, while women prefer rice bran for its nutritional value and buy it from the market.

Gendered and socially differentiated needs and risks

- Gendered needs: Men more so than women strongly agree with the need to improve the quality of fish feed.
- Gendered skills: More men believe they have the skills needed to improve quality, while more women are either uncertain or disagree.
- Gendered resources and assets: Most respondents, regardless of gender, are unsure or disagree about whether they have the necessary resources to improve the quality of fish feed.
- Feed availability: More women are uncertain about the availability of ingredients, while more men disagree about the lack of access to them.

- Innovation: Both genders are open to trying new ingredients, but men show stronger agreement.
- Innovation barriers: Regarding experiments with new ingredients, women more so than men face barriers like lack of funds, input access, knowledge and services.
- Innovation risks/opinions: More women than men agree that trying new fish feeds would likely lead to a loss of money, while more women disagree with this idea.
- Information needs: Both genders express a need for additional information on all ingredients.
- Quality barriers: Women cite barriers such as finance, technology, skills, income and infrastructure for improving the quality of preferred ingredients.
- Information access: Men are more aware than women about how to access information on new ingredients.
- Information barriers: Both genders face obstacles like cost, technology, information location and land availability when accessing information on new ingredients.
- Youth barriers: Similar barriers, such as lack of funds, input access, and knowledge, hinder youths more than adults in experimenting with new feed ingredients.
- Feeding: Men and women both feed fish across all three countries. In Zambia and Kenya, there is no significant age difference in this task between young men and women, while in Nigeria the responsibility is skewed toward adult women.
- Collecting water from the pond: In Nigeria, this is commonly done by adult women and men, though more men are involved and some young men also participate. This practice is less common in Zambia, but adult men take charge whenever it is done. In Kenya, about a third of men are involved, as well as some adult women and young men.
- Day-to-day management: In Nigeria, this responsibility is shared equally between men and women, but in Zambia and Kenya it is mostly done by men.
- Pond cleaning: In all three countries, half as many women as men clean ponds, with some young men involved.
- Unpaid domestic duties: Adult women primarily handle unpaid work across the countries. Some girls help as well as, as do some boys in Nigeria.
- Paid work: Across each country, men predominantly perform paid work. Overall, spouses tend to underestimate the amount of paid work their partner does.
- Fishing and harvesting: Male household members are the ones who mainly carry out these duties. Women are also involved, though to a lesser extent. In Nigeria, a significant percentage of women (62%) report being involved in harvesting.
- Selling fish products: Women mostly do this, with a notable percentage of men in Nigeria and Zambia also involved. Spouses are not accurately aware of each other's involvement in sales.
- Processing: In Nigeria and Zambia, a significant portion of fish farmers do not process fish. When done in Kenya, it is mainly women who do so, with no significant age difference.
- Selling surplus produce at markets: In Nigeria, men and women equally share any surplus sales. Younger women tend to do so more than men in both Zambia and Kenya.
- Food shopping at markets: Women primarily handle this. Men self-report their involvement, but it is not always acknowledged among women.

Laws, policies, regulations and institutional practices

The study highlighted a significant gap in the participants knowledge regarding the formal laws and regulations governing fisheries in all three nations. The household survey identified grassroots organizations working to address barriers that women and youths face, bringing attention to the lack of awareness surrounding these organizations.

Kenya exhibits a higher level of awareness and a greater number of organizations than Nigeria and Zambia. However, the overall pattern reveals the need for improved efforts to inform communities about the existence and initiatives of these organizations.

Gender roles in agricultural and household tasks

- Building and digging ponds: In Nigeria and Kenya, this is mostly done by adult men, though some young men are involved in Zambia.

Time use

Most respondents express satisfaction with the amount of leisure time they have, feeling it is sufficient for personal activities and relaxation. Both male and female respondents of all age groups should have time for any activities related to the project. In Kenya, however, a significant majority of respondents from both genders indicate having only 1 hour of leisure time.

Access to and control over resources and information

Cultural norms impact interactions with extension officers, often necessitating spousal approval to attend training. Key channels include farmer cooperatives, digital platforms like SMS and WhatsApp, local leaders and television.

In Nigeria, women rely on friends and group meetings. In Zambia, women value information from local leaders, and young people use the internet more than adults overall. In Kenya, 50% of young women prefer local leaders for information, compared to 35% of adult women. Conversely, 62% of adult men and 36% of young men rely on local leaders. These age differences were not significant the countries.

Norms and beliefs

In rural fishing communities in all three countries, deeply rooted cultural norms sustain gender disparities, especially regarding women's access to technology and opportunities for them within the fishing industry. The study highlighted prevalent norms, such as women predominantly handling unpaid domestic work, which limits their involvement in paid and physically demanding tasks. Although some communities expressed approval for sharing tasks between genders, significant portions believed their societies would disapprove. Particularly in Kenya, young women exhibited strong disapproval, emphasizing deeply ingrained societal norms. Despite theoretical acceptance of sharing tasks, these beliefs often did not translate into household practices.

Patterns of power and decision-making

The survey shows a preference for sharing decisions in households and communities, stressing the value of collaboration. Gender disparities are more evident in Nigeria but less so in Zambia and Kenya. Young individuals express a desire for more

involvement in decision-making, emphasizing the need for initiatives that engage youths.

In Nigeria and Kenya, women seek greater participation in decisions about earnings, highlighting the importance of empowering women economically. Comfort in public speaking varies across the three countries, with notable gender differences, suggesting a need for communication and confidence-building programs. Zambia stands out for higher comfort levels in public speaking. Most respondents stress the importance of consulting spouses when making decisions.

Recommendations

The study consolidated eight gender equality and social inclusion (GESI) recommendations to shape the Gender and Inclusive Development Action Plan (GIDAP):

1. Amend policies, laws and regulations for equal opportunities and rights in fisheries.
2. Support women's groups to diversify fish feeds and enhance their skills.
3. Ensure equal access to resources for women and marginalized groups.
4. Increase the participation of women and disadvantaged groups in decision-making.
5. Provide tailored extension services for women and youths in fish feed innovation.
6. Introduce time-saving technologies and involve men in domestic workloads.
7. Extend support from male-run businesses to reach more women and youths.
8. Establish a monitoring system to assess the action plan's progress and effectiveness.

3.1.8. Organization, team, experience in market assessments and scaling, and the workplan

Virtual presentation by Dr. Murat Sartas, IITA

Overview

IITA brings expertise in innovation, scaling and impact management, all of which contribute to WorldFish strategies for scaling and establishing hubs within FASA. Operating from Norrsken, Africa's largest innovation hub in Rwanda, IITA collaborates with entities like Katapult and Kivu Choice to fulfill its role for the project.

Analyzing and Accelerating Use of Sustainable Feed at Scale Results and approach

On the lead side, this included market studies, scaling strategies and workshops. Support for the lead included providing intelligence and facilitate innovation platforms, designing and disseminating communication products, building the capacity of the FASA team and partners on scaling, building infrastructure to support co-design as well as co-development of solutions, and integrating FASA into the business ecosystem.

As the team leader, Dr. Sartas is responsible for strategy and enabling, while Bruno Tran measures the readiness of innovative solutions as well as co-deployment, and Pat Udomkun ensures research rigor and field experience. Field researchers and facilitators produce high quality data and maintain continuous engagement, while support experts handle facilitation and communication.

The following list is the timeline for the implementation activities for year 1 and Year 2:

- August 2023: Finalize the contract
- September 2023: Design the team and develop the approach.
- October 2023: Draft the workplan.
- November 2023: Update and finalize the workplan.
- December 2023: Complete the recruitments.
- April 2024: Conduct market research.
- June 2024: Produce scaling strategies.

3.1.9. FASA in Sweden

Presentation by Dr. Kartik Baruah, SLU

Overview

Within the FASA project, the SLU plays an integral role as an academic partner alongside prominent entities such as ICIPE, CORAF, Aller Aqua Limited Zambia, and National Agricultural Research Services agencies in project countries, as well as local feed millers and fish farmers. Its contributions are multifaceted. The SLU focuses on capacity building while actively engaging in research and development endeavors, particularly in overseeing two PhD research projects in Nigeria and Zambia dedicated to sustainable feed. It also contributes to various other pertinent activities within the project.

Implementation

The SLU hired two PhD students for the project. The one from Zambia will carry out experiments on tilapia, while the one from Nigeria will do the same on catfish. PhD advisory members include Dr. Baruah, Dr. Torbjörn Lundhrof, Dr. Mette Sørensen (Norway), Dr. Christos Palaiokostas, Dr. Aleksendar Vidakovic, Dr. Parisa Norouzitallab and Dr. Yossa, as well as partner country members.

As part of the project, Sweden will import 11 ingredients from Zambia: *siavonga kapenta* fishmeal, *akeya* fishmeal, grinded crayfish meal, *tukanja* caterpillar, *vinkubala* caterpillar, *chisense* fishmeal, sunflower cake meal, velvet bean meal, velvet bean seed, tea waste and *chikanda* powder.

3.1.10. Q&A

Q: Dr. Nieyidouba asked what is the progress is on the shipments of ingredients from Nigeria.

A: Dr. Yossa explained that we have completed the scoping study and have gone through many rounds of selecting and reselecting ingredients for analysis. The ingredients have already been transferred to WorldFish's office in Ibadan, Nigeria, and will be shipped to Sweden and Malaysia soon. A: Yogi added that the Malaysia team will work closely with Dr. Siriwardena and Dr. Charity on the shipment of ingredients.

Q: Dr. Timothy Manyise congratulated Dr. Baruah on recruiting the two PhD students and hoped that they are adaptable to issues in Africa, not in Sweden.

A: Dr. Baruah explained that the project is well defined and that each student has an individual study plan that the research supervising team has approved. Therefore, the scope of the work is clearly stated. Dr. Rodrigue also added that during their 4 years fellowship the students will spend half of their time in Sweden and the other half in Nigeria. He also explained that the students will work with the ingredients they get from Nigeria. His role as co-supervisor is also to make sure that their work supports the overall scope of the project.

3.1.11. Theories of change and annual outcome monitoring studies

Presentation by Dr. Timothy Manyise, WorldFish Headquarters

Overview

This update focuses on each country's theory of change (TOC) and annual outcome monitoring studies. Emphasizing integration within larger systems, each TOC unveils the interconnectedness of intervention activities. Embracing a systemic view, the MEL team guards against underestimating impacts, and helps anticipate and manage potential negative repercussions. This holistic perspective enables the effective navigation of complexities and maximizes positive intervention outcomes.

Implementation

In the three focal countries, a workshop was organized to explore the impact of innovating fish feeds using new ingredients in each country. The workshops mapped issues with fish feeds, identifying actors involved in the sector, assessing how FASA can create wider impacts and prioritizing areas for impact assessment.

There were 25 to 30 participants in each workshop. Stakeholders involved included feed millers, nongovernmental organizations (NGOs), the Department of Fisheries (DOF), feed ingredient producers, fish farmers, aggregators, processors, farmer associations, women's groups, youths groups and feed manufacturing certification bodies.

In the workshops, maps were synthesized and digitized and then shared with participants for feedback with a textual narrative. A report of the workshops was published titled, [Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa: A systems theory of change](#). The proposal for the peer-review manuscript was accepted and the manuscript was submitted to the Special issue Innovation Inclusivity in Agricultural Systems, for publication

Study 1

This study was conducted 24 local government areas within six states in Nigeria. It involved engaging a substantial cohort of 600 fish farmers and 180 ingredient processors. To collect data,

specialized survey tools have been meticulously designed. Additionally, ethical approval for the study has been successfully obtained, and a team of enumerators has been selected and trained for the upcoming survey scheduled to take place from November to December 2023.

Study 2

This study covers 11 districts in six provinces in Zambia. A comparable engagement with 600 fish farmers and 120 ingredient processors is anticipated. The questionnaire design and programming have been implemented using Kobo Toolbox software an online data collection platform. Although the ethical approval process is currently underway, the survey for this study was slated to begin in January 2024.

Recommendations

The study made the following four recommendations:

1. Focus the impact assessment on both the intended and unintended consequences of the intervention.
2. Profile and identify who the project's activities will likely impact, either directly or indirectly.
3. Ensure that different activities, such as training sessions, workshops, information sessions and demonstrations by different partners, are synchronized to ensure effective follow-up evaluations.
4. Provide timely information to ensure that evaluation assessments are done on time.

3.1.12. Perspective of Aller Aqua Zambia Limited

Virtual presentation by Dr. Alexander M. Greiling, Aller Aqua Limited Zambia

Overview

Monthly feed production increased approximately 1000 t over the previous year. Purchases of raw materials, about 80% of which were sourced within Zambia, increased significantly. This increased local value addition for farming, transportation and logistics, job creation and aquaculture.

Implementation

Market trends

More fish feed factories and competitors are entering the East African market and can service Zambia and surrounding countries. This is good for aquaculture production, as competition

will likely reduce prices. Primary production of agricultural crops, such as grains and soy, are stable, including common products and processed crops and by-products. However, there are still insufficient quantities of animal by-products in the country, and quality remains low. East Africa has access to ports and could import these by-products at better rates.

Raw material Scoping study

The scoping study on raw materials provided great geographical coverage and good insight into primary production. It revealed that there are no animal by-products available, only primary animal-derived resources such as fish, crayfish and caterpillars, most of which are in great part directly consumed. As such, there is much room for development in the local industry.

FASA should evaluate untapped and available resources. Abattoirs can evaluate the processing potential of animal by-products, particularly from beef and poultry, while the project itself can explore emerging resources like pea proteins and investigate other innovative processing technologies. FASA should also evaluate the commercial market for raw materials. This would involve taking into consideration farmer cooperatives and assessing small-scale processing and value addition methods, with a focus on maintaining quality control, for commodities such as maize.

3.1.13. Perspective of the Natural Resources Development College

Presentation by Mr. Melon Mulamfu, NRDC

Overview

The NRDC was established in 1964 by the first Republican president Dr. Kenneth David Kaunda. It is among Zambia's seven agricultural colleges operating under the Ministry of Agriculture. The primary focus of the NRDC is to train middle-level human resources for the agriculture and related sectors. The college offers diploma-level training in 10 disciplines and is committed to nurturing skilled professionals in various aspects of agriculture.

The NRDC's wet laboratory was established in 2019 to conduct research projects using a flow-through aquaculture system that was designed and built, by WorldFish. In 2023, FASA upgraded the system

to Recirculating Aquaculture System (RAS). To avoid previous challenges, specifically theft, the NRDC also upgraded its security systems for the flab and the entire college.

Two research projects have been implemented in the facility since 2020: (1) Replacing fishmeal with a single cell protein feedstuff in the diet of Nile tilapia (*O. niloticus*) and (2) the performance of Nile tilapia and three-spotted tilapia in controlled laboratory conditions in Zambia.

Expectations and achievements

The NRDC supplied technical support to upgrade the system in the laboratory. Mrs. Majory Chma, a training officer from the Department of Fisheries Science and Aquaculture, was listed the contact person, and the college provided security by installing a lighting system, a security gate at the main entrance, burglar-bars on all the windows of the laboratory as well as hiring a security company. The purpose was to host the feed experiments in the lab.

Benefits

The college upgraded its Fisheries Science curriculum and built the Aquaculture Skills Training Centre. It implemented effective and efficient practical student activities and hosted short, demand-driven courses to boost small-scale fish farming. In addition to installing the RAS, the NRDC also built up the capacity of staff and students involved in research activities and exposed students to research findings through seminars and scientific talks.

3.1.14. Technical and Financial Reporting

Presentation by Mr. Tan Ban Swee and Mr. Tan Chao Yan, WorldFish Headquarters

Finance

FASA uses the Norwegian Kroner (NOK) as its currency, with a grant of NOK 80 million from the Norwegian Agency for Development Cooperation (Norad). However, the project's fund will be received in USD. Any equipment, intellectual property and consumables, like feed or supplies, generated or used during the project are owned either by WorldFish or collaborating partners. FASA must keep accounting records for at least 5 years from the time of Norad's approval of project's final report. There is a zero-tolerance policy against

corruption. Any financial irregularities will be applied to WorldFish and its partners.

The WorldFish's procurement provisions are:

- Contract must be awarded to the most economically advantageous tender
- Procurement of award with value of less than NOK 500,000 may be awarded following any procurement procedure established by the Grant Recipient.
- Procurement of award with value exceeding NOK 500,000 shall be awarded based on one of the following procurement procedures open tender procedure, restricted procedure or competitive procedure with negotiation

If the grant recipient does not launch an open tender procedure, it shall justify and document in writing the choice of tenderers that are invited to submit an offer.

The spending status of the FASA project is as follows:

- Year 1 (July 1, 2022–June 30, 2023): NOK 6,881,809
- Year 2 (July 1, 2023– September 30, 2024): NOK 1,523,817
- Total cumulative expenditure: NOK 8,405,626

Reporting and auditing schedules

FASA's technical and financial reporting schedule is as follows:

- July 1–December 31, 2022 (submission deadline: April 15, 2023)
- January 1–December 31, 2023 (submission deadline: April 15, 2024)
- January 1– December 31, 2024 (submission deadline: April 15, 2025)
- January 1–December 31, 2025 (submission deadline: April 15, 2026)
- January 1–December 31, 2026 (submission deadline: April 15, 2027).

After the conclusion of the project, the submission deadline for the final reports are October 31, 2027.

FASA's auditing schedule is as follows:

- July 1–December 31, 2022 (submission deadline: June 1, 2023)
- January 1–December 31, 2023 (submission deadline: June 1, 2024)
- January 1–December 31, 2024 (submission deadline: June 1, 2025)
- January 1–December 31, 2025 (submission

deadline: June 1, 2026)

- January 1–December 31, 2026 (submission deadline: June 1, 2027).

After the conclusion of the project, the submission deadline for the final report is October 31, 2027.

The SLU and IITA will follow the submission schedule and reporting requirements as stated in the original subgrant agreement (no changes). Both CORAF and the ICIPE will follow the submission schedule and reporting requirements as stated in a new addendum to the subgrant agreement.

CORAF and ICIPE will submit technical reports annually and financial reports quarterly. Deliverables required for submission include technical reports, financial reports, invoices, quarterly forecast workplans and quarterly forecast budgets.

The technical reporting schedule for both CORAF and ICIPE is as follows:

- 2023: January 31, 2024 (remaining submission deadline for the year)
- 2024: January 31, 2025
- 2025: January 31, 2026
- 2026: January 31, 2027.

The financial reporting schedule for both CORAF and ICIPE is as follows:

- 2023: December 31, 2023 (remaining submission deadline for the year)
- 2024: April 30, July 31, October 31, December 31
- 2025: April 30, July 31, October 31, December 31
- 2026: April 30, July 31, October 31, December 31

After the conclusion of the project, the submission deadlines for final technical and financial reports are April 30 and May 15, 2027 respectively.

3.1.15. Q&A

Q: Dr. Nieyidouba asked how the summary of the findings from the workshop would be communicated to all participants and target communities to ensure the information is conveyed to everyone accurately.

A: Dr. Yossa explained that people will not

send different messages to all the stakeholders. WorldFish will package all the information through a communication specialist based in Nigeria. The information will not be communicated separately to ensure that all partners are on the same page.

Q: Dr. Yossa asked Dr. Sartas who are the focal points or contact persons for scaling who are working on the ground there with the partners in Kenya, Zambia and Nigeria.

A: Dr. Sartas explained that the focal points have not been determined yet, as he is currently in the midst of recruiting people for those positions.

Q: Dr. Jere raised a concern regarding the practicality of using *kapenta* and maize, as they are also used for direct human consumption. As such, there will be competition in the availability of ingredients.

A: Dr. Greiling agreed and explained that all

ingredients, except for a few by-products, are subject to the food versus feed dilemma. It is possible that raw materials will be limited in the area that kapenta is predominantly fished. In contrast, planting maize exclusively for feed production is most likely more beneficial than using kapenta, which has higher nutritional and monetary value to the local communities.

3.2. Day 2: Planning sessions for 2024 (and tentatively 2025)

The project leader gave a comprehensive overview of the current implementation plan. The country partners presented in-depth workplans for 2024 and tentatively 2025 with tentative budgets (Plate 4). During the presentations, each team presented its workplan and specific outputs/deliverables to achieve. Copies of the PowerPoint presentations for Day 2 are in Appendix 4.



Plate 4. Participants at the workshop in Abuja, Nigeria.

3.2.1. Detailed plan of work: Kenya

Presentation by Dr. Chrysantus Mbi Tanga, ICIPE

The following activities are planned for 2024:

- Recruit 10 MSc students (ongoing).
- Conduct literature reviews.
- Design research protocols.
- Secure animal ethics approval.
- Conduct 12 tilapia experiments.
- Analyze data and samples.
- Organize an online stakeholder workshop in the country.
- Prepare and disseminate reports.
- Discuss the results with internal and external partners, and select 15 ingredients.

The following activities are tentatively planned for 2025:

- Conduct literature reviews (ongoing).
- Design research protocols (ongoing).
- Conduct 12 tilapia experiments (ongoing).
- Analyze data and samples (ongoing).
- Organize two stakeholder workshops in the country.
- Prepare and disseminate reports.
- Develop innovation platforms to bring key scaling stakeholders together.
- Identify and set up demonstration sites and model farms.
- Host farmer field days at demonstration sites and model farms.
- Build partnerships with cooperatives to test and use novel feeds
- Support the establishment of new feed services and business by young people, farmers, etc.
- Help small-scale feed millers develop new products.
- Build partnerships with NGOs, the private sector and extension service providers.

3.2.2. Detailed plan of work: Nigeria

Presentation by Dr. Charity Obetta, Dr. Ibiyo and Dr. Caroline, CORAF

Eight experiments are planned to determine the nutrient requirements (methionine, lysine, vitamin C, calcium and phosphorus) of improved strains of tilapia and African catfish using locally available ingredients in Nigeria.

The activities planned for 2024 are as follows:

- Conduct the feeding experiment to determine the methionine requirement.
- Analyze samples and data.
- Prepare a report for submission and publication.
- Conduct the feeding experiment to determine the lysine requirement.
- Analyze samples and data.
- Prepare a report for submission and publication.
- Hold an annual workshop in Zambia.
- Host a local workshop to share results with farmers and feed millers.

The tentative timeline planned for 2025 is as follows:

- Conduct the feeding experiment to determine the vitamin C requirement.
- The PhD student begins research with associated activities.
- Analyze samples and data.
- Prepare a report for submission and publication.
- Conduct the feeding experiment to determine the calcium and phosphorus requirements.
- Analyze samples and data.
- Organize a local workshop.
- Hold an annual workshop in Kenya.

3.2.3. Detailed plan of work: Zambia

Presentation by Dr. Arthertone Jere and Mr. Gregory Kasanga, WorldFish Zambia

Experiments are planned to determine the nutrient requirements. FASA will hold a stakeholder engagement workshop in the country. It will set up partnership meetings and support its partners and will also host the annual workshop 2024.

The following are the steps involved to conduct the experiments:

- Design the research protocol.
- Secure animal ethics approval.
- Conduct experiments to determine the nutrient requirements for tilapia.
- Analyze data and samples.
- Prepare a research report for publication.

The following is the timeline for the experiments:

- Experiment 1: January–March 2024
- Experiment 2: April–June 2024
- Experiment 3: July–September 2024
- Experiment 4: October–December 2024.

FASA will provide new knowledge on the type, price and seasonality of local ingredients used in fish feeds produced in Zambia and make it available within and outside the focal countries through published reports and results.

3.2.4. Detailed plan of work: Malaysia

Presentation by Ms. Nurulhuda Ahmad Fatan and Dr. Aaqillah Amr, WorldFish Headquarters

The following research activities were planned for 2024

- Three tilapia experiments will be conducted to assess the digestibility of the ingredients obtained from Zambia, Kenya and Nigeria
- Development of fish ingredient database
- Develop publication (technical and research report) from the experiments finding

All findings on the ingredients will be synthesized to enable prioritization, and the results will be discussed with internal and external partners to select 15 ingredients.

In addition to research activities, the project continuously receives support from the project management team which includes the grants and contracts, monitoring evaluation and learning (MEL), data management, impact assessment, communication, procurement, finance, to ensure that the project implementation is on track.

Digestibility experiments

Three experiments will be conducted using the GIFT to assess the digestibility of the ingredients samples collected from Zambia, Nigeria and Kenya. The experiments timeline was planned as following:

- Digestibility experiment with ingredient from Zambia (November – December 2023)
- Digestibility experiment with ingredient from Nigeria (Feb – March 2024)
- Digestibility experiment with ingredient from Kenya (May – July 2024)
- Digestibility experiment with ingredient from Zambia (Sep – Oct 2024)

Other research works in Malaysia

Solid-state fermentation: A tool for improving the nutritional value of novel feed ingredient

Other research works in Malaysia will be conducted to investigate and improve nutritional value of feed ingredient using solid state fermentation (SSF) application. Experiments will be conducted to optimize SSF process for effective fermentation, such as identification of microbes, moisture content, temperature, pH and inoculum concentration. This will be done by Q2. A further experiment by Q3 is to produce nutritious and functional products. Finally the fermented product will be tested as feed ingredient in a feeding trial on tilapia by Q4.

Enhancing reproductive performance using high-quality oil in the broodstock of the GIFT strain of tilapia (*Oreochromis niloticus*) diet

Another research to be conducted is to enhance reproductive performance using high quality oil in the diet for GIFT broodstock. The objective is to evaluate growth performance and gonad maturation at the early stage of development of juvenile tilapia and to assess fecundity and sperm quality during the breeding stage. GIFT tilapia weighing approximately 20 g will be used in the experiment. Different type of oil, fish oil and squid oil from Malaysia, insect oil produced from BSFL raised on potato waste from Kenya, sunflower oil from Zambia, and groundnut oil and palm oil from Nigeria will be tested and used as ingredient. There will be two feeding trials: one on gonadal maturation and the other on reproductive performance.

3.2.5. Detailed plan of work: Sweden

Presentation by Dr. Kartik Baruah, SLU

Two PhD students will conduct research and development on sustainable feeds for farmed fish. The student from Zambia will work on tilapia and the one from Nigeria on African catfish. The objective is to find a novel (functional) feed that will improve fish growth performance, health and robustness as well as cost effective and has a low ecological footprint.

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In addition, a comparative study will be conducted to investigate the functional responses of both wild and genetically improved strains of tilapia in response to feeding them novel feed.

The following additional activities are planned for 2024 and 2025:

- Conduct experiments to prioritize key ingredients by analyzing the biochemical parameters of ingredients.
- Develop and use processing techniques to improve the quality of key ingredients.
- Check the quality of improved ingredients, formulation and production on fish feeds for lab trials in Sweden.
- Conduct a validation study on farms in Nigeria and Zambia.

3.2.6. Training on proper financial reporting

Presentation by Mr. Tan Ban Swee and Mr. Tan Chao Yan, WorldFish Headquarters

With the exception of the first advance fund transfer to the partner, subsequent advances are subject to the following conditions:

- WorldFish must receive and accept technical and financial reports that are due in accordance with the submission schedule as stated in the subgrant agreement.
- Submit a quarterly forecast workplan and budget that are consistent with the implementation plan.
- Submit WorldFish-approved invoices for the relevant quarter.
- Provide sufficient supporting evidence to support spending.
- Upon request from WorldFish, the partner must support and revert the corresponding year-end balance confirmation.
- Final payment to partners will be cost-reimbursement and will be released only upon acceptance and approval of all deliverables and final technical and financial reports from partners.

With the exception of the first advance fund transfer to the partner, subsequent cost reimbursements are subject to following conditions:

- WorldFish must receive and accept technical and financial reports that are due in accordance with the submission schedule as stated in the subgrant agreement.

- Prior to receiving payment, partners must complete contractual deliverables and incurred expenses that exceed the first advance payment, subject to WorldFish approval.
- Submit WorldFish-approved invoices for payment.
- Provide sufficient supporting evidence to support spending.
- Upon request from WorldFish, the partner must support and revert the corresponding year-end balance confirmation.

Partners must ensure the following areas of improvement:

- Budgets must comply with subgrant agreement categories.
- The reporting period stated in the financial report must be accurate.
- Expenditures must be consistent with those reported in previous periods.
- Expenditures stated in the financial report must align with the fund status report and transaction listing.
- Complete the fund status report.
- Complete and ensure the accuracy of information reported in the transaction listing.

3.2.7. Q&A

Q: Dr. Baruah suggested acquiring species in earlier stages of experiment to prevent delays for required broodstock.

A: Kasanga agreed, as it is a challenge to acquire broodstock.

Q: Dr. Ndebele-Murisa asked is there any duplication on the digestibility experiment between the SLU with WorldFish.

A: Dr. Baruah explained that WorldFish Headquarters is primarily conducting the experiment, but it is happy to assist from Sweden.

A: Dr. Yossa added that the SLU may conduct digestibility experiments on ingredients that the organization will process and improve itself.

4. Field visits in Nigeria

4.1. TIDDO Fish Farms Limited

On November 6, 2023, the workshop participants visited feed producers at TIDDO Fish Farms in Abuja (Plate 5). This local feed mill produces feed for catfish at different life stages, both for farms and for sale. About 85% of the raw ingredients used to formulate and manufacture the feed are sourced locally (Plate 6). The feed mill is well equipped with all required equipment to produce complete feeds, including a hammer mill,

grinder, mixer, extruder, oil sprayer, feed dryers and packaging machine, most of which were purchased from China. The finished products, which include various pellet sizes (2, 3, 4, 6 and 8 mm), are packaged onsite. The farm also has a laboratory, which it uses to analyze the proximate composition of feed. Challenges that the company faces include a shortage of replacement parts, inconsistent feed prices because of seasonal variation and an increase in feed costs.



Plate 5. Field visit to TIDDO Fish Farms.



Plate 6. Fish feed equipment at TIDDO Fish Farms.



Plate 7. Fish feed produced at TIDDO Fish Farms

4.2. Flourishing Centre Fish and Agro Farms

On November 6, 2023, participants also visited the Flourishing Centre Fish and Agro Farms in Abuja. This farm has 30 concrete ponds and is owned by Mr. Onoja Sunday Musa, president of the Catfish Farmers Association of Nigeria (CAFAN). The farm produces its own fish feed and sells excess feed. It has five extruders onsite that can produce approximately 1000kg of fish feed

daily. Mr. Sunday also recommended using fresh azolla and duckweed as supplementary feed in addition to manufactured feed. The farm produces over 300,000 fingerlings of catfish per year. It also has other species, including pangasius, African arowana, tilapia and common carp. In addition, the farm offers training opportunities in fish farming to youths. One of the challenges that the farm faces is the high cost of repairing machinery.



Plate 8. Owner and CEO of Flourishing Centre Fish and Agro Farms, Mr. Sunday, briefs visitors



Plate 9. Fish feed extruder at Flourishing Centre Fish and Agro Farms.



Plate 10. Azolla used as fish feed at Flourishing Centre Fish and Agro Farms

4.3. Nigerian Institute for Oceanography and Marine Research

On November 9, 2023, the workshop participants visited the NIOMR in Lagos. Professor Abiodun Sule, executive director, welcomed the participants and introduced the company’s mandate and the range of research and innovation activities taking place. The NIOMR provides research in fisheries and aquaculture across the value chain. It has several departments and provides training

to people who are involved in oceanographic research and product development. Some of the notable sections under the institute include aquaculture, fish technology, extension services, marine geography, fishing technology and safety, marine culture, biotechnology, analytical laboratory, and fisheries resources assessment. The NIOMR is also equipped with a wet lab in its fish technology building, which can be used to run nutrient requirement experiments.



Plate 11. The NIOMR’s main office in Lagos



Plate 12. The NIOMR’s central analytical laboratory



Plate 13. The company’s RAS used for fish nutrition experiments



Plate 14. The NIOMR's fish technology section and products



Plate 15. Fishing gear and machinery developed by the NIOMR

5. Outcomes

The main outcome of the workshop was the revised implementation plan for the year 2024 and tentatively for 2025. The timeframe and specific outputs for each activity were specified. The revised plan was agreed upon and the project's partners will implement it. The amended plan will be used to carry out the project on the ground in 2024 and 2025

6. Next steps and conclusions

Each partner will implement the 2024 and, tentatively, 2025 project activities in Kenya, Nigeria, Zambia, Sweden and Malaysia, as per the revised implementation plan and the approved annual workplan. Partners have agreed to hold the project's next annual workshop in Zambia in 2024 .

Appendix 1. List of workshop participants

Partner/Consultant/Stakeholder			
No	Organization	Participant	Attendance
1	ARCN, CORAF	Charity Obetta	Yes
2	NIFFR, CORAF	Lenient Mercy Onivie Ibiyo	Yes
3	NIOMR, CORAF	Caroline Iretioluwa Ayo-Olalusi	Yes
4	CORAF	Lamien Niéyidouba	Yes
5	NRDC	Melon Mulamfu	Yes
6	SLU	Sri Kartik Baruah	Yes
7	ICIPE	Chrysantus Mbi Tanga	Yes
8	Includovate	Sujata Ganguly	Yes
9	NAGI Enterprise	Mzime Regina Murisa	No (Late arrival)
10	DOF, ARCN	Femi John Akinniyi	Yes
11	WorldFish, SLU	Arnold Ebuka Irabor	No (Late arrival)
12	WorldFish	Rodrigue Yossa	Yes
13	WorldFish	Arthertone Jere	Yes
14	WorldFish	Gregory Mulenga Kasanga	Yes
15	WorldFish	Aaqillah Amr Binti Mohd Amran	Yes
16	WorldFish Laboratory	Ning Shahira Binti Sharbini	Yes
17	WorldFish	Nurulhuda Ahmad Fatan	Yes
18	WorldFish	Tan Ban Swee	Yes
19	WorldFish	Tan Chao Yan	Yes
20	WorldFish	Sunil Siriwardena	No
21	WorldFish	Yogeswary Chellappan	Yes
22	WorldFish	Timothy Manyise	No (Late arrival)

Table 1. List of participants on Day 1 (November 6, 2023).

Partner/Consultant/Stakeholder			
No	Organization	Participant	Attendance
1	ARCN, CORAF	Charity Obetta	Yes
2	NIFFR, CORAF	Lenient Mercy Onivie Ibiyo	Yes
3	NIOMR, CORAF	Caroline Iretioluwa Ayo-Olalus	Yes
4	CORAF	Lamien Niéyidouba	Yes
5	NRDC	Melon Mulamfu	Yes
6	SLU	Sri Kartik Baruah	Yes
7	ICIPE	Chrysantus Mbi Tanga	Yes
8	Includovate	Sujata Ganguly	Yes
9	NAGI Enterprise	Mzime Regina Murisa	Yes
10	NAGI Enterprise	Angela Samundengo	Virtual
11	IITA	Murat Sartas	Virtual
12	Aller Aqua Zambia Limited	Alexander Michael Greiling	Virtual
13	ARCN	Garba Hamidu Sharubutu	Absent with reason
14	NIOMR	Sule Abiodu	Absent with reason
15	DOF, ARCN	Zakari Adamu Isah	Yes
16	DOF, ARCN	Femi John Akinniyi	Yes
17	Embassy of Norway	Svein Baera	Yes
18	Embassy of Norway	Eivind Fjeldstad	Yes
19	DOF, ARCN	Musa Musa	Yes
20	WorldFish, SLU	Arnold Ebuka Irabor	Yes
21	WorldFish	Rodrigue Yossa	Yes
22	WorldFish	Arthertone Jere	Yes
23	WorldFish	Gregory Mulenga Kasanga	Yes
24	WorldFish	Aaqillah Amr Binti Mohd Amran	Yes
25	WorldFish Laboratory	Ning Shahira Binti Sharbini	Yes
26	WorldFish	Nurulhuda Ahmad Fatan	Yes
27	WorldFish	Tan Ban Swee	Yes
28	WorldFish	Tan Chao Yan	Yes
29	WorldFish	Sunil Siriwardena	Yes
30	WorldFish	Yogeswary Chellappan	Yes
31	WorldFish	Timothy Manyise	Yes
32	WorldFish	Victor Siamudaala	No

Table 2. List of participants on Day 2 (November 7, 2023).

Partner/Consultant/Stakeholder			
No	Organization	Participant	Attendance
1	ARCN, CORAF	Charity Obetta	Yes
2	NIFFR, CORAF	Lenient Mercy Onivie Ibiyo	Yes
3	NIOMR, CORAF	Caroline Iretioluwa Ayo-Olalus	Yes
4	CORAF	Lamien Niéyidouba	Yes
5	NRDC	Melon Mulamfu	Yes
6	SLU	Sri Kartik Baruah	Yes
7	ICIPE	Chrysantus Mbi Tanga	Yes
8	Includovate	Sujata Ganguly	Yes
9	NAGI Enterprise	Mzime Regina Murisa	Yes
10	NAGI Enterprise	Angela Samundengo	Virtual
11	IITA	Murat Sartas	Virtual
12	Aller Aqua Zambia Limited	Alexander Michael Greiling	Virtual
13	ARCN	Garba Hamidu Sharubutu	Absent with reason
14	NIOMR	Sule Abiodu	Absent with reason
15	DOF, ARCN	Zakari Adamu Isah	Yes
16	DOF, ARCN	Femi John Akinniyi	Yes
17	DOF, ARCN	Musa Musa	Yes
18	WorldFish, SLU	Arnold Ebuka Irabor	Yes
19	WorldFish	Rodrigue Yossa	Yes
20	WorldFish	Arthertone Jere	Yes
21	WorldFish	Gregory Mulenga Kasanga	Yes
22	WorldFish	Aaqillah Amr Binti Mohd Amran	Yes
23	WorldFish Laboratory	Ning Shahira Binti Sharbini	Yes
24	WorldFish	Nurulhuda Ahmad Fatan	Yes
25	WorldFish	Tan Ban Swee	Yes
26	WorldFish	Tan Chao Yan	Yes
27	WorldFish	Sunil Siriwardena	Yes
28	WorldFish	Yogeswary Chellappan	Yes
29	WorldFish	Timothy Manyise	Yes
30	WorldFish	Victor Siamudaala	No

Table 3. List of participants on Day 3 (November 8, 2023).

Partner/Consultant/Stakeholder			
No	Organization	Participant	Attendance
1	ARCN, CORAF	Charity Obetta	Yes
2	NIFFR, CORAF	Lenient Mercy Onivie Ibiyo	Yes
3	NIOMR, CORAF	Caroline Iretioluwa Ayo-Olalus	Yes (Host)
4	CORAF	Lamien Niéyidouba	Yes
5	NRDC	Melon Mulamfu	Yes
6	SLU	Sri Kartik Baruah	Yes
7	ICIPE	Chrysantus Mbi Tanga	Yes
8	Includovate	Sujata Ganguly	Yes
9	NAGI Enterprise	Mzime Regina Murisa	Yes
10	WorldFish, SLU	Arnold Ebuka Irabor	Yes
11	NIOMR	Sule Abiodu	Yes (Host)
12	WorldFish	Rodrigue Yossa	Yes
13	WorldFish	Arthertone Jere	Yes
14	WorldFish	Gregory Mulenga Kasanga	Yes
15	WorldFish	Aaqillah Amr Binti Mohd Amran	Yes
16	WorldFish Laboratory	Ning Shahira Binti Sharbini	Yes
17	WorldFish	Nurulhuda Ahmad Fatan	Yes
18	WorldFish	Tan Ban Swee	Yes
19	WorldFish	Tan Chao Yan	Yes
20	WorldFish	Sunil Siriwardena	Absent with reason
21	WorldFish	Yogeswary Chellappan	Yes
22	WorldFish	Timothy Manyise	Yes

Table 4. List of participants on Day 4 (November 9, 2023).

Appendix 2. Workshop agendas

08:30–08:45	Registration, meet & greet	
Opening		
09:00–09:05	Welcome speech	Sule Abiodu, executive director, NIOMR
09:05–09:15	Welcome speech (virtual)	Essam Mohammed, director general, WorldFish
09:15–09:20	Welcome speech	Lamien Nieyidouba, CORAF
09:20–09:25	Welcome speech	Sunil Siriwardena, WorldFish Nigeria
09:25–09:35	Opening speech	H.E. Svein Baera, Norwegian Ambassador to Nigeria, Embassy of Norway
09:35–09:40	Introduction and scope of the meeting	Rodrigue Yossa
Session 1		
09:45–10:15	Year 1 implementation update for Nigeria	Charity Obetta, CORAF
10:15–10:45	Year 1 implementation update for Kenya	Chrysantus Mbi Tanga, ICIPE
10:45–11:00	Coffee break	
11:00–11:30	Year 1 implementation update for Zambia	Arthertone Jere, WorldFish Zambia
11:30–12:00	Year 1 implementation update for Malaysia	Rodrigue Yossa, Aaqillah Amr and Nurulhuda A. Fatan, WorldFish
12:00–12:30	Discussion, Q&A	All participants
12:30–13:30	Lunch	
Session 2		
13:30–14:00	Year 1 implementation update for the climate change section	Mzime Regina Murisa, NAGI Enterprise
14:00–14:30	Year 1 implementation update for the gender and social inclusion study section	Sujata Ganguly, Includovate
14:30–14:45	Introduction on organization and team, experience in market assessments and scaling, workplan (virtual)	Murat Sartas, IITA
14:45–15:00	Year 1 implementation update for Sweden	Sri Kartik Baruah, SLU
15:00–15:30	Discussion, Q&A	All participants
15:30–15:45	Coffee break	
Session 3		
15:45–16:15	Update on country TOC and annual outcome monitoring studies	Timothy Manyise, WorldFish Headquarters
16:15–16:30	Perspectives of Aller Aqua Zambia Limited on Year 1 implementation (Virtual)	Alexander Michael Greiling, Aller Aqua Zambia Limited
16:30–16:45	Perspectives of the NRDC on Year 1 implementation	Melon Mulamfu, NRDC
16:45–17:00	Update on project finances	Tan Chao Yan and Tan Ban Swee, WorldFish
17:00–17:15	Technical and financial reporting	Rodrigue Yossa and Tan Chao Yan, WorldFish
17:15–17:45	Discussion, Q&A	All participants
End of open session		

Table 5. Day 2 agenda (November 7, 2023).

08:30–08:45	Meet and greet	
09:00–09:05	Introduction and scope of the meeting	Rodrigue Yossa, project leader, WorldFish
Session 1		
09:05–10:05	Detailed plan of work in Kenya	Chrysantus Mbi Tanga, ICIPE
10:05–11:05	Detailed plan of work in Nigeria	Charity Obetta, CORAF
11:05–11:30	Coffee break	
11:30–12:30	Detailed plan of work in Zambia	Arthertone Jere, WorldFish Zambia
12:30–13:30	Lunch	
Session 2		
13:30–14:15	Detailed plan of work in Malaysia	Rodrigue Yossa, Aaqillah Amr Mohd Amran and Nurulhuda A. Fatan, WorldFish
14:00–14:30	Detailed planning of work in Sweden	Sri Kartik Baruah, SLU
14:30–15:00	Discussion, Q&A	All participants
15:00–15:15	Coffee break	
Session 3		
15:15–15:45	Training on proper financial reporting	Tan Chao Yan and Tan Ban Swee
15:45–16:15	Updated implementation plan	Rodrigue Yossa, WorldFish
16:15–16:45	Discussion, Q&A	All participants
16:45–16:55	Closing remarks	Rodrigue Yossa, WorldFish
End of open session		

Table 6. Day 3 agenda (November 8, 2023).

Appendix 3. Slides presentations for Day 1

Introduction and scope of the meeting WorldFish (Dr. Rodrigue Yossa)




2023 FASA Project Annual Workshop:
Introduction and scope of the meeting

By Rodrigue Yossa, Project Leader




Content

1. Project Objective, Partners and Geographies
2. Annual Workshop Goal & Frequency
3. 2022 Annual Workshops



Project Objective, Partners and Geographies




GOAL: July 2022 - June 2017

To develop low-cost, highly nutritious fish feeds based on novel ingredients and enable 5,000 smallholder fish farmers in 3 African countries to test and adopt these ingredients and feeds, leading to increased income, improved food security, and reduced waste and pollution.

Consultants

Local feed millers & farmers groups



Project Objective, Partners and Geographies (continued)

Outcome 1: Enhanced capacity of at least two stakeholder groups in each country to integrate best practices toward a more sustainable feed sector

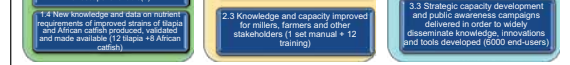
- 1.1 New knowledge on type, price & seasonality of local ingredients used in animal (fish) feeds produced (3)
- 1.2 Viable opportunities and pathways for women and youth to be more integrated into and benefit from the fish feed sector identified (3)
- 1.3 Strategies and opportunities to increase environmental sustainability and climate resilience in the fish feed landscape available (3)
- 1.4 New knowledge and data on nutrient requirements of improved strains of tilapia and African catfish produced, validated and made available (12 tilapia + 8 African catfish)

Outcome 2: Quality of at least 15 local ingredients has been improved through processing techniques and the ingredients are used by stakeholders

- 2.1 New data and knowledge on local ingredients generated and used to formulate novel feeds (3 SLU+6 Penang)
- 2.2 Database and digital solutions developed and used by farmers for formulating local feeds (1)
- 2.3 Knowledge and capacity improved for millers, farmers and other stakeholders (1 test manual + 12 training)

Outcome 3: 5000 farmers directly or indirectly linked to the project access, test and use novel fish feed solution

- 3.1 Integrated knowledge for enabling the scaling environment and strategies for scaling-up the use of novel feeds and management approaches co-developed (23)
- 3.2 Strategic partnerships for scaling the use of project's innovations and knowledge built and operational (3000 farmers)
- 3.3 Strategic capacity development and public awareness campaigns delivered in order to widely disseminate knowledge, innovations and tools developed (6000 end-users)



Annual Workshop Goal & Frequency

Objectives of annual workshop:

- 1) Meet in person: synergy and complementarity; **it is a project workshop, not a conference!**
- 2) Discuss project progress in each country
- 3) Conduct the annual planning for next year
- 4) Site visits in Abuja and Lagos



Annual project workshop cost breakdown - Malaysia (HQ) - x 2 (Y1 & Y5)
Annual project workshop cost breakdown - Nigeria (Y2)
Annual project workshop cost breakdown - Zambia (Y3)
Annual project workshop cost breakdown - Kenya (Y4)



2023 Annual Workshop

Day 1, Tuesday 7th November 2023 : 3 technical sessions / Presentations of last year activities from FASA partners

Day 2, Wednesday 8th November 2023: 3 technical sessions / Planning sessions for years 2024

Day 3, Thursday 9th November 2022: Site Visit in Lagos (following site visits of 6th November in Abuja)



Thank You

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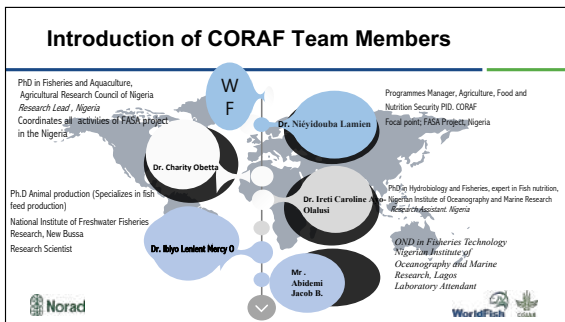
Introduction of the team members and update on the implementation of year 1 of the FASA project in Nigeria CORAF (Dr. Charity Obetta)



Introduction

- Nigeria is the largest aquaculture producer in SSA but with a big challenge of supplying quality and affordable nutrient to farmed fish.
- The expansion of smallholder aquaculture production is limited due to the scarcity, unsustainability, and high environmental and economic costs of fish feeds.
- Through the FASA project, we hope to have an inclusive, equitable and sustainable aquatic food system in Nigeria.





Project key facts



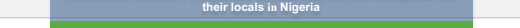
Scoping studies on the type, price and seasonality of local ingredients used in fish feeds in Nigeria.



Plate 1: Hybrid Catfish strain (Cross of *Heterobranchus* sp & *Clarias* Sp)


Plate 2: Hybrid Tilapia strain (Cross of Nile Tilapia and Red Tilapia)

Nutrients requirement of improved strain of African catfish (Hybrid of *Heterobranchus* Spp. X *Clarias gariepinus*) and Hybrid Tilapia (*Oreochromis niloticus* X *Oreochromis mossambicus*) with both compared with their locals in Nigeria




Project goals

- Scoping studies:
 - to conduct an in-depth literature review on available fish feed ingredients in Nigeria
 - to assess, document and publish information on local ingredients that could be used sustainably in fish feeds in order to fill up data gap on available local ingredients for fish feed in Nigeria.



Project componets

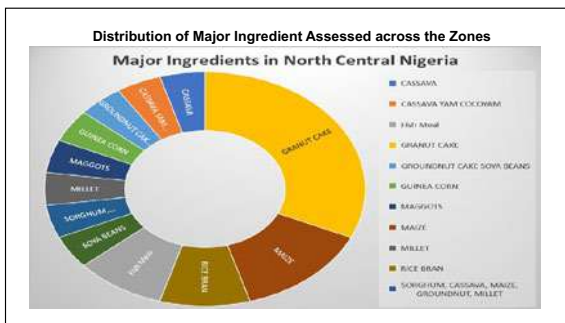
- Literature review
- Meetings with stakeholders
- Study design
- Approval of research protocol
- Human ethics approval
- Selection and training of enumerators
- Data collection
- Ingredient collection
- Packaging of samples and sending to WF and SLU
- Data analyses, report writing and publication

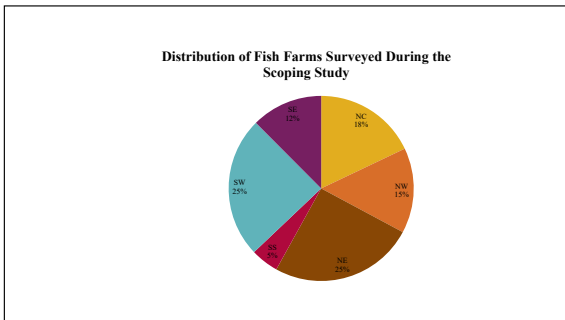
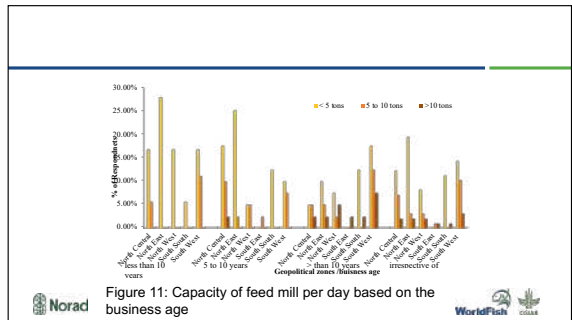
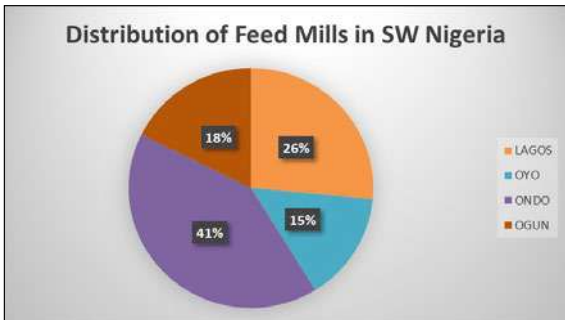
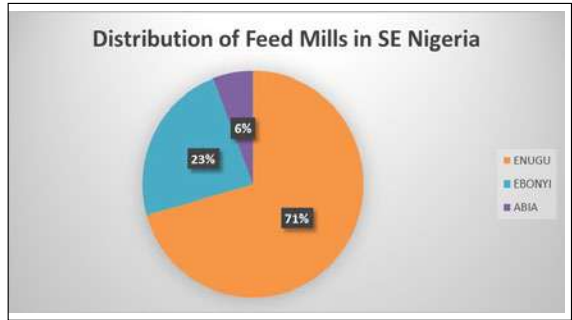
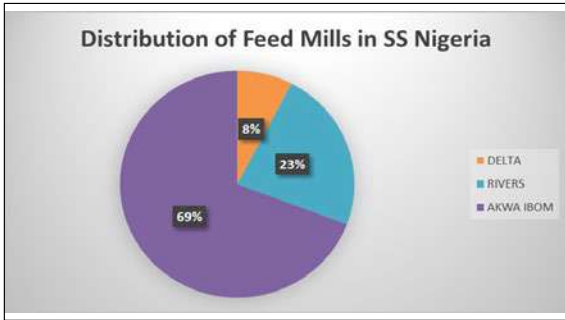
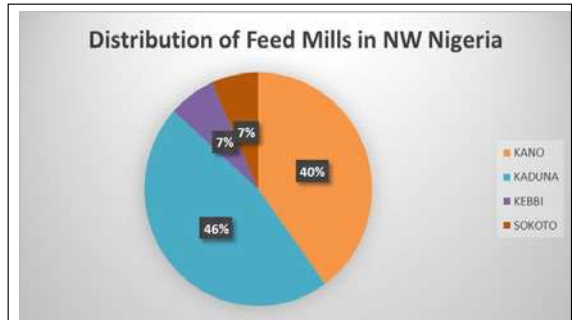
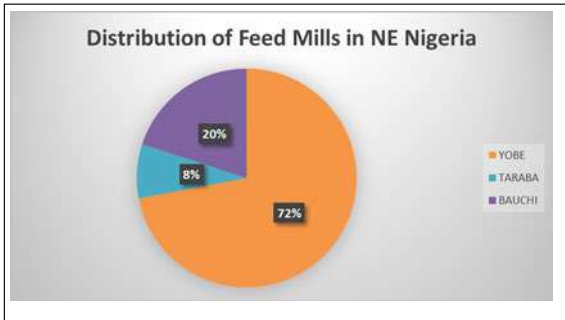


Study Area



- 46 locations
- 20 respondents
- Five (5) respondents
- Total 920



Ingredients packaged for further studies

Collection and packaging of 16 selected ingredients sent to WorldFish Malaysia and Sweden for analysis & processing.

SELECTION OF 16 INGREDIENTS FOR ANALYSIS AND PROCESSING

- African Lacust bean (*Pisidium albidum*)
- African Sesabeh (*Adansonia digitata*)
- White Cowpea (*Vigna unguiculata*)
- Brown Cowpea (*Vigna unguiculata*)
- Bambara nut (*Vigna subterranea*)
- Brewery waste (*Hordeum vulgare*)

Packaged ingredients

- Roselle seed meal (waste after extracting oil from the roselle seed)
- Hibiscus sabdariffa
- Tiger nut (*Cyperus Esculentus*)
- White yam (*Dioscorea rotundata*)
- Yam powder

SELECTION OF 16 INGREDIENTS FOR ANALYSIS AND PROCESSING




SELECTION OF 16 INGREDIENTS FOR ANALYSIS AND PROCESSING

- Shear nut seed cake (*Vitellaria paradoxa*)
- Clupeoid fish (*Pellonidia leucomis*) (2-3 high specific; used mostly for animal feed)
- Black soldier fly larvae
- Plantain (*Musa sapientum*)

Nutritional studies




Nutrients requirements of improved strains of Tilapia and African Catfish using locally available ingredients in Nigeria.

- ❖ Methionine requirement
- ❖ Lysine Requirement
- ❖ Vitamin C Requirement and
- ❖ Mineral (Calcium and Phosphorus) requirement. Eight experiments in all.




Nutritional studies

- ❖ Progress made
 - Research protocol approved by the project coordinator.
 - Human ethics approval obtained
 - Rehabilitation of experimental system (WRS) done
 - Procurement of experimental fish done
 - Acclimation of experimental fish species on-going
- Planning for Feed formulation, Sampling and Chemical analysis of this experimentation.

Partners

- ❖ Federal Ministry of agriculture
- ❖ Agricultural Development Programme
- ❖ Ingredient producers
- ❖ Ingredient farmers
- ❖ Fish farmers
- ❖ Feed millers
- ❖ Research Scientist and Technologist
- ❖ Local cooperatives/groups
- ❖ Women and youth groups;
- ❖ Local NGOs;
- ❖ private sector; extension service providers; policy and finance organizations; government; regional bodies (AFDB, SADC, ECOWAS, EAC, and environmental agencies)

Thank You

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Introduction of the team members and update on the implementation of year 1 of the FASA project in Kenya
 CIPE (Dr. Chrysantus Mbi Tanga)

Introduction of the team members and update on the implementation of year 1 of the FASA project in Kenya

TANGA MBI CHRYSANTUS

Team Members

Dr. Chrysantus Mbi Tanga
 Dr. Menaga Meenakshisundaram
 Dr Jonathan Munguti
 Mr. Isaiiah Rachami
 Mr John Muia
 Ms Judy Kaguthi
 Mrs Evalyne Wambui Ndoton

Update on the implementation of year 1 of the FASA project in Kenya

Recruit New Staff

- Assistant Professor at Tamil Nadu University
- Five years of experience in the Aquaculture sector
- Specialized in different culture systems, such as raceways, recirculating aquaculture systems, aquaponics, and intensive ponds.
- Trained aquapreneurs seeking to enhance their production.

Dr. Menaga Meenakshisundaram
 Mr. Isaiiah Rachami

Recruit of MSc & PhD Students

Mr John Muia
 Master of science in Aquaculture and Fisheries Management

Ms Judy Kaguthi
 Insect-based diet in fish: implications for gut microbiota

Mrs Evalyne Wambui Ndoton

Conduct project start-up workshops

- Attended the online FASA partners' kick-off meeting (05th August 2022) with 18 participants.
- Attended the in-person Kick-off workshop: 28 - 30th Nov. 2022 at WorldFish HQ, Penang, Malaysia, followed by a site visit to Fisheries Research Institute Malaysia, Pulau Sayak and Jitra Aquaculture Extension Centre in Kedah
- Over 30 participants present at the WorldFish Headquarter Penang.
- On 18th January 2023, online Kenyan stakeholder kick-off meeting was organized with over 25 participants.

Conduct project start-up workshops

- First Kenyan stakeholders' meeting: 16 - 25th February 2023.
- Fish farms:** Kamuthanga farm (Machakos), Kenya Marine and Fisheries Research Institute (KMFRI) (Sagana), Bukani Aquapark, Hydro Victoria Fish Hatchery and Farm Ltd, and Bunyala Agro Industrial Park (Busia), Victory Fish Farms & Jabali Fish Farm
- Feed millers:** Great Lake Feeds and Hatchery Ltd (Siaya), Captain Feeds and KMFRI Sangoro centre in Kisumu County, and Kinyasaga group in Homa Bay county.

Conduct literature review of insect farming industry in Africa

Over 20,000 MT/Year

394,640,000 tonnes of feed at 50% inclusion of BSF meal

Where Do Our Grains Go?

62%
 23%
 12%
 3%

STIFF COMPETITION BETWEEN MAN & HIS ANIMALS

How to Reduce Competition

Reduce competition between man and his animals

Conduct scoping review on role multilateral development organization, public & private investments in aquaculture subsector in Kenya



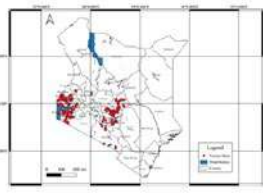
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- More collaborative research
- Devoted to the design and construction of climate smart culture systems
- Developing new species to guarantee supply of high-quality products
- Developing and scaling low-cost and highly nutritious fish feeds based on novel ingredients

Conduct scoping review on role multilateral development organization, public & private investments in aquaculture subsector in Kenya

- Enhancing resilient livelihoods through innovative aquaculture practices and market linkages to create employment opportunities for youth and women.
- Governments should create an enabling policy environment through tax incentives and regulatory reforms to combat climate change, protect nature and biodiversity, sustain livelihoods, and mainstream food and nutrition initiatives into the design and implementation of future aquaculture projects.

Scoping assessments in fish production zones

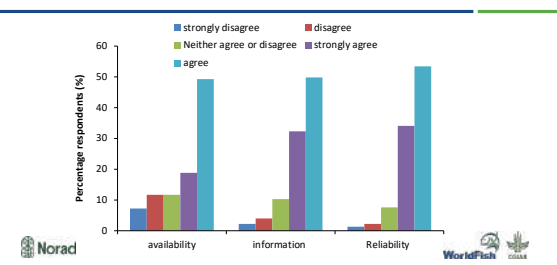


- Out of 220 respondents interviewed, 93.2% kept tilapia (93.2%) followed by catfish (6.2%).
- Most farmers (70.7%) harvested their fish once yearly.
- Majority of fish farmers obtain their feed supply from other farmers (15.2%), private companies (10.8%) and only 5.8% produce their own fish feeds.
- 66% of farmers use compounded feeds to feed their fish, only 25.8% have reportedly use insect meal.


Scoping assessments in fish production zones

- Government is the highest supplier of fingerlings (25.6%) to the farmers followed closely by the private companies (22.9%) and other farmers (22.4%).
- Most farmers used complete compounded feeds (65.5%) and dry supplements (63.2%) and only 10.3% used wet supplements to feed their fish.
- Farmers strongly agreed (20.6%) and agreed (47.5%) that the use of insect meals in fish production might help lower the feed price and overall production cost in fish farming.
- The most used protein sources included: freshwater shrimp (commonly referred to as "Ochonga") at 45.3%, fishmeal (17.9%), dry poultry waste (9.4%), Sardines (Omena) (6.7%), insects/earthworms (5.8%), legume residues (5.4%), sunflower cake (4.4%), blood meal (5.4%), soybean meal (3.1%), cotton seed cake (2.7%) and sesame seed meal (1.3%).
- Common home-made feeds for the fish are either single ingredients used on feed formulation such as maize bran or household food left-overs.

Factors influencing the utilization of insect-based feeds

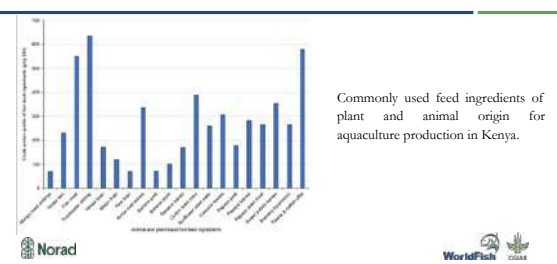


Design scoping studies for Kenya




Development and Utilization of Sustainable Feeds for Aquaculture: Feeds Systems in Fish Production in Kenya

Data collection (ingredients): Top 20 protein sources



Data collection (ingredients): Proximate Composition



Parameter (%)	Full fat BSFL	Defatted BSFL
Dry matter	93.65 ± 0.035	92.41 ± 0.198
Protein	48.17 ± 0.427	57.00 ± 0.219
Ash	10.43 ± 0.145	14.43 ± 0.033
Fat	21.48 ± 0.223	9.47 ± 0.067
Fibre	7.12 ± 0.113	9.11 ± 0.162

Defatted and full-defatted black soldier fly (*Hermetia illucens*) larvae meal

Data collection (ingredients): Amino acids

Amino acid (mg/g)	Full fat BSFL	Defatted BSFL
Histidine	0.18 ± 0.003	0.19 ± 0.004
Isoleucine	0.76 ± 0.025	1.23 ± 0.124
Leucine	1.59 ± 0.067	2.36 ± 0.083
Lysine	0.31 ± 0.009	0.46 ± 0.011
Methionine	0.30 ± 0.005	1.03 ± 0.034
Phenylalanine	1.69 ± 0.050	2.65 ± 0.293
Threonine	0.14 ± 0.002	0.17 ± 0.004
Valine	1.13 ± 0.017	1.77 ± 0.033
Arginine	0.41 ± 0.005	0.47 ± 0.013
Cystine	0.01 ± 0.005	0.02 ± 0.002
Glutamic acid	0.31 ± 0.008	0.45 ± 0.004
Proline	0.82 ± 0.009	1.13 ± 0.30
Tyrosine	0.86 ± 0.013	2.91 ± 0.191
Cysteine	0.25 ± 0.004	0.26 ± 0.006
Alanine	0.13 ± 0.003	0.15 ± 0.004

Amino acid profile of partially defatted and full-defatted black soldier fly (*Hermetia illucens*) larvae meal

Data collection (ingredients): Minerals

Mineral	Full fat BSFL	Defatted BSFL
Calcium (g/100g)	0.03 ± 0.008	0.91 ± 0.528
Phosphorous (g/100g)	0.15 ± 0.028	0.63 ± 0.424
Potassium (g/100g)	0.21 ± 0.060	1.14 ± 0.527
Sodium (mg/100g)	245.33 ± 60.416	155.93 ± 71.071
Magnesium (g/100g)	0.03 ± 0.008	0.20 ± 0.090
Sulphur (g/100g)	0.11 ± 0.018	0.20 ± 0.056
Iron (mg/100g)	12.33 ± 0.841	32.67 ± 20.228
Manganese (mg/100g)	0.90 ± 0.223	4.82 ± 2.497
Copper (mg/100g)	0.27 ± 0.067	0.83 ± 0.411
Zinc (mg/100g)	4.72 ± 1.185	4.80 ± 1.886

Mineral profile of partially defatted and full-defatted BSF

Data collection (ingredients): BSF Oil



- 40% Lauric acid
- Highly rich in antimicrobial agent



Investigate nutrient requirements in improved strains of tilapia

Design Research Protocol

Utilization of black soldier fly (*Hermetia illucens*) larvae as a potential substitute for fish meal in the production of Nile tilapia (*Oreochromis niloticus* L.)



IMPROVED NILE TILAPIA, KMFRI-SAGANA STRAIN (F-8)



Secure Animal Ethics Approval

Institutional Animal Care and Use Committee (IACUC) of Kenya Agricultural and Livestock Research Organization (KALRO)-Veterinary Science Research Institute (VSRI); Muguga North, in compliance with all applicable regulations and guidelines, under the reference code KALRO-VSRI/IACUC028/16032022



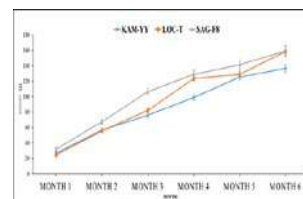
Results: Study site



National Aquaculture Research Development and Training Center, Sagana



Results: Comparative growth performance



Benefits of selective breeding

- Increased farm production
- Fish with better fillet yield
- Fish with improved growth rates
- Fish resistant to diseases
- Resilience to climate changes

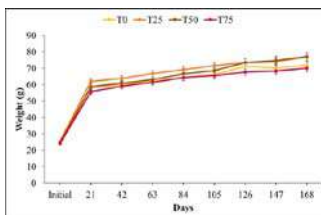


Results: Ingredients and nutritional composition of experimental diets

Ingredient	T0	T25	T50	T75
Wheat pollard	7.00	7.00	7.00	7.00
Rice polishing	20.00	19.25	19.00	18.75
Maize germ	22.00	22.00	21.50	21.00
Fish meal	7.00	5.25	3.50	1.75
BSFLM	-	2.50	5.00	7.50
Soybean meal	35.00	35.00	35.00	35.00
Sunflower cake	5.00	5.00	5.00	5.00
Lysine	1.00	1.00	1.00	1.00
Methionine	1.00	1.00	1.00	1.00
Fish premix	2.00	2.00	2.00	2.00
Total	100.00	100.00	100.00	100.00
Nutrient Level				
CP (%)	30.60	30.52	30.42	30.32
Energy (MJ/kg)	3,037.21	3,049.11	3,049.95	3,050.80



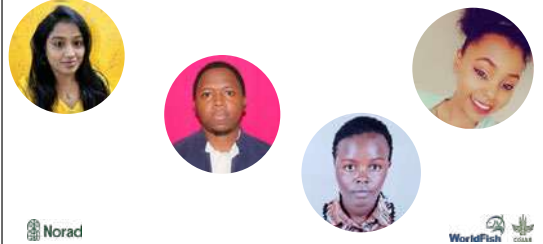
Results: Growth curves (weight) for *O. niloticus*



- 25% and 50% replacement of fishmeal protein with BSFLM provides best growth performance of Nile tilapia, as measured by final mean body weight gain (BWG), specific growth rate (SGR), feed conversion ratio (FCR) and condition factor (K).



Conduct 7 tilapia and 7 catfish experiment (Ongoing)



Capacity Building



- Trained over 357 farmers (70% women)
- 100 women from 31 Counties supported by the office of the first Lady (Mama Rachel Ruto)
- 75 Government extension officers

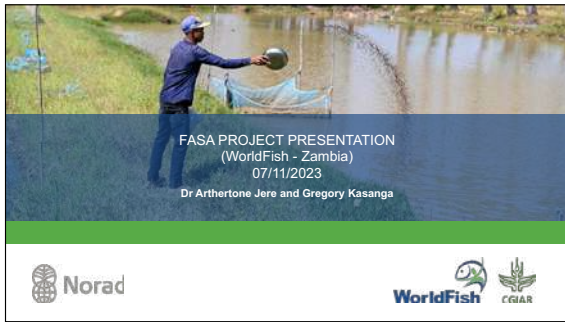


Partnerships

- Kenya Marine and Fisheries Research Institute (KMFRI)
- Kamuthanga Fish Farm, Machakos, Kenya
- Victory Farms Ltd, Kenya (Private sector)
- National Universities
- JABALI FISH FARM (JABALI FISHERIES TRADERS)
- Beach Management Units (BMU), County Government
- Kenya Bureau of Standards (KEBS)



Update on the implementation of year 1 of the FASA project in Zambia
WorldFish Zambia (Dr. Arthertone Jere and Gregory Kasanga)

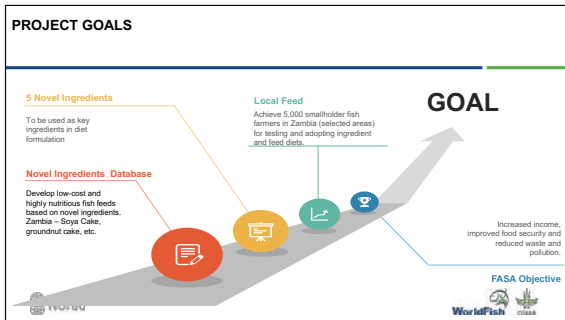


INTRODUCTION

The Development and Scaling of Sustainable feed for Resilient Aquatic food Systems in Sub-Saharan Africa (FASA) project aims to develop low-cost, highly nutritious fish feeds based on novel ingredients.

The development of these feeds will lead to:

- ✓ Increased income,
- ✓ Improved food security,
- ✓ Reduced waste and pollution.



PROJECT GOALS

Launched the FASA project in Zambia on 20th December, 2022

IMPLEMENTATION PATH

Phase	SCOPING STUDY	RESEARCH TRIALS	TESTING	CAPACITY & SCALING
Process	Local feed ingredient	Nutrient requirements for strains of Tilapia	Testing and Use of novel fish feeds	Enhance capacity of 2 stakeholders
Achieve	5 novel low cost feed ingredients to be developed	Developed fish feed diets for tilapia strains	5,000 smallholder farmers across Zambia to test novel fish feed	✓ Local Millers: (1) ✓ Smallholder fish farmer Cooperative: (1)
Subsequent impact	★★★★	★★★★	★★★★	★★★★

IMPLEMENTATION

- Ingredient and fish feed scoping study.**
Conduct a ingredient and feeds scoping study of novel feed ingredients.
✓ Study completed: samples sent for proximate analysis and digestibility studies.
- Upgrade of NRDC Laboratory.**
Fisheries wet laboratory from a flow through system to a recirculation aquaculture system.
✓ Completed and operational.
- Nutrient requirement experiment.**
✓ 1st Study on strains of tilapia and completed.

1. IMPLEMENTATION: Scoping study

Ingredient and fish feed Scoping Study Report

Arthertone Jere (Principal Investigator)

Co-Authors
Gregory Kasanga, Alexander M. Greiling & Rodrigue Yossa.

1. IMPLEMENTATION: Scoping study of fish ingredients and feed

INTRODUCTION

- ✓ Fish feed cost is a major constraint to fish farming in Sub-Saharan Africa.
- ✓ In Zambia, fish feed is a determinant factor in the aquaculture value chain and accounts for 60 -70% of the fish production cost.

1. IMPLEMENTATION: Scoping study of fish ingredients and feed

OBJECTIVE

To provide information on the **type, price, availability & seasonality** of the ingredients in Zambia.

Furthermore, to provide insights on the **fish feed value chain & its influences** on the aquaculture industry in Zambia.

1. Scoping study of fish ingredients and feed

METHODOLOGY

Province	Number of Districts	Number of Camps/Wards
Eastern	5 districts visited	15 camps/wards visited
Northwestern	5 districts visited	15 camps/wards visited
Southern	5 districts visited	15 camps/wards visited
Lusapula	5 districts visited	15 camps/wards visited
Northern	5 districts visited	15 camps/wards visited
Lusaka	5 districts visited	15 camps/wards visited
Total	30	90

1. Scoping study of fish ingredients and feed

Results (Summary) Ingredient Identified across

Table: Type of ingredients mapped during the March-May 2023 scoping study.

ID	Ingredient	Province	Type	Availability
1	Maize	Central	Plant	Dependent
2	Rice	Central	Plant	Dependent
3	Sorghum	Central	Plant	Dependent
4	Maize bran	Central	Plant	Dependent
5	Chickpea	Central	Plant	Dependent
6	Chickpea	Eastern	Plant	Dependent
7	Soy bean	Provincia	Plant	Dependent
8	Sunflower	Provincia	Plant	Dependent
9	Corn meal	Provincia	Plant	Dependent
10	Wheat bran	Provincia	Plant	Dependent
11	Peanut bran	Provincia	Plant	Dependent
12	Wheat bran	Provincia	Plant	Dependent
13	Sunflower	Provincia	Plant	Dependent
14	Wheat bran	Provincia	Plant	Dependent
15	Sunflower	Provincia	Plant	Dependent
16	Sunflower cake	Provincia	Plant	Dependent
17	Sunflower cake	Provincia	Plant	Dependent
18	Sunflower cake	Provincia	Plant	Dependent
19	Sunflower cake	Provincia	Plant	Dependent
20	Sunflower cake	Provincia	Plant	Dependent
21	Sunflower cake	Provincia	Plant	Dependent
22	Sunflower cake	Provincia	Plant	Dependent
23	Sunflower cake	Provincia	Plant	Dependent
24	Sunflower cake	Provincia	Plant	Dependent
25	Sunflower cake	Provincia	Plant	Dependent
26	Sunflower cake	Provincia	Plant	Dependent
27	Sunflower cake	Provincia	Plant	Dependent
28	Sunflower cake	Provincia	Plant	Dependent
29	Sunflower cake	Provincia	Plant	Dependent
30	Sunflower cake	Provincia	Plant	Dependent

1. Scoping study of fish ingredients and feed

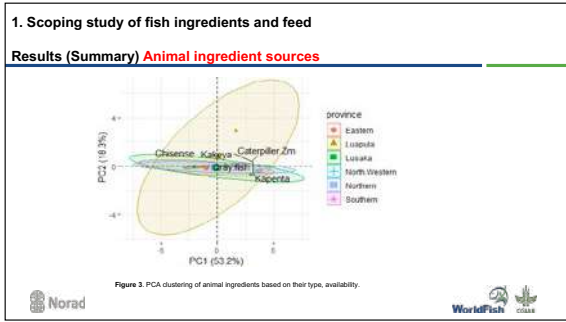
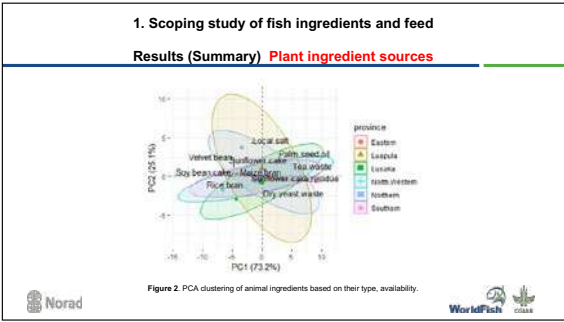
Results (Summary) Ingredient Identified across

3 main categories of ingredient sources were found, namely:

Plant (70.4% of found ingredients),

Animal (22.2%) and

Other ingredient sources (7.4%).



CONCLUSION

Study overall revealed a diversity of local ingredients available in Zambia with huge potential for use as aqua feed.

Plant ingredient sources produced by the agriculture farmers was high 56% compared to the processor (23%) who produce by-products such as maize bran, rice bran, sunflower cake, soy bean cake and brewery waste.

About 85.2% of the agriculture farmers did not process their ingredients to produce the ingredients for feed production & was similar across the sampled provinces.

CONCLUSION

Similarly, the animal ingredient sources production by fishers, processors, forest gatherers used for human consumption is higher standing at only 78.6% on average than other uses like fish feeds.

In Lusaka & Southern Provinces, use & demand of commercial fish feeds was high compared to North-Western, Northern, Luapula & Eastern Provinces due to accessibility & proximity to fish feed factories.

Use of ingredients for human consumption was 87.8% & higher than livestock user at 12.2%

RECOMMENDATION

- Proximate analysis & digestibility studies are required on the selected ingredient to understand their nutritional composition & potential use as local fish feed ingredients.
- Need to encourage the private sector participation in deliberate production, supply & distribution of key local ingredient to support aquaculture feed industry

SAMPLE OF INGREDIENTS COLLECTED FOR LABORATORY ANALYSIS

Province	Ingredient	Date	Availability	Sample ID	Sample Size (g)	Sample No.	Sample No.
ZAMBIA	MAIZE BRAN	March 18, 2023	ANIMAL	KALAMBO	1000	DEV	1
ZAMBIA	MAIZE BRAN	March 21, 2023	ANIMAL	CHITWAN	1000	DEV	2
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	KALAMBO	1000	DEV	3
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	4
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	5
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	6
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	7
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	8
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	9
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	10
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	11
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	12
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	13
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	14
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	15
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	16
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	17
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	18
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	19
ZAMBIA	MAIZE BRAN	March 28, 2023	ANIMAL	CATSKELLET	1000	DEV	20

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)


Gregory M. Kasanga, Dr. Arthelene Jere, Majori Chama, Khuzali Abu Bakar and Dr. Rodrigue Yossa
UPGRADE OF NRDC WET LABORATORY

UPGRADE OF NRDC FISH WET LABORATORY




- Introduction
- Recirculation Aquaculture System Set-up
- Complete set-up of Recirculation Aquaculture System Set-up
- Operation of Recirculation Aquaculture System

INTRODUCTION

FLOW-THROUGHT SYSTEM (2019)



Design by Dr. Rodrigue Yossa
Fabrication and operationalized by: Dr. Rodrigue Yossa and NRDC staff








INTRODUCTION

Wet- Laboratory Status at Beginning of Upgrade - 2023



CHALLENGES
Theft
 After experiments, and Covid19 interruptions, vital components were stolen as a result staff and students halted using the flow through system.
Finance
 Challenges to bring Laboratory to life. Hence, it was not in operation.
OPPORTUNITY
 FASA project - upgrade of the Wet Laboratory from a Flow Through System to Recirculation Aquaculture System.

Recirculation Aquaculture System Set-up

Recirculation Aquaculture System required installation of the following components

1. Mechanical Filter
2. Biological Filter
3. Sand Filter
4. Sump
5. Aeration
6. Aquarium tanks
7. Reservoir tanks
8. Water pumps
9. UV light
10. Heaters



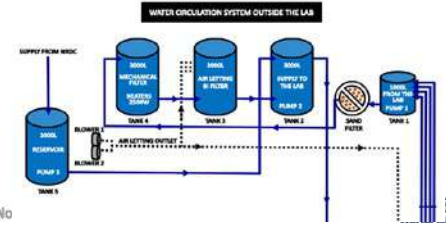
Mr. Isaac, Mr. Gregory, Mrs. Majory, Mr. Chanda, Mr. Simon, Mr. Mumbi, Mr. Khairul and Mr. Anthony (from left to right)








Recirculation Aquaculture System Set-up

Components used to set up system were divided two parts outdoor and indoor



Recirculation Aquaculture System Set-up

Outdoor components



Pipe work and installation of sand filter and tanks for mechanical and biological filtration








Recirculation Aquaculture System Set-up

Fencing of tank area to secure outdoor unit components




BEFORE AFTER

Recirculation Aquaculture System Set-up

Outdoor components



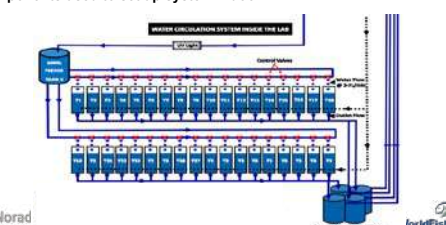
Securing area and installation of air blowers to supply oxygen to fish tanks and biological filter








Recirculation Aquaculture System Set-up

Components used to set up system indoor



Recirculation Aquaculture System Set-up

Indoor Components



Electrical switch board installation (control of water heaters, air blowers, water pumps)






Recirculation Aquaculture System Set-up

Indoor Components



Pipe works to ensure indoor water supply to aquarium tanks


Recirculation Aquaculture System Set-up

Indoor Components



Testing of water flow system and works on linkages

Norad WorldFish CGIAR

Recirculation Aquaculture System Set-up

Indoor Components



Replacement of broken Aquarium tanks, and installation and connection of water outlet system

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COMPLETE SET-UP OF RECIRCULATION AQUACULTURE SYSTEM



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OPERATIONAL RECIRCULATION AQUACULTURE SYSTEM



Norad WorldFish CGIAR

OPERATIONAL RECIRCULATION AQUACULTURE SYSTEM



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3. IMPLEMENTATION: 1st Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

Arthertone Jere (Principal Investigator)

Co-Authors
Gregory Kasanga, Alexander M. Greiling, Majory Chama & Rodrigue Yossa.

Norad WorldFish CGIAR

3. IMPLEMENTATION: Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

Introduction

- ✓ Among the essential amino acids, **lysine is necessary for many bodily functions** such as growth.
- ✓ Despite its importance, lysine is among **most limiting amino acids in plant based ingredient** (Gatlin III et al., 2007)




Image source: FoodNavigator, Google Images

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3. IMPLEMENTATION: Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

Introduction

- ✓ Lysine requirement levels were estimated at **1.4% of the diet & 5.4% of crude protein** for Nile tilapia (Santiago & Lovell, 1988).
- ✓ This lysine level requirement is **still recommended** today for other strains of tilapia species (Wing-Keong Ng & Romano, 2013).
- ✓ However, **no studies conducted** to estimate the lysine requirement for *O. andersonii*.

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3. IMPLEMENTATION: Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

The overall objective:

- ✓ To estimate the lysine requirement of SUZ and GIP strains of *O. andersonii* species.

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3. IMPLEMENTATION: Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

Hypothesis:

- ✓ Lysine requirement level of SUZ strain is the same as GIP strain of *O. andersonii*.

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3. IMPLEMENTATION: Nutrient Requirement Experiment

Comparative estimation of the lysine requirements for the strains of *Oreochromis andersonii* at Juvenile stage.

MATERIALS AND METHODS

1. Experimental design:

- ✓ Completely randomized 2⁶ factorial design
- ✓ Experiment period was 10 weeks from August 2023
- ✓ 36 tanks (75liters/tank)
- ✓ 20 fish per tank = 720 fish stock at average 10grams (360 fish/strain).
- ✓ Lysine level in feed (1.13%, 1.30%, 1.48%, 1.64%, 1.89% and 2.14%).



3. IMPLEMENTATION: Nutrient Requirement Experiment

MATERIALS AND METHODS

2. Experimental feed:

Table 1: Composition of the experimental diets (in feed)

INGREDIENT	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
Flour fish	95.1	95.1	95.1	95.1	95.1	95.1
Soybean meal (48 ISO)						
Crude fish oil	28.6	28.6	28.6	28.6	28.6	28.6
Crude fish meal	18.9	18.9	18.9	18.9	18.9	18.9
Crude fish oil	10	10	10	10	10	10
Mineral trace	10.9	10.9	10.9	10.9	10.9	10.9
Canola oil	1.5	1.5	1.5	1.5	1.5	1.5
Fish oil	1.25	1.25	1.25	1.25	1.25	1.25
Vitamin Phosphorus	2	2	2	2	2	2
Trace mineral vitamin	1	1	1	1	1	1
Vitamin C	0.15	0.15	0.15	0.15	0.15	0.15
Vitamin E	0.2	0.2	0.2	0.2	0.2	0.2
DL Methionine	0.2	0.2	0.2	0.2	0.2	0.2
L-lysine acid	1.2	1	0.8	0.6	0.4	0
L-cystine	0	0.2	0.4	0.6	0.8	1.2
TOTAL	100	100	100	100	100	100



3. IMPLEMENTATION: Nutrient Requirement Experiment

✓ Experimental feed making:



3. IMPLEMENTATION: Nutrient Requirement Experiment

MATERIALS AND METHODS

3. Data collection & Sampling:

- ✓ Initial stocking,
- ✓ week 3 sampling,
- ✓ week 6 sampling,
- ✓ week 9 sampling,
- ✓ Final Sampling



- ✓ Weight of fish (Body +Bulk)
- ✓ Length of fish
- ✓ Liver weight
- ✓ Visceral weight
- ✓ Collection of fish samples



3. IMPLEMENTATION: Nutrient Requirement Experiment

4. Data collection:

✓ Proximate composition Determination:

- Samples have been collect for analysis; Dried fish samples (654 specimen)
- Dry matter, Ash content, Crude fat, Crude Protein, Crude Fibre, Gross Energy, Amino Acid profile



3. IMPLEMENTATION: Nutrient Requirement Experiment

4. Data collection:

✓ Growth performance and feed utilization computation:

- Average final weight = $\frac{\text{sum of individual weights in the sample}}{\text{total number of observation}}$
- Weight gain (WG, g) = final weight (g) - initial weight (g)
- Specific growth rate = $\frac{\text{final mean weight} - \text{initial mean weight}}{\text{initial mean weight}} \times 100$
- Survival rate (%) = $\frac{\text{initial number of fish} - \text{number of dead fish}}{\text{initial number of fish}} \times 100$
- Feed intake (% BW/day) = $\frac{\text{Feed consumption (g)} \times 100}{\text{average biomass (g)} \times \text{days}}$
- AFCR = $\frac{\text{Weight of food consumed}}{\text{Weight gain}}$
- HSI = $\frac{\text{Weight of the liver}}{\text{Body weight of fish}} \times 100$
- VSI (%) = $\frac{\text{Cut Weight}}{\text{Fish Weight}} \times 100$



3. IMPLEMENTATION: Nutrient Requirement Experiment

5. Data analysis

➢ ANOVA was used to determine the significant difference (p<0.05) between the treatments and strains of tilapia. Tukey test was applied to separate treatment means. Polynomial contrast were further used to determine linear, quadratic & cubic effects

➢ Data analyses were carried out using R software version 4.3.2

The following statistical model was used:

$$Y_{ij} = \mu + \tau_i + \epsilon_{ij}$$

Where: Y_{ij} = jth observation or response on ith level of treatment.

μ = Overall mean.

τ_i = Effect of the ith level of factor.

ε_{ij} = Random and independent errors.



3. IMPLEMENTATION: Nutrient Requirement Experiment

RESULTS

TABLE 4. EFFECT OF DIETARY LYSINE LEVELS ON THE GROWTH PERFORMANCE AND FEED UTILISATION ON STRAINS OF O. ANDERSONII (MEAN±SE).

Growth parameters (6 values)	Treatments						Control	
	Diet 1 (1.13%)	Diet 2 (1.30%)	Diet 3 (1.48%)	Diet 4 (1.64%)	Diet 5 (1.89%)	Diet 6 (2.14%)	Linear	Quadratic
Initial Weight (g)	15.19±0.24	15.06±0.34	15.03±0.12	15.01±0.55	14.87±0.34	14.95±0.23	ns	ns
Final Weight (g)	51.47±1.97*	49.63±1.68*	50.35±1.99*	48.62±1.95*	6.47±0.32*	51.86±0.43*	ns	*
Weight Gain (g)	36.28±2.20	34.57±1.87	32.34±1.54	33.60±2.47	37.99±0.97*	37.90±0.29	ns	ns
SGR (%) (day)	3.16±0.05	3.13±0.05	3.21±0.09	3.11±0.06	3.19±0.12	3.22±0.01	ns	ns
Survival rate (%)	76.56±8.22	71.33±7.26	68.33±1.74	72.33±1.67	74.73±6.73	73.67±7.64	ns	ns
Hepatosomatic index (%)	0.42±0.02**	0.37±0.03*	0.26±0.04*	0.45±0.03*	0.42±0.12*	0.43±0.03*	*	*
Feed intake (g)	2.62±0.157	2.58±0.14	2.16±0.55	2.12±0.22	2.46±0.14	2.34±0.113	ns	ns
AFCR (%)	3.62±0.156	3.23±0.25	3.19±0.32	3.38±0.476	3.41±0.23	3.18±0.21	ns	ns
HSI (%)	2.93±0.30	2.89±0.28	2.71±0.02	2.67±0.09	2.62±0.22	2.62±0.22	ns	ns

NB: Values are means ± standard error, within the row, treatments with the same letter are not significantly different. ns=non-significant, ** significant; AFCR= Feed conversion ratio; SGR = Specific growth rate.



3. IMPLEMENTATION: Nutrient Requirement Experiment

CONCLUSION

- Different replacement levels of Lysine at 1.13%, 1.30%, 1.48%, 1.64% and 2.14% on the strains of *O. andersonii* diet does not have any effect on the growth parameters, except for 1.89%.
- Replacement of Lysine level in diet at 1.13% and 1.64 up to 2.14% did not affect the Hepatosomatic index, except for 1.30% on strains of *O. andersonii*.



3. IMPLEMENTATION: Nutrient Requirement Experiment

RECOMMENDATION

- ✓ Similar study should be carried out with similar Lysine replacement level on native fish species such as *O. machochir*, *O. tanganyicae* & *C. rendalli*.



PARTNERS



PARTNERSHIPS















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Update on the implementation of year 1 of the FASA project in Malaysia
WorldFish Malaysia (Rodrigue Yossa, Aaqillah Amr and Nurulhuda A. Fatan)

FASA Project work in Malaysia
By Rodrigue Yossa, Nurulhuda A. Fatan, Aaqillah Amr Mohd Amran, Muhammad Rahimi Ramli & Ning Shahira &
PMU, MEL, Communication, Procurement, Accounting, Finance & Consultant Teams

Norad WorldFish CGIAR

Content

1. Scope of Project Work in Malaysia
2. Aquaculture Research in Malaysia
3. Aquaculture Extension from Malaysia
4. Other project works in Malaysia

Norad WorldFish CGIAR

Scope of Project Work in Malaysia

<p>Non- Aquaculture work:</p> <ul style="list-style-type: none"> Project Management MEL & Data Management Communication Procurement Finance Accounting 	<p>Aquaculture work+:</p> <ul style="list-style-type: none"> Aquaculture Research Aquaculture Extension Impact Assessment Consultants
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Norad WorldFish CGIAR

FASA project MEL plan

Norad WorldFish CGIAR

FASA project communication: Comm Plan

Norad WorldFish CGIAR

FASA project communication: website

Project webpage

[Development And Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa \(FASA\) | WorldFish \(worldfishcenter.org\)](#)

Norad WorldFish CGIAR

FASA project staffing plan

Norad icipe CORAF SLU IITA TAMARA WorldFish CGIAR

Aquaculture Research in Malaysia

Work Plan

Output 2.1: New data and knowledge on local ingredients generated, used in the formulation of novel fish feeds, and made widely available			
Activity 2.1.1: Conduct experiments to prioritise 15 ingredients			
			Quarters (3 months each)
Subactivity 2.1.1.2: Conduct digestibility experiments of ingredients samples collected for output 1.1	Postdoc Fellow	Nurulhuda Fatan; research assistant; laboratory technician (all in Penang)	
Subactivity 2.1.1.3: Database development and research report preparation and publication	Postdoc Fellow	Nurulhuda Fatan; Saadiah Ghazali; research assistant; laboratory technician (all in Penang)	

Norad WorldFish CGIAR

Aquaculture Extension from Malaysia

Activity 2.1.2: Stakeholder consultations (1 online workshop per country) to discuss results of activity 2.1.1 and potential benefits, risks, challenges, and hazards to the use of local ingredients

Subactivity 2.1.3.1: Synthesize all findings on ingredients generated so far to enable prioritization

Subactivity 2.1.3.2: Discuss all results with internal and external partners (including 1 online workshop per project country) and select 15 ingredients

Activity 2.3.1: Develop printed booklets/manuals for ingredients and fish feeds and make available to the public

Output 3.3: Strategic capacity development and public awareness campaigns delivered in order to widely disseminate knowledge, innovations, and tools developed by the project

Norad WorldFish CGIAR

Research Protocol and Animal Ethics: Digestibility 1

Objectives

- To study the **nutritional composition, apparent digestibility coefficients, and anti-nutritional factors** of various sustainable local ingredients obtained from Sub-Saharan African
- To examine the **growth performance and the biochemical composition** of GIFT, *Oreochromis niloticus* fed with sustainable local feed ingredients
- To assess fish **health status** through the analysis of histopathology and cortisol levels when fed with sustainable local feed ingredients

Norad WorldFish CGIAR

Experimental Design

Norad WorldFish CGIAR

Ingredients received from Zambia

Received on 5 September 2023

Norad WorldFish CGIAR

Ingredients received from Zambia

- Caterpillar (Vinkubala)
- Caterpillar (Tukanja)
- Slavonga kapenta
- Kakeya
- Chisense
- Crayfish
- Velvet bean meal
- Velvet bean seed
- Tea waste
- Sunflower cake meal
- Chikanda

Norad WorldFish CGIAR

Ingredients received from Zambia

- Caterpillar (Vinkubala)
- Caterpillar (Tukanja)
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- Tea waste
- Sunflower cake meal
- Chikanda

Animal-based → Digestibility 1

Plant-based

Proximate analysis

Norad WorldFish CGIAR

Feed Production

Norad WorldFish CGIAR

Feed Production

Norad WorldFish CGIAR

Digestibility 1

Activity	2023												2024	
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	
Protocol and formulations														
Preparation and approval of animal ethics														
Ingredients arrive from Zambia														
Feed manufacture														
Animal sourcing and acclimating														
Start of experiment														
Final sampling														
Sample Preparation														
Biochemical Analysis														
Data analysis														
Reporting														

Norad WorldFish CGIAR

Effects of Insect Meals on Fish Digestibility, Health, and Economic Performance: A Meta-Analysis

Asqillah-Amr, M.A., Hidir, A., Ikhwanaudin, M., Fatan, N.A., Muhammad-Rahmi, R., Ning-Shahira, S., Sriakhe, R.G.N., Vandenberg, G.W., Tonga, C.M., Yosso, R.

Norad WorldFish CGIAR

Meta-analysis

Various meta-analyses on several parameters in various fish species in response to substitution of FM by IM


- Fish nutritional profiles^{1,2}
- Growth performance^{3,4}
- Feed efficiency⁵
- Consumer acceptance⁶

However, the study did not include the fish welfare and economic performance

Norad WorldFish CGIAR

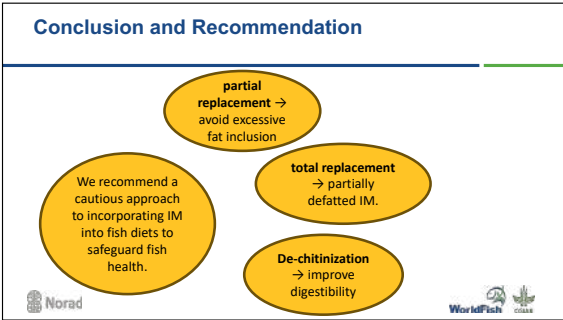

Objectives

- Recent progress in developing fish feeds from various insect proteins and the impact on
 - Apparent digestibility coefficient (ADC)
 - Fish health (blood parameters)
 - Economic analysis
- Such data are essential, especially to the public and policymakers, to fully understand the benefits gained from IM when used as FM replacement




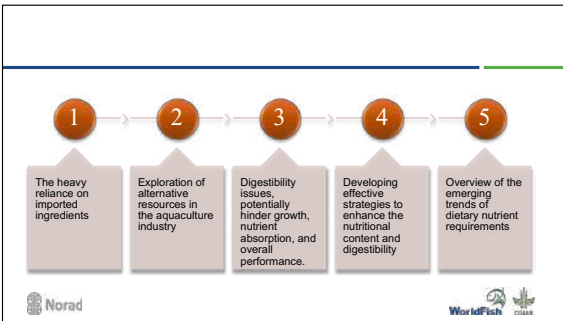
Parameter	Mixed model (fixed or random effect) based on heterogeneity				Effect summary	C95%
	d ²	s ²	Q	p		
Apparent digestibility coefficients						
(i) Dry matter	19	3.88	62.41	0.00	69.05	-0.92 -1.97 to 0.14
(ii) Crude protein	27	5.25	77.46	0.00	65.14	0.12 -0.82 to 1.07
(iii) Crude lipid	21	2.72	37.85	0.03	44.51	-0.51 -1.33 to 0.31
Fish health (blood parameters)						
(i) Non-specific immune						
Lipolytic activity	15	12.05	129.25	0.00	88.14	2.38 0.40 to 4.87
(ii) Blood metabolite						
Glucose	21	1.99	4.80	1.00	-337.60	0.31 -0.38 to 1.00
Total protein	15	4.844	8.92	0.86	719.51	-1.36 -2.52 to -0.20
Triglycerides	17	5.16	76.91	0.00	77.81	0.84 -0.34 to 2.02
Cholesterol	23	4.04	92.68	0.00	75.18	-0.46 -1.38 to 0.45
(iii) Hematological						
Hemoglobin	7	10.34	0.61	1.00	-762.11	0.31 -1.99 to 2.60
Monocytes	7	0.48	13.17	0.07	46.84	0.02 -0.72 to 0.69
Economic analysis						
(i) Fish feed cost	9	0.00	6.91	0.64	-29.86	0.07* -0.91 to 0.15
(ii) Economic profit index	5	0.00	4.39	0.90	-14.02	0.60 -0.47 to 0.49

*The negative effect summary for feed cost indicates a positive outcome associated with lower costs


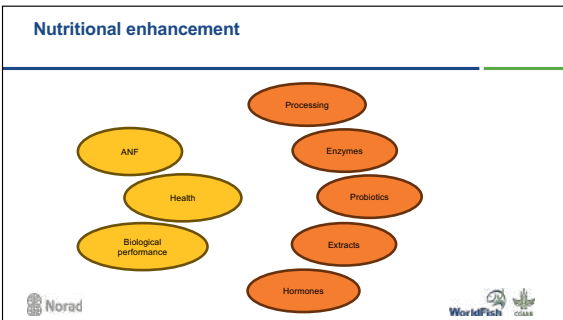
Unveiling the effect of nutrition on freshwater-farmed fish during different life cycles: A systematic review

Aaqilah-Amr MA, Hidir A, Faleh NA, Ikhwanuddin M, Ley TM, Rosalia S, Mat Noordin Noordinyana, Kharul-Adha AR, Sanihke RGN, Yossa R

Objectives


To compile the present research focus, nutritional strategies, and management practices to address critical industry challenges.

Conclusion and Recommendation

By prioritizing alternative energy sources and improving their nutritional value, the industry can move towards a more efficient, eco-friendly, and nutritionally balanced approach to freshwater aquaculture.


Exploring broodstock nutrition is crucial for maintaining optimal breeding conditions and ensuring the production of healthy offspring.




Establishment of Fish Feed and Nutrition Lab




Lab inauguration




On May 25, 2023, WorldFish board member Dr. Baba Yusuf Abubakar has officially inaugurated the lab.




Fish Feed and Nutrition lab

Person in charge:
Ms Ning Shahirah Mohd Sharbini with the supervision of Dr Rodrigue Yossa
Interns





The lab will serve WorldFish scientists and partners in Penang and across Asia, Africa, and the Pacific to conduct experiments on proximate analysis and more!




Analysis that can be conducted:

- Main analysis
 - Dry matter
 - Ash
 - Acid insoluble ash
 - Crude protein
 - Crude fat
 - Crude fiber
 - Gross energy
- Upcoming analysis
 - Calcium
 - Phosphorus
 - etc

Result of the raw ingredients from Zambia

Proximate Analysis (dm)	Vinkubala	Tukanja	Siavonga kapenta	Kakeya	Chisense	Crayfish
Dry Matter (%)	86.5	89.6	89.8	86.5	88.3	88.7
Ash (%)	8.7	11.9	34.4	13.7	21.8	25.5
Crude Protein (%)	62.5	54.4	48.3	55.3	58.1	45.8
Crude Fibre (%)	10.5	10.8	0.14	1.28	0.05	11.0
Crude Lipid (%)	7.83	13.8	7.90	23.4	8.9	4.62
Gross Calorific Value (J/g)	19,700	22,800	13,400	21,900	18,400	14,700




Solid-state fermentation: a tool for improving the nutritional value of novel feed ingredient





Objective of the study

- The overall objective of this study will be to investigate the effect of solid-state fermentation (SSF) on the changes in the nutrients profile particularly protein and fiber and reduction of anti-nutritional factors in agriculture waste
- Optimization of solid-state fermentation parameters for the production of functional product by the microorganism on selected agriculture waste

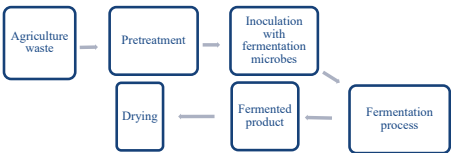


Significant of the research


- Urgent need to identify and develop new sources of aquaculture feed, particularly those rich in nutritious and palatable protein.
- Therefore, repurposing or transforming agriculture waste into functional forms to be used in animal feed as a sustainable alternative



Methodologies




- Nutritional value evaluation of fermented product
- Application effect of fermented product on Tilapia
- Optimization of solid-state fermentation parameters for the production of functional products by the microorganisms





SSF activities conducted at WorldFish Penang

- Collaboration with expert from the Bioprocess Technology, school of Technology Industry, USM Penang
- Literature review
- Develop a research protocol on SSF in an application using bacteria, yeast, and fungi
- Conducted a preliminary SSF experiment on tea waste using Lactic acid bacteria




SSF activities conducted at WorldFish Penang- Cont'd

- A preliminary SSF experiment on tea waste using Lactic acid bacteria
- 10g of tea waste
- Microorganisms
 - Lactobacillus acidophilus*
 - Pediococcus acidilactis*
- Morphology
- Inoculum preparation
 - MRS broth (37 °C, 24hrs)
- SSF
 - 10% w/w microbes
 - Substrate: water – 1:2
 - Incubate at 37 °C, 3 days
- Sample drying – proximate analysis

Expected Outputs

There will be changes and improvement in the nutrient composition of fermented tea waste and reduced anti-nutritional factors.





Climate Change and Environmental Assessment:

An update on the implementation of year 1 of the FASA project

By Dr. Mzime Ndebele-Murisa
on behalf of

Presentation outline

1. Introduction
2. Year 1 activities
3. Implementation challenges and successes
4. Outputs
5. Recommendations for Year 2
6. Year 2 activities

Introduction

Identify opportunities for the project to benefit the environment within the novel feeds landscape in the 3 project countries using life cycle assessment (LCA) methods

1. Highlight situational analysis of the climate and the environment
2. Analyze LCA feasibility; focus:
 - weaknesses in the currently available data
 - contribute towards improved and broadened understanding of aquaculture fish feed carbon footprint along value chains-where and how GHGs emissions arise
 - identify potential opportunities including mitigation pathways within the novel fish feed landscape

Year 1 activities

Implementation challenges and successes

Successes

- Representative sample achieved despite challenges met in data collection
- Good sense of industry and VC processes; farmers and millers willing to engage and potentially work with project
- Research reports and articles successfully compiled and reviewed

Challenges

- Quantitative data inaccessible as solicitation was considered to be intrusive
- Mobilisation quite challenging for some sites
- Delayed kick off of activities and consequent delays in meeting some of the deadlines
- Daily targets during field work difficult to meet due to sparsely located farmers in one of the sites/identification of these farmers cumbersome due to unavailability of updated list of registered farmers/inaccessibility of some communities

Outputs

Climate and environmental assessment report

LCA report

Outcomes report including

3 journal articles

Recommendations for Year 2

- Update of climate and environmental analysis
- Comprehensive LCA based on modeling
- Capacity building

Year 2 activities

- Annual workshop in Nigeria
- Year 1 annual report
- Update on climate change and environment analysis
- Comprehensive LCA and implementation
- Year 2 mid year reporting
- 1 Journal article

Update on the implementation of year 1 of the FASA project in Gender and Social Inclusion Study Section
 Gender and Social Inclusion (Includovate/Sujata Ganguly)



Year 1 progress

- Gender and social assessments (Gender Equality and Social Inclusion (GESI)) analysis for each country - Report
- Gender and Inclusive Development Action Plan (GIDAP) and Outcome report
- One Journal article

Introduction – GESI report

Research objectives
 The primary purpose is to lead the gender and social inclusion work in the FASA project. The specific objectives are to:

1. Conduct gender and social assessments for the development and scaling of sustainable feeds;
2. Identify opportunities for the project to advance gender and social inclusion goals of Norad, WorldFish, and other key stakeholders within the novel feed landscape.

Research questions

1. What are the gendered and socially differentiated *needs* associated with the use of novel ingredients?
2. What are the gendered and socially differentiated *risks* associated with the use of novel ingredients?
3. What are the gendered and socially differentiated *opportunities* associated with the use of novel ingredients?

Methodology used

- To conduct this Gender and Social Inclusion (GESI) assessment, the project utilised the ADS 205 domains, focusing on identifying key gender and social inclusion-related issues and constraints.
- The assessment involved a meticulous desk-based policy review of the legal frameworks governing the fisheries sector in Kenya, Nigeria, and Zambia, analysing existing laws, policies, and regulations related to fisheries resource management, including aquaculture, from a gender perspective.
- This review was followed by primary data collection, employing a mixed research approach involving 28 key informant interviews and 420 survey responses across the three countries.

ADS 205 framework

INTERSECTIONALITY

<p>Laws, Policies, Institutional Practices</p> <p>The extent to which laws, policies, regulations, and institutional practices contain explicit gender biases.</p>	<p>Cultural Norms, Beliefs</p> <p>Locally accepted rules that influence how females and males behave in different domains.</p>	<p>Gender Roles, Responsibilities, & Time Use</p> <p>The division of labour between productive (market) economic activity and reproductive (non-market) activity that characterises gender-based roles and activity.</p>	<p>Access to, and Control Over Resources</p> <p>How genders behave in different domains related to productive assets and resources and information access.</p>	<p>Power & Decision-Making</p> <p>The ability of men and women to decide, influence, & exercise control over material, human, intellectual and financial resource.</p>
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Gendered policy review of fisheries laws

Nigeria: The policies governing Nigeria's fisheries sector predominantly focus on technical aspects, overlooking broader social dynamics and gender differences within fishing communities. While some regulations benefit small-scale communities, *there's a lack of consideration for distinct experiences, needs, and contributions of men and women.* Nigeria's policies reinforce informal customary rules rooted in traditional norms, limiting women's access rights and decision-making power.

Despite this, there are opportunities for the FASA project to integrate gender-sensitive approaches, aligning with the National Gender Policy and the SDGs. On average, Nigeria's policies are gender unequal.

Gendered policy review of fisheries laws

Zambia: Zambia's Fisheries Act (2011) and regulations exhibit gender inequality, but the National Water Policy stands out as gender-responsive, considering specific challenges faced by women in water management. The Water Management Act promotes gender balance in representation and management, encouraging women's meaningful participation. *Despite the gender-aware policies, access and tenure rights for women remain inadequately protected.*

The FASA project can address this imbalance by ensuring gender balance in aquaculture-related bodies and sharing gender studies with policymakers.

Gendered policy review of fisheries laws

Kenya: Kenya's policies vary in their gender responsiveness. While the Fisheries Management and Development Act (2016) showcases gender responsiveness with provisions for women's representation and gender parity, other regulations demonstrate varying degrees of gender awareness. *Policy incongruence is significant in Kenya, creating challenges for effective gender integration.*

The FASA project can enhance institutional capacity by including women, youth, and marginalised groups in fish feed production, advocating for compliance, and adopting a gender-transformative approach aligned with the National Gender Policy.

Fishfeed ingredients and usage

In Nigeria, the study revealed that respondents, regardless of gender, utilise *maize powder, genetically modified plants (GMP), and rice bran* for fish farming, although women's usage is slightly lower than men's.

- Maize powder is predominantly chosen due to its availability, a factor highlighted primarily by women. Men also mentioned its affordability and nutritional value as reasons for use.
- Genetically modified plants are favoured for their availability and nutritional benefits, with both men and women recognising these qualities.
- Rice bran is utilised mainly due to its availability, a factor mentioned by both men and women respondents.

These essential ingredients are typically acquired through purchases, primarily made by women, from local stores or suppliers in larger towns. Additionally, some individuals, mainly women, process maize powder at home.

Fishfeed ingredients and usage

In Zambia, the study uncovered that respondents utilise *chicken manure and feathers, along with genetically modified plants*, for their aquaculture practices. Notably, women tend to use chicken manure and feathers more than men.

- Chicken manure and feathers are sourced and utilised, especially by women, due to their availability. Chicken manure is typically processed at home, reflecting a common practice among respondents, particularly women.
- GMP is utilised, with higher usage reported by women. Respondents, especially women, emphasised the affordability and availability of GMP which are key factors influencing their choice. GMP is primarily purchased from local markets, making it accessible to aquaculturists, particularly women engaged in fish farming.

Fishfeed ingredients and usage

In Kenya, the study revealed that respondents employ *plant leaves and rice bran* in their aquaculture practices, reflecting the diverse and resourceful approaches of aquaculturists in the region. Plant leaves are a common choice, with a higher percentage of men using them.

- These leaves are predominantly utilised due to their availability, making them accessible resources for aquaculturists. Respondents, particularly men, emphasised that plant leaves are processed at home, showcasing a sustainable and localised approach to aquaculture inputs.
- Rice bran is another significant input, with a higher percentage of women using it. The choice of rice bran is primarily based on its nutritious value, indicating a focus on the health and well-being of the aquatic organisms.

Unlike plant leaves, rice bran is purchased from the market, indicating a market-driven approach to acquiring this input.

Gendered and socially differentiated needs and risks

The need to improve the quality of fish feeds are reported both by men and women, however, more men than women strongly agree.

A high percentage of the respondents (with negligible difference by gender) are unsure or disagree that they have the resources and assets they need to improve the quality of fish feeds.

Across genders, respondents are willing to trial new fish feed ingredients. Though men have stronger agreement than women.

Half of the respondents (more men than women) agree they have the skills they need to improve the quality of their fish feeds, while the other half (more women than men) are either unsure or disagree that they have the required skills.

More women than men are unsure whether the fish feed ingredients they want are available. Also, more men than women disagree that fish feed ingredients are not available to them.

The main factors causing women to miss out on experimenting with new feed ingredients compared to men include: a lack of funds, lack of access to inputs, lack of knowledge, and a lack of access to services.

Gendered and socially differentiated needs and risks

More women than men agree that trialing new fish feeds means losing money. However, in disagreement to the same, more women than men disagree.

Man are more aware than women on how to access information about new fish feed ingredients while women are unsure regarding the same.

Cost of information, not having the right technology, location of information, and not enough land are the factors (reported by both genders) preventing access to the information needed for novel fish feed ingredients.

The respondents (of both genders) reported that they need additional information on all ingredients.

Lack of funds, lack of access to inputs, lack of knowledge are the main factors causing youth to miss out on experimenting with new feed ingredients compared to adults.

For women, finance, technology, new skills, mechanisation, income, knowledge, infrastructure are the factors preventing them from improving the quality of their preferred ingredients.

ADS 205 framework

Laws, policies, regulations, and institutional practices

The study highlights a significant gap in the participants' knowledge regarding the formal laws and regulations governing fisheries in all three nations. The household survey identifies grassroots organisations working to address barriers faced by women and youth, bringing attention to the lack of awareness surrounding these organisations.

While Kenya exhibits a higher level of awareness and a greater number of organisations in comparison to Nigeria and Zambia, the overall pattern emphasises the need for improved efforts to inform communities about the existence and initiatives of these organisations.

ADS 205 framework

- Pond construction (digging)**: Is men's work across countries, involving adult men in Nigeria and Kenya and also some young men in Zambia.
- Collecting water from the pond**: Adult women and men do this task a lot in Nigeria with 20% of young men involved. It is not often done in Zambia, but if it is, adult men are responsible. A third of men do this in Kenya with some adult women and young men involved.
- Pond cleaning**: Half as many women as men clean ponds in Nigeria, Zambia and Kenya with some young men involved.
- Feeding**: Men and women are responsible for feeding fish across countries. Young men compared to adults doing the task with negligible difference across age among women in Zambia and Kenya. In Nigeria, where adult women are responsible for doing the same.
- Day to day management**: Men and women are equally responsible for day to day management of the household in Nigeria, while it is majority men's work in Zambia and Kenya.
- Unpaid domestic duties: adult women do the bulk of the unpaid work across all countries, with some girls/children helping and some boy children in Nigeria.**
- Paid work: men do more of the paid work across all countries, than women. All spouses tend to under report the amount of paid work done by their spouse.**

ADS 205 framework

- Fishing/harvesting**: Is mainly done by male household members, although women are involved to a lesser extent. Neither spouse is accurately aware of how much fish harvesting their spouse does. However, Nigeria has the largest number of women (62%) out of all the countries reporting their involvement in harvesting.
- Selling the fish product**: This is mainly done by women across countries, with no stark difference by age. In Nigeria and Zambia, a large percentage of men also sell fish. Neither spouse is accurately aware of how much fish selling their spouse does.
- Processing**: In Nigeria and Zambia, half to most of the sample do not process fish. If they do, it tends to be a stark difference by age, except that in Kenya the task is mainly done by adult women.
- Selling surplus produce at markets**: In Nigeria there are a number of subsistence farmers in our sample but if there is a surplus then men and women equally sell it with no gender differentiation by age. In Zambia and Kenya more younger women than men sell the surplus.
- Food shopping at markets**: Women do the most of the food shopping in all countries. Men self report their involvement although women do not see this contribution in their answers.

ADS 205 framework

Timeuse

Respondents across the board express a high level of satisfaction, being either satisfied or very satisfied, with their available leisure time. Generally, individuals within these communities feel they have a sufficient amount of time for personal activities and relaxation.

Consequently, both male and female respondents of all age groups should have ample time to participate in training sessions and events for the NORAD-funded project. However, in Kenya, a significant majority of respondents from both genders indicate having only one hour of leisure time.

ADS 205 framework

Access to and control over resources and information

Cultural norms impact interactions with extension officers, often necessitating spousal approval for training attendance. Key channels include farmers' cooperatives, digital platforms like SMS and WhatsApp, local leaders, and television.

In Nigeria, women primarily rely on friends and group meetings, while Zambian women highly value information from local leaders. Across various countries, young individuals tend to use the internet more than adults. In Kenya, 50% of young women prefer local leaders as their information source, compared to 35% of adult women. Conversely, 36% of young men and 62% of adult men rely on local leaders. Similar age-related differences were not significant in other countries.

ADS 205 framework

Norms and beliefs

In rural fishing communities of Nigeria, Zambia, and Kenya, deeply rooted cultural norms sustain gender disparities, especially regarding women's access to technology and opportunities within the fishing industry.

The study highlighted prevalent norms, such as women predominantly handling unpaid domestic work, limiting their involvement in paid and physically demanding tasks. While some communities expressed approval for shared tasks, significant portions believed their societies would disapprove.

Particularly in Kenya, young women exhibited strong disapproval, emphasising deeply ingrained societal norms. Despite theoretical acceptance of task sharing, these beliefs often didn't translate into household practices.

ADS 205 framework

Patterns of power and decision-making

The survey reveals a preference for shared decision-making in household and community matters, highlighting the importance of collaboration.

Gender disparities exist, particularly in Nigeria, but are less prominent in Zambia and Kenya. There's a notable desire among young individuals for increased involvement in decision-making, underlining the necessity for youth engagement initiatives.

In Nigeria and Kenya, women express a need for greater participation in decisions concerning earnings, emphasising the significance of women's economic empowerment. Public speaking comfort varies across countries, with evident gender differences, indicating a requirement for communication and confidence-building programmes. Zambia stands out for its higher overall comfort levels in public speaking. Additionally, the majority of respondents emphasise the importance of consulting spouses in decision-making processes.

Eight consolidated GESI recommendations shaping the GIDAP

- Propose amendments in policies, laws and regulations to explicitly address gender disparities, ensuring equal opportunities and rights for all participants in the fisheries sector
- Improve the quality of what women feed their fish by engaging with women's groups to raise awareness about the importance of feed ingredient diversity and by providing them with the necessary skills to improve their fish feeds
- Encourage equal access to resources for women and marginalised communities, including economic assets, vital services, financial support, education, information, technology, capacity-building, and market opportunities
- Increase visibility of women and other disadvantaged groups through participation and decision-making.



Eight consolidated GESI recommendations shaping the GIDAP

- Strengthen extension services to provide tailored support to women and youth in overcoming barriers to fish feed innovation
- Introduce timesaving technologies and mechanisation for producing fishfeeds and work with men to promote positive masculinity and unpaid domestic workload contribution
- Help male run businesses and financial inclusion businesses to reach more women and youth
- Implement a monitoring and evaluation system to assess the progress and effectiveness of the action plan.



Journal article

Journal article - Kenya

Title: Beyond Tradition: Bridging Gender Disparities in Fish Farming Communities of Kenya

Authors: Shams, Vitoria, Kibira, Rachael

Abstract: The Gender and Social Inclusion (GSI) assessment undertaken in the context of the AGS 2020, draws attention to the existence of gender disparities within the fisheries sector in Kenya. The assessment also, albeit a limited understanding, unveils a diverse array of existing legal frameworks and primary data collection through interviews and surveys across six counties in Kenya. The research highlights gender roles and responsibilities within fish farming households. While women were primarily engaged in unpaid domestic roles, men often oversaw fish services, feeding, and pond work. The study underscored the disparity between theoretical acceptance and practical implementation of shared responsibilities due to fear of social disapproval, particularly among men. Despite these challenges, a preference for collaborative, shared decision-making was evident, emphasizing the need for targeted programs enhancing communication skills and women's entrepreneurial acumen for success. The study also highlighted the pivotal role of extension agents and service providers in bridging gender gaps, necessitating targeted support for training extension agents. Key recommendations derived include: promote opportunities digital platforms like SMS and WhatsApp, rural radio, and television. Foster partnerships digital extension agents, community-based organizations, and local government. Encourage income-generating activities. Overall, the research underscores the need to bridge gender disparities through targeted programs, foster a more inclusive and gender-responsive regulatory framework, and enhance communication skills and entrepreneurial acumen among women, bridging the gap between theory and practice. The findings underscore the necessity of informed policy-making and tailored initiatives to address disparities, empower women economically, bridge youth and service communication gaps within these communities. In summary, the GSI assessment provided deep insights into the multifaceted challenges within the fisheries sector. By addressing these challenges through focused interventions, there is a substantial opportunity to transform gender dynamics, enhance economic prospects, and foster better community and individual well-being across these communities. These findings serve as a roadmap for targeted programming, driving the development of inclusive initiatives that can take in leading change and promote gender equality in Kenya's fisheries sector.



Thank You

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Introduction on organization and team, experience in market assessments and scaling, workplan to implement the FASA project : IITA (Murat Sartas)



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)
Scaling Team, Analyzing and Accelerating Use of Sustainable Feed at Scale

Norad IITA WorldFish CGIAR

Presenter: Dr. Murat Sartas



- Innovation, Scaling and Impact Management Experience
- Supported WorldFish thinking on scaling and establishing hubs
- Based in Rwanda in Nordsken, Africa's largest innovation hub with offices
 - Katapult
 - Kivu Choice

Norad IITA WorldFish CGIAR

Analyzing and Accelerating Use of Sustainable Feed at Scale

1. Results and Approach
2. Team
3. Status and The Way Forward

Norad IITA WorldFish CGIAR

Results Overview

A. Lead


1. Market Studies
2. Scaling Strategies
3. Workshops

A. Support

1. Provide intelligence and facilitate innovation platforms
2. Design and disseminate communication products

A. But also whenever and wherever possible

1. Build capacity of FASA team and partners on scaling
2. Build infrastructure to support co-design, co-development of solutions
3. Integrate FASA into business ecosystem



Norad IITA WorldFish CGIAR

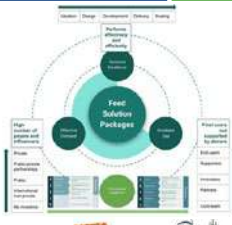
Results Build capacity of FASA team and partners on scaling

Scaling is

Increasing the use of a solution at large

- In users (adoption)
- In times (age)
- In types (age)
- In geographies (out)
- In objectives (cross)
- In behaviour (deep)

Fundamental	Delivery	Scaling	Impact
the responsible and	the user need	relevant strategies	higher volume, faster and
aligned with	business	collaborative	enabled
Proven as	the solution	complementary, resilient	systems, accessible
able to	performance	use	health
build capacity of	technicians	users and supporters	ecosystems, resilient,



Norad IITA WorldFish CGIAR

Results Build infrastructure to support co-design, co-development of solutions

Specific Scaling Support Demand of the case managers of some USD 45 Million Initiative



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Results Integrate FASA into business ecosystem



Rwanda's fish firm Kivu Choice teams up to raise \$35 million to expand production operations

Norad IITA WorldFish CGIAR

Scaling Team



- Murat Sartas
 - Team Lead
 - Strategy and Enabler
- Bruno Tran
 - Measuring readiness of innovative solutions
 - Co-deploying them
- Pat Udenkhan
 - Research rigour
 - Field experience
- Field Researcher and Facilitators
 - High quality data
 - Continuous engagements
- Support Experts
 - Facilitation
 - Communication

Norad IITA WorldFish CGIAR

Status and the Way Forward

- Finalizing the ontract (Aug)
- Designing the team (Sep)
- Developing the approach (Sep)
- Drafting the workplan (Oct)
- Updating and finalizing the workplan (Nov)
- Completing the recruitments (Dec)
- Market Research (Apr 24)
- Scaling Strategies (June 24)

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Update on the implementation of year 1 of the FASA project in Sweden
 SLU (Sri Kartik Baruah)

Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)
 Dr. Kartik BARUAH
 Associate Professor & Research Group Leader
 Department of Animal Nutrition and Management
 Swedish University of Agricultural Sciences (SLU), Uppsala

Norad WorldFish CGIAR

Overview of Presentation

1. Overview of SLU-Sweden
2. Brief of the Research Group
3. Role of SLU in the FASA Project
4. Implementation of Year 1 of the FASA project in Sweden

Norad WorldFish CGIAR

VISION
 SLU plays a key role in development for sustainable life, based on science and education

SLU

A WORLD-CLASS INTERNATIONAL UNIVERSITY

- High scientific quality in our fields
- SLU ranks 3rd in the world for agriculture and forestry, and
- 31st for veterinary medicine

SLU

COLLABORATE WITH US

At SLU, we are convinced that collaboration is a win-win strategy. This is why we often collaborate with other public authorities, organisations and businesses to jointly achieve goals and results that are only possible if we work together.

SLU

Overview of SLU

EDUCATION

Sustainability experts of the future

- Some 50 degree programmes
- Many popular international programmes
- Developed programme offering and increased number of students by 2027!

SLU Department University of Agricultural Sciences Norad WorldFish CGIAR

Overview of SLU

Departments and faculties

SLU has 33 departments and units, here presented in alphabetical order. They are organised in four faculties.

- Faculty of Veterinary Medicine and Animal Sciences
- Faculty of Forest Sciences
- Faculty of Natural Resources and Agricultural Sciences
- Faculty of Architecture, Horticulture and Crop Production Sciences

SLU Department University of Agricultural Sciences Norad WorldFish CGIAR

Overview of SLU

Faculty of Veterinary Medicine and Animal Sciences

QS Ranking: 3rd Best University (Agriculture & Forestry)

SLU Department University of Agricultural Sciences Norad WorldFish CGIAR

Swedish University of Agricultural Sciences

Department of Animal Nutrition and Management

We conduct research and teaching about nutrition and management of several animal species such as cattle, pigs, poultry, reindeer, fish, horses and dogs.

Research, Education, Laboratories, Available topics projects, Collaboration

SLU Department University of Agricultural Sciences Norad WorldFish CGIAR

Aquaculture Nutraceuticals Research Group: ANARG

SLU Department University of Agricultural Sciences Norad WorldFish CGIAR

ANARG – International Cooperation

Logos: SLU, Norad, WorldFish, CGIAR

Research Lines: Novel & Circular Feed

Linear economy

Circular economy

Source: <https://www.sustainableanimalnutrition.com/2020/12/01/sustain-circular-economy-keeping-nutrients-in-the-food-chain/>

Logos: SLU, Norad, WorldFish, CGIAR

Research Lines: Novel & Circular Feed

Linear economy

Circular economy

Source: <https://www.sustainableanimalnutrition.com/2020/12/01/sustain-circular-economy-keeping-nutrients-in-the-food-chain/>

Logos: SLU, Norad, WorldFish, CGIAR

Sustainable Animal Farming: Waste2Feed Approach

Source: <https://www.sustainableanimalnutrition.com/2020/12/01/sustain-circular-economy-keeping-nutrients-in-the-food-chain/>

Logos: SLU, Norad, WorldFish, CGIAR

Transnational Projects on Circular Feed

Logos: SLU, Norad, WorldFish, CGIAR

Workshop on Microbial Feed Ingredients

Participants: > 74; both from academia & industry (Hybrid)

Logos: SLU, NordFeed, ForestFeed, NordForsk, The Research Council of Norway, FOODS/NORWAY

Ås, Norway: 26th September, 2023

Role of SLU in FASA Project: Academic Partner

- International Centre of Insect Physiology & Ecology, Kenya
- West & Central African Council for Agricultural Research (CORAF), Nigeria
- Aller Aqua Africa (Zambia)
- Local Feed Millers & Fish Farmers Groups
- National Agricultural Research Services (NARS) agencies of project countries

Logos: SLU, Norad, WorldFish, CGIAR

Role of SLU in FASA Project

- Capacity Building
- Conduct Research & Development Activities on Sustainable Feed: 2 PhD Research Projects (Nigeria & Zambia)
- Contribute to other relevant activities of the project

Logos: SLU, Norad, WorldFish, CGIAR

Aquaculture Africa: Constraining Factors

Source: FAO, 2022

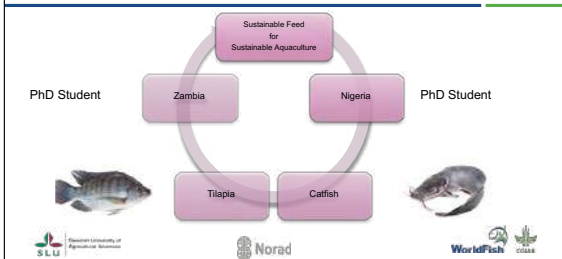
Logos: SLU, Norad, WorldFish, CGIAR

Aquaculture Africa: Constraining Factors

Source: FAO, 2022

Logos: SLU, Norad, WorldFish, CGIAR

Update on Implementation (year 1) : 2 PhDs Selected



PhD Advisory Members

Import of feed ingredients: Zambia to Sweden

#	NAME OF INGREDIENT
1	FISH MEAL (SIAWONGA KAPENTA)
2	GRINDED CRAWFISH MEAL
3	KAKEVA (FISH MEAL)
4	CATERPILLAR (TUKANJA)
5	CATERPILLAR (VINKUNALA)
6	FISHMEAL(CHISENSE)
7	SUNFLOWER CAKE MEAL
8	VELVET BEANS MEAL
9	VELVET BEANS SEED
10	TEA WASTE
11	CHIKANDA POWDER

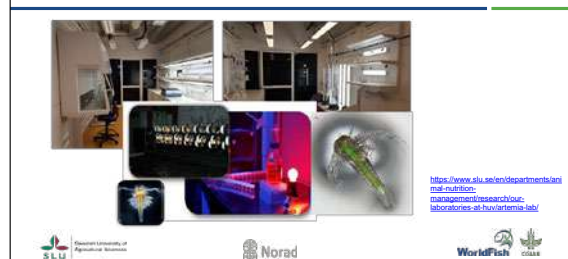
Fish wet lab facilities at SLU



Feed Technology Lab Facility at SLU



Artemia as model in Feed Ingredients Screening



FASA Project Activities in Sweden

Swedish Launch of FASA Project

- Over 50 participants
- 09 countries (Asia, Europe & Africa)
- SLU Global, SIDA & Stockholm Resilience Center
- ACKNOWLEDGEMENT: SLU Aquaculture Platform & SLU Global**

Thank You

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Update on country ToC and Annual outcome monitoring studies
WorldFish HQ (Timothy Manyise)



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)


Theory of Change and Annual Monitoring Studies

Timothy Manyise (PhD) – WF HQ




Outline

- o Introduction
- o Contextualising the theory of change
- o Ongoing baseline characterization studies
- o Key messages and recommendations
- o Q&A



Introduction

- o We operate in dynamic environments with **interrelated components**.
- o The FASA Project is not an isolated entity but is **embedded in larger systems**.
- o A systems approach allows us to uncover and comprehend the **ripple effects of intervention activities**.
- o Avoiding **underestimating** impact of intervention activities.
- o Anticipation and **management of potential negative repercussions**.

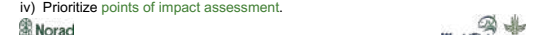


Workshops to contextualizing the theory of change to inform monitoring

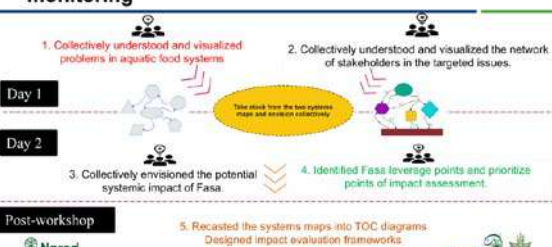

To explore the potential socio-ecological and economic impact of developing and scaling fish feed using novel ingredients in Zambia, Kenya and Nigeria.

The workshop aim to;

- Map the **problems or issues** around fish feeds that need to be addressed
- Map the **network of actors** surrounding fish feeds
- Map the **potential systemic impact** of the FASA project
- Prioritize **points of impact assessment**.





Contextualizing theory of change to inform monitoring

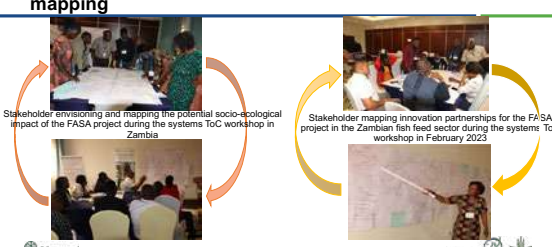




Contextualizing theory of change to inform monitoring

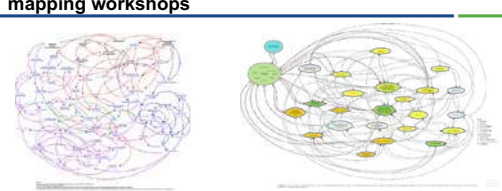
Stakeholders: Feed millers, NGOs, DoF, feed ingredient producers, fish farmers, aggregators, processors, farmer association, women and youth groups, feed manufacturing certification bodies (25 -30 participants * 3 workshops – Nigeria, Kenya and Zambia)

Contextualizing theory of change: Participatory systems mapping

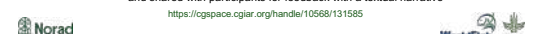



Contextualizing theory of change: Outputs of systems mapping workshops



From the workshop paper versions, maps were synthesised, digitised and shared with participants for feedback with a textual narrative

<https://cgspac.cgiar.org/handle/10568/131585>



Contextualizing theory of change: outputs of systems mapping workshops



Participants during the FASA TOC workshops pausing for photos in front of their systems maps in February and March 2023

<https://cgspac.cgiar.org/handle/10568/131585>



Contextualizing theory of change: outputs of systems mapping workshops

Stakeholders: Feed millers, NGOs, DoF, feed ingredient producers, fish farmers, aggregators, processors, farmer association, women and youth groups, feed manufacturing certification bodies (25 - 30 participants * 3 workshops – Nigeria, Kenya and Zambia)




<https://cgspac.cgiar.org/handle/10568/131585>



Contextualizing theory of change: outputs of systems mapping workshops


Scientific article
One journal manuscript prepared and submitted for publication.

- Peer-reviewed manuscript proposal accepted
- Full manuscript *under review*
- Using examples from the workshops to illustrate how inclusive innovation can be coordinated using participatory systems mapping.




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Baseline characterization of the practices and utilization of fish feed ingredients



Study 1: Six states in Nigeria, 24 LGAs.

- o 600 fish farmers.
- o 180 ingredient processors.
- o Survey tools designed.
- o Ethical approval obtained.
- o Enumerators selected.
- o Survey (November - December)



Study 2: Six provinces in Zambia, 11 districts

- o 600 fish farmers, 120 ingredient processors
- o Questionnaire designed and programmed in KoBo.
- o Ethical approval (in progress)
- o Survey (Jan 2024)


Norad WorldFish CGIAR

Four key messages and recommendations

- Impact assessment should focus on both the intended and unintended consequences of the intervention
- It is necessary to profile and identify who the project's activities will likely impact, either directly or indirectly.
- Ensure that different project activities such as training sessions, workshops, information sessions, demonstrations by different partners are synchronized to ensure effective follow-up evaluations.
- Timely provision of information to ensure that evaluation assessment are conducted on time.

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- Questions
- Suggestions
- Answers



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Perspectives of Aller Aqua Zambia on the implementation of year 1 of the FASA project
 Aller Aqua (Alexander Michael Greiling)



Perspectives of Aller Aqua Zambia on the implementation of year 1 of the FASA project

1. Update on Aller Aqua Zambia
2. Market Trends
3. Raw Material Scoping Study
4. Possible Outlook and Perspectives

Norad WorldFish CGIAR

- Update on Aller Aqua Zambia**
- Increased production by approx. 1000t/month compared to last year
 - Significantly increased purchase of raw materials
 - ~80% sourced locally within Zambia
 - Significantly increased local value addition to:
 - Farming
 - Transport/logistics
 - Job creation
 - Aquaculture
- Norad WorldFish CGIAR

- Market Trends**
- More fish feed factories/ competitors entering East African Market
 - Can service Zambia and surrounding countries too
 - Good for Aquaculture Production as competition will likely bring prices down
 - Primary Production of Agricultural Crops (Grains, Soya, etc.) stable
 - Processed crops and by-products also available
 - Nothing new, just more of common products
 - Animal by-products still not locally available in sufficient quantities and quality
 - East Africa has access to ports and can import at better rates
- Norad WorldFish CGIAR

- Raw Material Scoping Study**
- Great geographical coverage
 - Provides good insight into primary production
 - Revealed that there is no animal by-products available
 - Only primary animal-derived resources (fish, crayfish, caterpillars)
 - Are these not in great part directly consumed?
 - There is great room for development in the local industry!
- Norad WorldFish CGIAR

- Possible Outlook and Perspectives**
- Evaluation of untapped and available resources
 - Abattoirs to evaluate potential animal by-product processing potential
 - Beef and Poultry by-products
 - Evaluation of untapped yet unavailable resources
 - Pea proteins?
 - Other processing technologies?
 - Evaluation of commercial aspect of raw material market
 - Farmers' Cooperatives?
 - Small scale processing and value addition (and Quality Control)? e.g. maize
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Perspectives of NRDC on the implementation of year 1 of the FASA project
NRDC (Mr. Melon Mulamfu)



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

Presentation by: Mr. Melon Mulamfu - Principal
Natural Resources Development College (NRDC)


Norad WorldFish CGIAR

Content

1. Introduction
2. Brief History
3. Project components - Planned
4. Project components – Achieved
5. Benefits

Norad WorldFish CGIAR

Introduction



The Natural Resources Development College (NRDC) is one of the seven Agricultural colleges in Zambia under the Ministry of Agriculture. The college was established in 1984 through a declaration by the First Republican President Dr. Kenneth David Kaunda.

AIM
Training middle level human resource for the Agriculture and related sectors. In ten (10) disciplines at a diploma level

Norad WorldFish CGIAR

Brief History

The NRDC Wet Laboratory was upgraded in 2019 through the design and building of a flow-through aquaculture system to conduct Research Projects.

WORLD FISH PROJECT 1
"Replacing fishmeal with a single cell protein feedstuff in Nile tilapia Oreochromis niloticus diets"

PROJECT 2
"Performance of Oreochromis niloticus and Oreochromis andersonii in controlled laboratory conditions in Zambia."

RESEARCH
NRDC students and staff then utilized the Fish Wet Laboratory to conduct Basic Research. Unfortunately between 2021 -2022 operations came to a halt due to theft.

FASA UPGRADE
In 2023 the Laboratory was upgraded by the (NORAD - FASA project) to facilitate hosting of the novel feed experiments.

To avoid previous challenges, NRDC upgraded its security systems to the Fish Laboratory and entire college

Norad WorldFish CGIAR

Project components – Planned NRDC

01 NRDC to provide Fish Wet Laboratory and technical support to the Upgrade of a Recirculating Aquaculture System through WorldFish (NORAD funded project –FASA).

02 NRDC to provide a contact person


03 NRDC to provide Security

04 NRDC shall host the feed experiments in the Fisheries Laboratory

Norad WorldFish CGIAR


Project components – Achieved

01 Upgrade of the Fish Lab to a Recirculating Aquaculture System through WorldFish support.



Norad WorldFish CGIAR

Project components - Achieved



02 NRDC has provided a contact person to support the project.

Mrs. Majory Chama
Training Officer
Department of Fisheries science and Aquaculture

Norad WorldFish CGIAR

Project components - Achieved


- ✓ Lighting System
- ✓ Main entrance Security Gate
- ✓ Hired Security Company
- ✓ Installation of burglar-bars on all windows in the Wet Laboratory.

03 NRDC has provided Security



Norad WorldFish CGIAR

Project components - Achieved



04 NRDC is hosting the fish feed project experiments in the Wet Laboratory.

Norad WorldFish CGIAR

Benefits

1. The Fisheries Science curriculum was upgraded.
2. Construction of Aquaculture Skills Training Centre
 - ✓ Effective and efficient Practical student activities
 - ✓ Hosting of short demand driven courses to boost small scale fish farming.
3. Installation of Recirculation Aquaculture System in the Fish Wet Laboratory
 - ✓ NRDC Staff and student capacity building in research activities
 - ✓ Exposure of students to research findings through seminars and scientific talks.

Norad WorldFish CGIAR

Update on Project Finance and Technical Report WorldFish (Tan Chao Yan and Tan Ban Swee)




Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

Dolore magna aliqua



Update on Project Finance

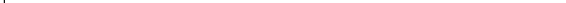
- Project Currency - Norwegian Kroner (NOK)
- Project Grant – NOK 80,000,000
- Project Fund Exchange Rate – Bank Fund Receipt Rate
- Ownership of Equipment, Consumables and IP vested in WorldFish or cooperating partners
- Project's accounting records must be kept for at least 5 years from the time of Norad's approval of Project's final report
- Zero-tolerance policy against corruption and other financial irregularities will be applied to WorldFish and its cooperating partners



Update on Project Finance

Procurement Provisions

- Contract must be awarded to the most economically advantageous tender
- Procurement of award with value of less than NOK 500,000 may be awarded following any procurement procedure established by the Grant Recipient
- Procurement of award with value exceeding NOK 500,000 shall be awarded based on one of the following procurement procedures:
 - Open tender procedure
 - Restricted procedure
 - Competitive procedure with negotiation
- Where Grant Recipient does not launch open tender procedure, it shall justify and document in writing the choice of tenderers that are invited to submit an offer



Update on Project Finance

Year 1 (1st July 2022 – 30th June 2023) Spending Status

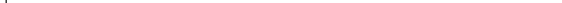
- NOK 6,881,809

Year 2 (1st July 2023 – 30th September 2023) Spending Status

- NOK 1,523,817

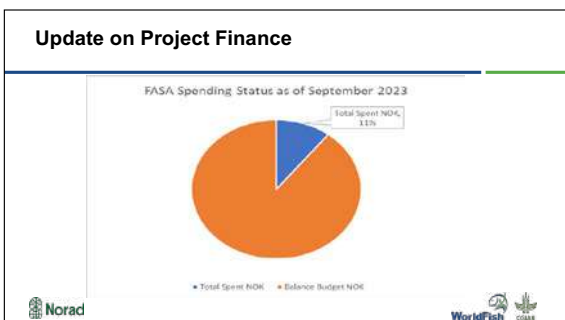
Year 1 & Year 2 Total Cumulative Expenditure

- NOK 8,405,626

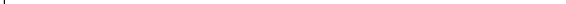


Update on Project Finance

FASA Spending Status as of September 2023

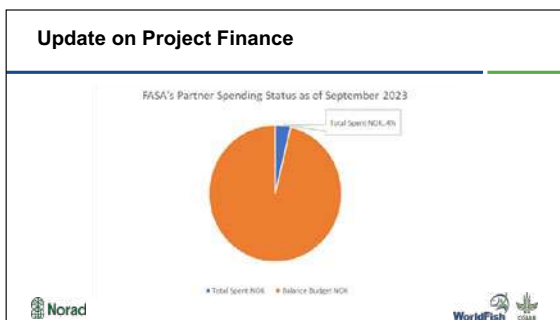


• Total Spent NOK 8.4%
• Balance Budget NOK 91.6%

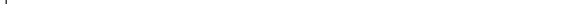


Update on Project Finance

FASA's Partner Spending Status as of September 2023



• Total Spent NOK 4%
• Balance Budget NOK 96%

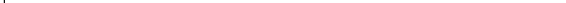


Technical / Financial Reporting

FASA Project Implementation Period: 1st July 2022 – 30th June 2027

FASA Project Technical / Financial Reporting Schedule

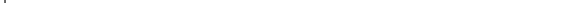
- 1 July – 31 December 2022 (Submission Deadline - 15 April 2023)
- 1 January – 31 December 2023 (Submission Deadline – 15 April 2024)
- 1 January – 31 December 2024 (Submission Deadline – 15 April 2025)
- 1 January – 31 December 2025 (Submission Deadline – 15 April 2026)
- 1 January – 31 December 2026 (Submission Deadline – 15 April 2027)
- 1 July 2022 – 30 June 2027 (Final Report Submission Deadline – 31 October 2027)



Financial Reporting

FASA Project Annual Audit Schedule

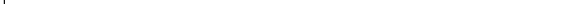
- 1 July – 31 December 2022 (Submission Deadline - 1 June 2023)
- 1 January – 31 December 2023 (Submission Deadline – 1 June 2024)
- 1 January – 31 December 2024 (Submission Deadline – 1 June 2025)
- 1 January – 31 December 2025 (Submission Deadline – 1 June 2026)
- 1 January – 31 December 2026 (Submission Deadline – 1 June 2027)
- 1 July 2022 – 30 June 2027 (Final Report Submission Deadline – 31 October 2027)



Technical / Financial Reporting

WorldFish Partner Technical & Financial Reporting

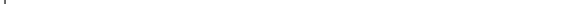
- SLU & IITA will follow submission schedule and reporting requirements as stated in original sub-grant agreement (no changes)
- CORAF will follow submission schedule and reporting requirements as stated in new addendum to sub-grant agreement (refer to subsequent slide)
- ICIPE will follow submission schedule and reporting requirements as stated in new addendum to sub-grant agreement (refer to subsequent slide)



Technical / Financial Reporting

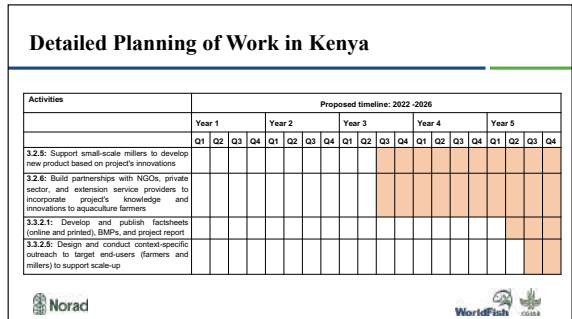
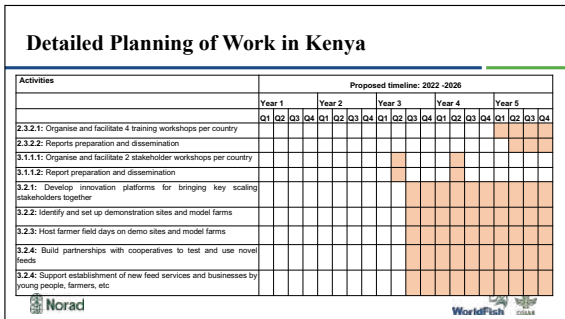
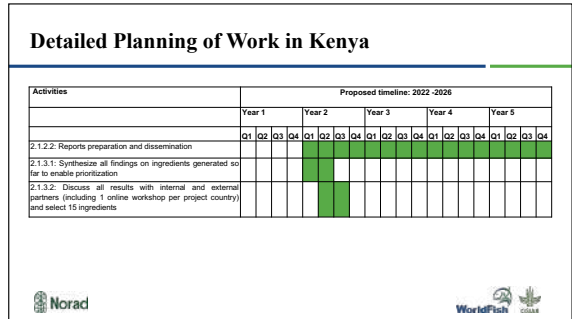
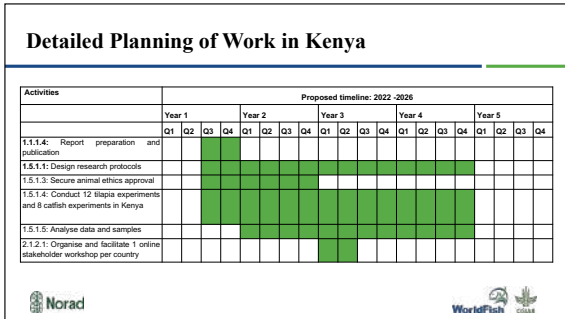
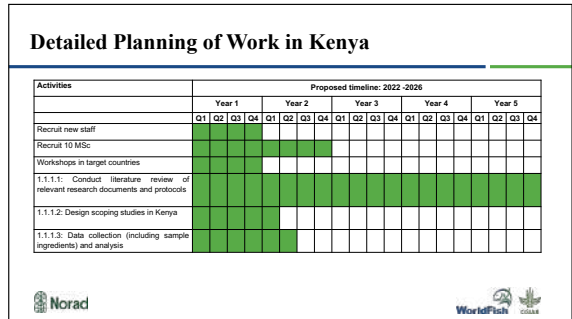
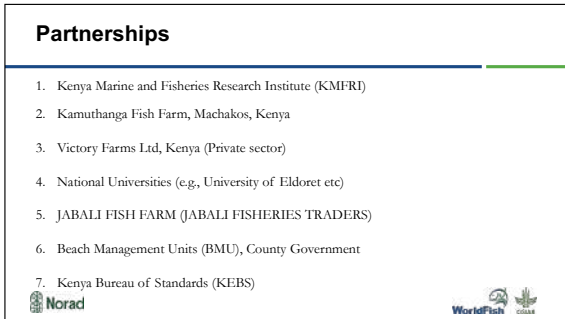
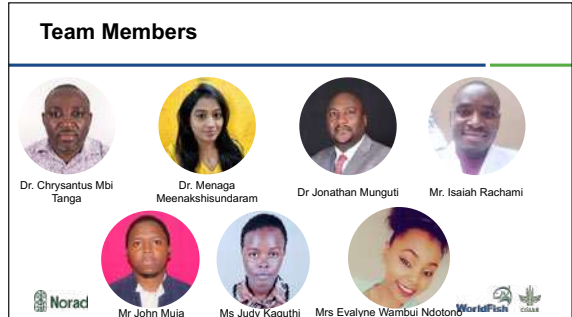
WorldFish Partner - CORAF & ICIPE

- Reporting frequency : Quarterly
- Deliverables required for submission : Technical Report, Financial Report, Invoice, Quarterly Forecast Work Plan & Quarterly Forecast Budget
- Submission Schedule (Technical & Financial Reporting) :
 - 2023 (Remaining Submission Deadline) – 31 Dec 2023 (Fin) / 31 Jan 2024 (Tech)
 - 2024 – 30 Apr 2024; 31 July 2024; 31 Oct 2024; 31 Dec 2024 (Fin) / 31 Jan 2025 (Tech)
 - 2025 – 30 Apr 2025; 31 July 2025; 31 Oct 2025; 31 Dec 2025 (Fin) / 31 Jan 2026 (Tech)
 - 2026 – 30 Apr 2026; 31 July 2026; 31 Oct 2026; 31 Dec 2026 (Fin) / 31 Jan 2027 (Tech)
 - 2027 – 30 Apr 2027; 15 May 2027 (for final report from 2022 – 2027)



Appendix 4. Slides presentations for Day 2

Detailed planning of work in Kenya ICIFE (Dr. Chrysantus Mbi Tanga)



Detailed planning of work in Nigeria : CORAF (Charity Obetta)



Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)

CORAF

CORAF: NIGERIA
 Dr. Lamien Nieyidouba
 Dr. Obetta Charity
 Dr. Caroline Ayo-Olalusi
 Dr. Ibiyo L.M.O.




Experimental system

Nutrients requirements of improved strains of Tilapia and African Catfish using locally available ingredients in Nigeria.


Plate 1: Hybrid Catfish strain (Cross of *Heterobranchus* sp & *Clarias* Sp)

Plate 2: Hybrid Tilapia strain (Cross of Nile Tilapia and Red Tilapia)

Nutrients requirement of improved strain of African catfish (Hybrid of *Heterobranchus* Spp. X *Clarias gariepinus*) and Hybrid Tilapia (*Oreochromis niloticus* X *Oreochromis mossambicus*) with both compared with their locals in Nigeria.


Project Title: Nutrients requirements of improved strains of Tilapia and African Catfish using locally available ingredients in Nigeria.

1. Introduction
2. Project key facts
3. Project goals
4. Project components
5. Partnerships




Introduction

- ❑ Catfish play a crucial role in sustaining Nigeria's aquaculture industry, making the catfish species particularly vital (Owodeinde and Ndimele, 2011). In recent times interest in tilapia is growing and farmers are now deliberately farming tilapia for harvest.
- ❑ Hybridization which is the breeding of individuals from different genetic background has been recognized as a tool in aquaculture industries for stock improvement and management purposes.




Introd.

- ❑ **Tilapia and catfish have been identified to require the same ten essential amino acids as other finfishes.**
- ❑ **The most limiting amino acids in plant based ingredients are lysine and methionine so the scope of this project will be focusing on these amino acids.**




Project key facts

- ❖ Provision of data for sustainable fish feeds production in Nigeria.
- ❖ Formulation and Production of a balanced affordable and quality fish feeds using locally available ingredients.
- ❖ Improved nutritional quality of fish feed to enhance optimum growth of fish which will contribute to increase in fish farmers incomes, improve nutrition and alleviation of poverty.



Project Goals

- To determine the nutrients requirements of hybrid strains of *Oreochromis niloticus* cross with *O. mossambicus* compare with the known level for the *O. niloticus* strain.**
- To determine the nutrients requirements of hybrid (*Heterobranchus* spp. cross with *Clarias gariepinus* (*Heteroclarias*)) and local strains of *Clarias gariepinus*.**
- To compare the requirement of the local pure line with the hybrid**




Project components Contd.

Nutrients requirements of improved strains of Tilapia and African Catfish using locally available ingredients in Nigeria.


1. Methionine requirement
2. Lysine Requirement
3. Vitamin C Requirement and
4. Mineral (Calcium and Phosphorus) requirement.

Eight experiments in all.



Project components Contd.

- Methionine requirement of improved African catfish (Hybrid of *Heterobranchus* Spp X *Clarias gariepinus*) compared with local *Clarias gariepinus* and Hybrid Tilapia (*Oreochromis niloticus* X *Oreochromis mossambicus*) in Nigeria.
- Rehabilitation of experimental system (WRS) just concluded.
- Procurement of experimental fish.
- Acclimation of experimental fish species on-going
- Feed formulation, Sampling and Chemical analysis are strong components of this experimentation. (proximate composition)



Time line for Catfish and Tilapia studies' Activities

S/Ns	Milestones	Months
1	Procurement of Water quality kits, Laptops, office cabinet, Chairs and tables.	
2	Purchase of ingredients for fish diets	Nov. 2023
3	Preparation of experimental feeds	"
4	End of acclimation and set up of experiments	Nov. 2023
5	Feeding Experiment: twelve weeks monitoring involving water quality management, samplings, Analysis of feeds (twelve samples) and fish (one initial and final samples from all the 2 X 6 groups making a total of twelve with replicates) considering all parameters. For Methionine.	Nov 2023 - Feb 2024
6	Analyses of samples and data	Feb -Mar'24
7	Report preparation for submission and publication	Apr. 2024

Time line for Catfish and Tilapia studies' Activities

S/Ns	Milestones	Months
8	Preparation of Research protocols on Lysine studies	April 2024
9	Purchase of ingredients for fish diets	May 2024
10	Preparation of experimental feeds	"
11	Purchase of fingerlings after feed preparation for lysine studies	May, 24
12	Feeding Experiment: Twelve weeks trial, involving water quality management, samplings, Analysis of feeds (twelve samples) and fish (one initial and final samples from all the 2 X 6 groups making a total of twelve with replicates) considering all parameters. For Lysine	June-Aug 24
13	Analyses of samples and data	September
14	Report preparation and publication	Sep - Oct
15	International Workshop/Annual review meeting to be held in Zambia facilitated by WorldFish	November
16	Local Workshop to share results to farmers and millers	Nov, 24

Time line for Catfish and Tilapia studies' Activities.

S/Ns	Milestones	Months
17	Preparation of Research protocols on Vitamin C studies	Nov 2024
18	Purchase of ingredients for fish diets	Nov 2024
19	Preparation of experimental feeds for Activity 2.1	"
20	Purchase of fingerlings after feed preparation for Vit C studies	Dec 24
21	Feeding Experiment: Monitoring involving water quality management, samplings, Analysis of feeds, six samples and fish (one initial and final samples from all the 2 X 6 groups making a total of twelve with replicates) considering all parameters outline above . For Vitamin C	Jan - Mar 25
22	Ph. D Student Research need to commence with associated activities	Jan-June
23	Analyses of samples and data	Mar/Apr '25
24	Report preparation	May, 2025
25	Organization of local workshop	June 2025
26	International Workshop/Annual review meeting to be held in Kenya facilitated by WorldFish	November

Time line for Catfish and Tilapia studies Activities

Activities to be carried out under requirement studies in improved strain of Catfish and Tilapia (Hybrid) in 2024 and 2025 if activities before its execution are accomplished as stated in annual work plan.

S/Ns	Milestones	Months
17	Preparation of Research protocols on Mineral studies	July, 2025
18	Purchase of ingredients for fish diets	July 2025
19	Preparation of experimental feeds for Activity 2.1 & Student	"
20	Purchase of fingerlings after feed preparation for Vit C studies	July 2025
21	Feeding Experiment: Monitoring involving water quality management, samplings, Analysis of feeds, six samples and fish (one initial and final samples from all the 2 X 6 groups making a total of twelve with replicates) considering all parameters outline above . For Mineral	Aug-Oct 25
22	Analyses of samples and data	Nov 2025
23	Report preparation	Nov 2025
24	International Workshop/Annual review meeting to be held in Kenya facilitated by WorldFish	November

Partnerships

Fish Farmers and Millers

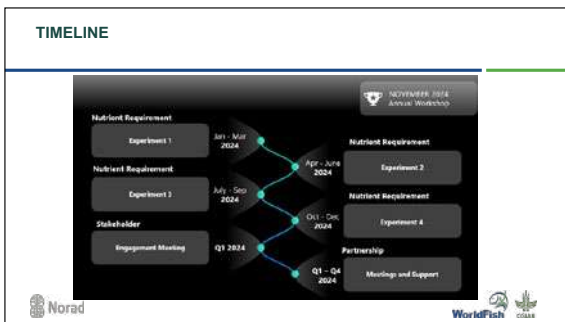
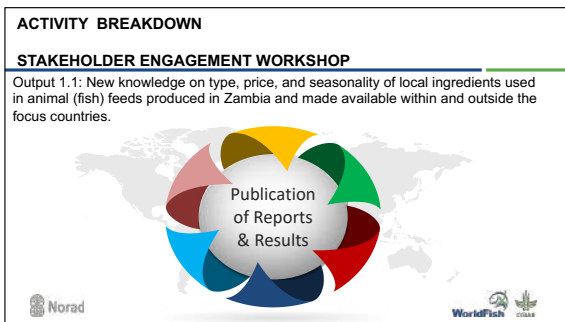
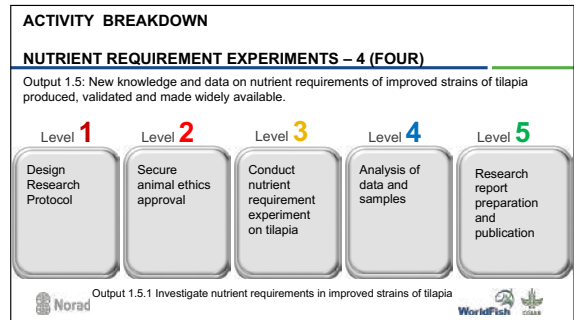
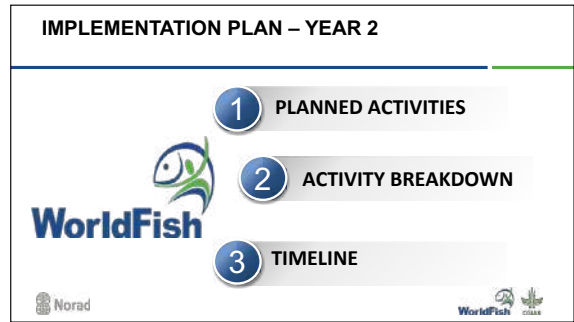
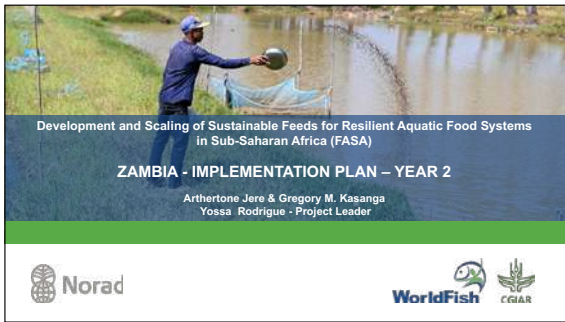
Thank You

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Detailed planning of work in Zambia: WorldFish Zambia (Arthertone Jere and Gregory M Kasanga)





Content

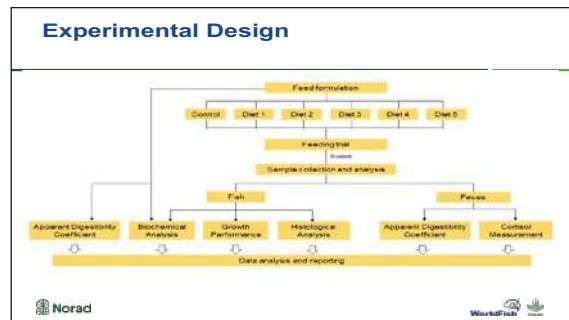
1. Detailed planning of work in Malaysia
2. Aquaculture Research in Malaysia
3. Other project works in Malaysia

Detailed planning of work in Malaysia

Outcomes, Outputs, Activities, & Subactivities	Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Outcome 2: Quality of at least 15 local ingredients has been improved through various processing techniques and the ingredients are used by stakeholders in the 3 target countries, including local millers and farmers, to produce 9 novel, cost-efficient feed formulations, to improve aquaculture productivity and resilience.								
Output 2.1: New data and knowledge on local ingredients generated, used in the formulation of novel fish feeds, and made widely available								
Activity 2.1.1: Conduct experiments to prioritize 25 ingredients								
Subactivity 2.1.1.1: Conduct digestibility experiments of ingredients samples collected for output 1.1								
Subactivity 2.1.1.2: Database development and research report preparation and publication								
Activity 2.1.3: Produce ingredients and co-formulate fish feeds								
Subactivity 2.1.3.1: Synthesize all findings on ingredients generated so far to enable prioritisation								
Subactivity 2.1.3.2: Discuss all results with internal and external partners (including 1 online workshop per project country) and select 15 ingredients								
Project Management (Grants and contracts, MEL, Data Management Impact Assessment, Communication, Procurement, Finance, Accounting, Consultants, Reporting internal and to the donor)								



- ### Digestibility experiment
1. To study the **nutritional composition, apparent digestibility coefficients, and anti-nutritional factors** of various sustainable local ingredients obtained from Sub-Saharan African
 2. To examine the **growth performance and the biochemical composition** of GIFT, *Oreochromis niloticus* fed with sustainable local feed ingredients
 3. To assess fish **health status** through the analysis of histopathology and cortisol levels when fed with sustainable local feed ingredients



- ### Upcoming Digestibility Experiments Year 2
- Digestibility 1: Zambia (November – December 2023)
 - Digestibility 2: Nigeria (Feb – March 2024)
 - Digestibility 3: Kenya (May – July 2024)
 - Digestibility 4: Zambia (Sep – Oct 2024)



- ### Digestibility experiment : Sample Ingredients
- Shipment of sample ingredients from Nigeria and Kenya
 - Conduct nutrient analysis
 - Proximate analysis
 - Amino acids
 - Fatty acids
 - Anti Nutritional factors



- ### Objective of the study
- To investigate the effect of solid-state fermentation (SSF) on the changes in the nutrients profile particularly protein and fiber and reduction of anti-nutritional factors in agriculture waste
 - Optimization of solid-state fermentation parameters for the production of functional product by the microorganism on selected agriculture waste



Plan of SSF activities at WorldFish Penang

- > Further collaboration with School of Technology Industry, USM Penang
- > Finalization research protocol on SSF in an application using bacteria, yeast, and fungi
- > Conduct SSF experiment
 - Investigate the effect of SSF on the nutrient profile of agriculture waste meal, including changes in micronutrient composition (protein content, lipid content, carbohydrate, fibre, ash, minerals, fatty acids and amino acid profiles)
 - Optimization of SSF process parameters (eg: moisture content, temperature, pH, and inoculum concentration, for effective fermentation)
 - Identification of potential functional product
- > Feeding trial on use of SSF product on Tilapia

Plan for SSF activities

Activities	2024
Optimization of SSF process parameters (eg: microbes, moisture content, temperature, pH, and inoculum concentration, for effective fermentation)	By Q2
SSF experiment to produce valuable and functional product-	By Q3
Feeding trial on Tilapia	By Q4




Enhancing reproductive performance using high-quality oil in the broodstock of the GIFT strain of tilapia (*Oreochromis niloticus*) diet

Aaqillah Amr M.A., Fatan, N.A., Ramli, M.R., Sharbini, N.S., Ley, T.M., Hui, P.J., Yossa, R.






Introduction

- Lipids play an important role in the reproduction of fish especially during the maturation of gonads
- For fish with high reproductive performance, diets with high lipid content are required.
- Lipids from fish oil are rich in ARA, EPA, and DHA required in broodstock diets to ensure high fecundity, spawning success, and larvae survival.
- The present work will generate data on the gonad maturation, sperm quality, and fecundity of tilapia during the breeding.

Objectives

- Growth performance and gonad maturation at the early stage of development of juvenile tilapia
- Fecundity and sperm quality of tilapia during the breeding stage






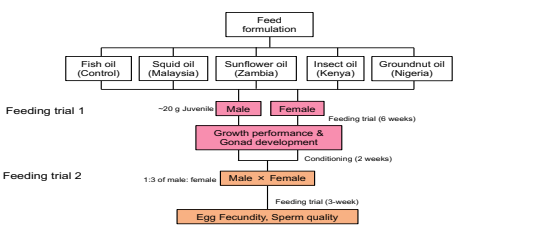


Materials and Methods

Fish collection

- Tilapia ~20 g BW.
- Male fish will be manually separated from the female
- 5 diets × 3 replicates × 2 sexes × 30 individuals per aquarium



Oil collection

- Malaysia: Fish oil (control) and squid oil
- Kenya (ICIPE): Insect oil (BSFL raised on potato waste)
- Zambia (WorldFish Zambia): Sunflower oil
- Nigeria (CORAF): Groundnut oil



Feeding trial 1

Ingredient (%)	Treatments				
	FO	SO	IO	SFO	GNO
Fishmeal (70% Danish)	20.3	20.3	20.3	20.3	20.3
Soybean meal (48 solv)	18	18	18	18	18
Corn gluten meal, 60% CP	25.8	25.8	25.8	25.8	25.8
Corn meal	12	12	12	12	12
Rice bran	8	8	8	8	8
Wheat bran	12	12	12	12	12
Fish oil (FO)	1.2				
Squid oil (SO)		1.2			
Insect oil (IO)			1.2		
Sunflower oil (SFO)				1.2	
Groundnut oil (GNO)					1.2
Soy lecithin	0.3	0.3	0.3	0.3	0.3
Vitamin premix	0.5	0.5	0.5	0.5	0.5
Vitamin C	0.5	0.5	0.5	0.5	0.5
Vitamin E	0.5	0.5	0.5	0.5	0.5
Choline chloride	0.3	0.3	0.3	0.3	0.3
Dicalcium phosphate	0.1	0.1	0.1	0.1	0.1
Mineral premix	0.5	0.5	0.5	0.5	0.5
	100	100	100	100	100

Feeding trial 2

Ingredient (%)	Treatments				
	FO	SO	IO	SFO	GNO
Fishmeal (70% Danish)	17	17	17	17	17
Soybean meal (48 solv)	19	19	19	19	19
Corn gluten meal, 60% CP	20	20	20	20	20
Corn meal	16.5	16.5	16.5	16.5	16.5
Rice bran	13.5	13.5	13.5	13.5	13.5
Wheat bran	8.8	8.8	8.8	8.8	8.8
Fish oil (FO)	2.5				
Squid oil (SO)		2.5			
Insect oil (IO)			2.5		
Sunflower oil (SFO)				2.5	
Groundnut oil (GNO)					2.5
Soy lecithin	0.3	0.3	0.3	0.3	0.3
Vitamin premix	0.5	0.5	0.5	0.5	0.5
Vitamin C	0.5	0.5	0.5	0.5	0.5
Vitamin E	0.5	0.5	0.5	0.5	0.5
Choline chloride	0.3	0.3	0.3	0.3	0.3
Dicalcium phosphate	0.1	0.1	0.1	0.1	0.1
Mineral premix	0.5	0.5	0.5	0.5	0.5
	100	100	100	100	100

ACTIVITY	TIMELINE
Protocol and formulations	by July 2023
Animal Ethics approval	by December 2023
Animal sourcing and acclimating	by November 2023
Feed manufacture	by December 2023
Start of experiment	by December 2023
Final sampling	by February 2024
Data analysis	by April 2024
Reporting	by June 2024

Norad WorldFish CGIAR

- ### Expected outputs
- The different oil sources are likely to impact the timing and quality of gonad maturation in the broodstock.
 - Certain oils may accelerate or delay the onset of gonad maturation, while others may contribute to better overall gonad health and development.
 - Various oil sources may affect the quality of sperm produced by the broodstock.
 - The fecundity could vary based on the oil sources used in the diet of the broodstock.
- Norad WorldFish CGIAR

Upcoming broodstock experiment

Activity	2024
Systematic review on broodstock diets	By Q1
To explore FM-free diets on the reproductive performance of broodstock	By Q2
To estimate the macronutrient and micronutrient requirements for broodstock to establish a database	Q4

Norad WorldFish CGIAR

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Detailed Planning of FASA Work in Sweden

Dr. Kartik BARUAH
Associate Professor & Research Group Leader
Department of Animal Nutrition and Management
Swedish University of Agriculture Sciences, Uppsala

SLU, Norad, WorldFish, CGIAR

Role of SLU in FASA Project

- ✕ Capacity Building
- ✕ Research & Development Activities:
 - 2 PhD Research Projects (Nigeria & Zambia)
- ✕ Contribute to other relevant activities of the project

SLU, Norad, WorldFish, CGIAR

Role of SLU in FASA project: 2 PhDs Selected

Conduct Research & Development on Sustainable Feeds for Farmed African Catfish & Nile Tilapia

SLU, Norad, WorldFish, CGIAR

PhD Thesis Projects: Constraining Factors

SLU, Norad, WorldFish, CGIAR

PhD Thesis Projects: Overall Aim

SLU, Norad, WorldFish, CGIAR

Selected Feed Ingredients (Zambia)

#	NAME OF INGREDIENT
1	FISH MEAL (SIAVONGA KAPENTA)
2	GRINDED CRAYFISH MEAL
3	KAKEYA (FISH MEAL)
4	CATERPILLAR (TUKANJA)
5	CATERPILLAR (VINKUBALA)
6	FISHMEAL(CHISENSE)
7	SUNFLOWER CAKE MEAL
8	VELVET BEANS MEAL
9	VELVET BEANS SEED
10	TEA WASTE
11	CHIKANDA POWDER

SLU, Norad, WorldFish, CGIAR

FASA Project: SLU's Roles

- Small, easy and cheap to maintain and manipulate
- Relatively less expensive
- Continuous supply
- **Genome sequenced**
- RNAi technique developed
- Highly controllable
- Less ethical concerns

SLU, Norad, WorldFish, CGIAR

Artemia Lab at SLU

<https://www.slu.se/en/department/animal-nutrition-management/research/laboratory/germ-free-artemia-lab/>

SLU, Norad, WorldFish, CGIAR

Feed Development & Quality Analysis

- **Nutritional Quality**
- **Pellet Quality**

SLU, Norad, WorldFish, CGIAR

FASA PhD Project in Zambia: Nile Tilapia

- Genetic improvements increase the nutritional requirement of fish (Rotta et al. 2023).
- Methionine requirement level of genetically improved farmed tilapia (GIFT) increased by 60% compared to non-GIFT strains (Yossa et al., under review).
- Comparative study to investigate the functional responses of wild-type and genetically improved tilapia strains in response to feeding novel feed.

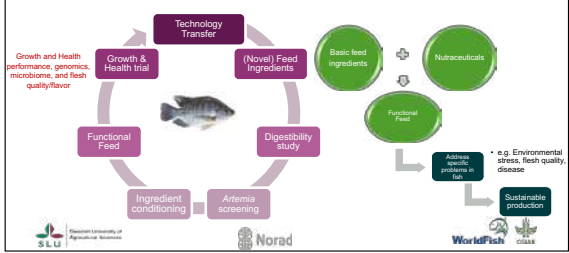
Tilapia

SLU, Norad, WorldFish, CGIAR

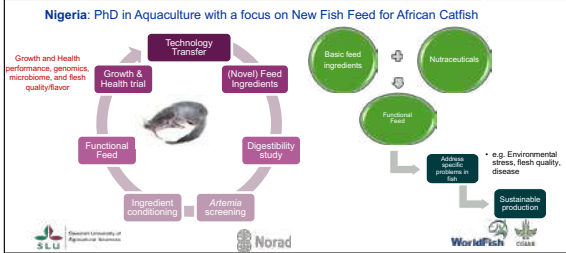
Fish wet lab facilities at SLU



FASA PhD Project in Zambia: Nile Tilapia



FASA PhD Project in Nigeria: African Catfish



Current Status & Future Plan

Activities	Timeline	Status
Recruit 2 PhDs (Zambia and Nigeria)	Year 2 (Q1)	Completed before Year2 (Q2)
Conduct experiments to prioritise KEY ingredients: biochemical analysis of ingredients	Year 2 (Q1) – Year 3	In line with timeline (Ingredients from Zambia)
Digestibility study at WorldFish	Year 1 (Q3) – Year 3 (Q4)	
Develop and use processing techniques to improve quality of KEY ingredients	Year2 (Q3) – Year 3 (Q1)	
Quality check the improved ingredients, and formulate and produce fish feed, and lab trial	Year 2 (Q3) – Year (Q4)	
Conduct validation study on farm	Year 3(Q3) – Year 4 (Q4)	
PhD Defense	Year 4(Q2) – Year 5 (Q2)	

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Development and Scaling of Sustainable Feeds for Resilient Aquatic Food Systems in Sub-Saharan Africa (FASA)


Tan Ban Swee & Tan Chao Yan
Research Finance



Training on Proper Financial Reporting

Partner Financial Reporting – Advance Liquidation Type


- With the exception of first advance fund transfer to the partner, subsequent advances to the partner is subject to following conditions:
 - Technical and financial reports that are due in accordance with the submission schedule as stated in the sub-grant agreement must be received and accepted by WorldFish
 - Submission of quarterly forecast Work Plan and Budget that are consistent with the Activity Implementation Plan and submission of invoice for relevant quarter that is approved by WF
 - Sufficient supporting evidence must be provided to support the spending
 - Upon WorldFish request, the partner must support and revert the corresponding year-end balance confirmation to WorldFish
 - Final payment to partner will be cost-reimbursement payment and release only upon acceptance and approval of all deliverables, final Technical & Financial Reports from partner



Training on Proper Financial Reporting

Partner Financial Reporting – Cost Reimbursement Type

- With the exception of first advance fund transfer to the partner, subsequent cost reimbursements to the partner is subject to following conditions:
 - Technical and financial reports that are due in accordance with the submission schedule as stated in the sub-grant agreement must be received and accepted by WorldFish
 - Payment will be made after partner has completed the contractual deliverables and incurred expenses that exceed first advance payment, subject to WorldFish approval
 - Partner must submit an invoice for payment request, subject to WorldFish approval
 - Sufficient supporting evidence must be provided to support the spending
 - Upon WorldFish request, the partner must support and revert the corresponding year-end balance confirmation to WorldFish




Training on Proper Financial Reporting

Sample partner budget in sub-grant agreement

NY WorldFish Reporting and Payment Schedule


TABLE 1: BUDGET (USD) IN MILLION

Budget Item	Year 1 (2018)	Year 2 (2019)	Year 3 (2020)	Year 4 (2021)	Year 5 (2022)	Total (2018-2022)
Personnel Costs	342,000	342,000	342,000	342,000	342,000	1,694,000
Travel	45,115	45,115	76,361	45,115	45,115	216,821
Operating and maintenance costs	281,070	344,811	381,037	357,061	355,150	1,719,135
Equipment	3,100	3,100	3,100	3,100	3,100	15,500
Participating organization	27,000	-	-	-	-	27,000
Unallocated	42,000	107,000	40,000	101,000	12,000	302,000
Total (2018)	697,285	777,926	849,500	849,276	827,365	3,901,352





Training on Proper Financial Reporting

Sample financial reporting template attached to sub-grant agreement




Sample partner year-end balance confirmation template

Training on Proper Financial Reporting

Partner Financial Reporting – Areas of Improvement

- Ensure the budget allocated are complied with sub-grant agreement categories.
- Ensure the reporting period stated in financial report is accurate
- Ensure consistency of expenditure reported for previous periods
- Ensure the expenditure stated in financial report is aligned with fund status report and transaction listing
- Ensure fund status report is complete
- Ensure the information reported in transaction listing is accurate & complete



Thank You

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About WorldFish

WorldFish is a leading international research organization working to transform aquatic food systems to reduce hunger, malnutrition, and poverty. It collaborates with international, regional, and national partners to co-develop and deliver scientific innovations, evidence for policy, and knowledge to enable equitable and inclusive impact for millions who depend on fish for their livelihoods. As a member of CGIAR, WorldFish contributes to building a food- and nutrition-secure future and restoring natural resources. Headquartered in Penang, Malaysia, with country offices across Africa, Asia, and the Pacific, WorldFish strives to create resilient and inclusive food systems for shared prosperity.

For more information, please visit www.worldfishcenter.org