



Combating Malnutrition in Vulnerable
Populations with Spirulina

UGANDA 2023-2025

THE PROJECT

Project Title:

Combating Malnutrition in Vulnerable Populations with Spirulina

Project Description:

Promoting Health and Food Security by introducing a food with a complete nutritional profile to be added to drinking stations and creating bio-fortified foods to aid in the optimal health of children and those in vulnerable situations.

DURATION OF PROJECT

Start Date: January 2023

End Date: December 2025

THE BLUE ATLAS PROJECT

The Blue Atlas Project is a 501(c)3 non for profit registered in the United States. Blue Atlas (BA) is chiefly dedicated to creating sustainable food system solutions with vulnerable populations contributing to food security, resiliency and economic independence. We study the pre-existing challenges to nutrition, farming and growing food in each location, before introducing tailored solutions designed to overcome the specific obstacles faced by these vulnerable communities. We respond to needs, create culturally aware approaches, and empower community members to control their health and food system.

We believe each individual, family, and community deserve access to locally grown, inexpensive, nutrient dense food. The primary benefits of supporting food security through a hands-on training center are immediate access to locally produced nutrient dense food, knowledge sharing and capacity building that will improve health and reduce dependence on aid and imports. Secondary benefits include economic stimulation by keeping more money circulating locally, nutrient dense food, and value-added goods small business development.



EXECUTIVE SUMMARY

Innovation within the agriculture sector creates opportunity to radically change both the economics of small shareholder farmers and help combat the leading causes of death worldwide; hunger and malnutrition. Most parts of the world are impacted adversely by climate change and disasters, making it increasingly difficult for subsistent and small shareholder farmers to provide for themselves and their communities. This is also true for small farmers to grow nutrient dense foods in a way that effectively fight greenhouse gas emissions. This has led to a reduction in the variety of crops and yields. This proposal provides an approach to help combat both ailments through a simple farming paradigm that supplies spirulina through a climate responsible method that drastically reduces greenhouse emissions while supplying a nutrient dense food supplemental with a complete nutritional profile to schools, partner organizations and businesses.

Our aim at The Blue Atlas Project (BA) is to help provide sustainable food solutions with vulnerable communities. This proposal will introduce a project sponsoring the development of a Community Based Organization in Uganda as the first spirulina farm in the country; the Spirulina Development Institute (SDI). The BA leadership team will develop SDI over a two-years to fully scale production and be positioned to work with schools across Uganda. In accordance with the Uganda Nutrition Action Plan (UNAP) for 2019-2025 (see link in addendum; page 70-71) we are working with the Government to develop standardization on the spirulina and develop capacity to work together to achieve the common goals. We also will partner with organizations to enhance public and private food programs, provide the superfood to those interested, and provide a regional training center. SDI will stand as a platform to bring together a new paradigm of farming, health and nutrition, and environmental benefits of plant-based, protein-rich, nutrient dense spirulina. Lastly, this will create an awareness campaign based on the continuing research and oversight with our partner schools and case-studies.

As SDI grows and partnerships expand, BA will utilize SDI to create a Give Back Program (GBP), which will be cornerstone of research carried out through this project. GBP will partner with schools during Phase I by building agreement-based partnerships where SDI will install and build sanitary drinking stations infused with spirulina daily to provide the supplement in a bio-available way to the student population. During construction of the pilot and initial expansion, we will grow to work with 10 schools and 12 selected individuals as a case-study over the first 12 months. The GBP will be utilized as the foundation of the research carried out to demonstrate the effectiveness of this superfood into combating illnesses and malnutrition. As SDI grows and the partnerships expand to provide financial sustainability to the institution, so will the GBP. Utilizing the information gathered from the schools and case-studies, the GBP will transition to offer small grants to farmers. These grants will help establish their own businesses enabled by SDI's training and expertise, to create their own spirulina farms or value-added good businesses.

NEEDS ANALYSIS

- As research and programs have shown, small shareholder and subsistent farmers are most adversely affected by climate change and will continue to be so, especially in locations such as Uganda, where high percentages of malnutrition remain despite availability of land and fertile soil. This is quantified most exceptionally in infant mortality and death among children under 5 (population under 5 = 7.5 million)
 - The irreversible effects of wastedness -4% under 5;
 - The irreversible effects of stuntedness-29% under 5;
 - 53% suffering from anemia and 11% underweight.

Spirulina is an exceptionally stable, scalable and sustainable method to provide an avenue for combating these all-too-common ailments, as well as become a demonstration project to be replicated in many regions for overall health and to serve as emergency nutrients when disaster strikes. The most vulnerable are heavily reliant on on-going food aid; this is true during and post disaster. Yet poverty is an on-going disaster, as seen through the efforts of many agencies attempting to combat the suffering it creates. However, climate change will continue to multiply these challenges, therefore we must look for unique techniques in the near term to create the most comprehensive solutions possible, for immediate responses and long-term impacts. At BA, we believe it is imperative to invest in solutions that use space efficiently and effectively to grow the most nutrient dense food in locations to create the most impact.

- Uganda suffers from a high poverty rate; 42% living on less than \$1.90/day according to recent studies. Uganda is also positioned to be influential and stable force in the region, offering support to numerous surrounding countries. It is also home to several refugee camps. We are creating partnerships with those who operate and fund the private and public schools, the refugee camps and other food programs to see how we can enhance the nutrient value of the food and/or the water they provide. This will be through controlled sanitary drinking stations or bio-fortified foods, such as maize flour.
- BA looks for creative methods to provide immediate and long-term solutions. While our aim is to combat malnutrition and utilize SDI as a means to achieve this, we also want to look at the long-term impacts of malnutrition over time. While the physical impacts of malnutrition appear to be the most noticeable, there are also long-term detrimental effects on both cognitive and emotional capacity. Malnutrition is a form of trauma. A complete nutritional profile must be more than calories - one is still destined to suffer throughout their lives if lacking the necessary nutrition throughout their childhood, resulting in stuntedness in mental development as well as physical. This creates a cycle that will take generations to overcome. As each generation begins with a solid nutritional profile, there will be a reduction in costs and in income lost, impacting the GDP of Uganda over time.

SOLUTION

- The Government of Uganda has several policies and programs to support optimal nutrition. These include fortifying selected foods, breeding crops to increase nutritional value, providing supplements, and offering infant and young child feeding programs, according to the CDC. They have taken samples from 3200 households attempting to monitor micronutrients status in infant and young child feeding. While there have been improvements, we believe it will take a more innovative approach working with the Ministry of Education, Health, and agriculture to make this superfood more readily available to combat nutritional deficiencies that are the leading causes of child and mother ailments. We are in conversations with the Ministry of Education to work with all schools across Uganda as we build SDI to capacity. We are in the initial phases of constructing the infrastructure for our pilot demonstration where we will be able to support 10 schools in the Fort Portal region along with a diverse sampling for a case-study. Through existing studies and institutions there is evidence that spirulina has quantifiable nutrient density to have a lasting and great impact on those suffering from malnutrition.
- Through the SDI pilot center, BA will be positioned to provide on-going training for the expansion of farming spirulina for personal and commercial production in the region. Our research clearly illustrates the market for health focused foods exists, while the awareness of spirulina is low. SDI will also maintain a market and awareness campaign for our governmental and food agency partnerships. This campaign will focus on the nutritional profile of spirulina and the specific health problems it helps alleviate. Through this, we will have the platform and health indicators to collectively monitor the overall success of the addition of spirulina into the food system and food programs.
- This initiative creates a nutrient dense food and supplement at the farm level. Working with both National Drug Authority and the Uganda Standards Body, SDI will be the first spirulina farm in the country to provide standardization and regulation of the superfood. As a method to provide additional information for study, BA will be working with a sampling of individuals who suffer from specific ailments over a 12-month period to monitor results. This information will be provided to partner agencies and the public.



- Spirulina is an effective tool against greenhouse gas emissions. Through photosynthesis, one acre of spirulina can remove 2.7 tons of CO₂ per day. This stands to be 10x-50x more than terrestrial plants. BA focuses solutions that are climate smart and lead to a more holistically healthy individual and planet. It is imperative that we create nutrition and agriculture solutions with a forward thinking climate smart approach to combating climate change.
- We will also be focused on creating and demonstrating the market viability for commercial farms in Uganda. This will be through creating Business to Business (B2B) opportunities with SDI. Sales are linked to market research to ensure that partnerships are made to further the impact of overall health and wellness for sustainable and meaningful income.
- This proposal seeks funding from donor agencies, focused on alleviating the impacts of malnutrition and hunger primarily on children, mothers and those in vulnerable communities in Uganda by developing a Spirulina Development Institute as an innovative approach to provide trainings and education for replication and opportunities for expansion through partnerships. It will serve as blueprint for spirulina development in the country and region, this pilot project will be implemented on 4.5 acres just outside of Fort Portal, Uganda. We will also be selecting a random 12-15 people with diverse health concerns to take part in a health study.
 - Pilot Project: which will be based on providing an innovative solution to malnutrition with spirulina (see addendum 1 for the complete nutritional breakdown along with benefits and what deficiencies look like) along with on-going trainings for expansion and other income generating initiatives. Phase I will include the infrastructure to grow, harvest, dry, store and package spirulina in a safe and secure way.
 - Two- 7-meter x 15-meter cement ponds with liner constructed as a raceway. The water is circulated by an agitator which is connected to a turbine. It will be harvested by micro screens and water pumps into a separate cement station. Tools will be on site to support the growth and monitoring of the integrity of the spirulina. Post-harvest the spirulina will be taken to the production shed where it will be examined, pressed, dried, and stored.
 - A member of our team has been trained by spirulina farmers and is overseeing the initial phases of construction with support. We have spoken to an additional two trainers who would come to Uganda and provide in depth knowledge and support for farming and spreading awareness of Spirulina. These will be the cornerstone trainings of our "Train the Trainer" series to enable the staff and leadership of SDI to then carryout additional trainings for the public.
 - Surveys to better understand through the Pilot and Phase I of the project the impact on the children at schools and diverse case- studies will be provided as baseline forms for a sampling of 10% of the student body the spirulina is being provided for along with follow up surveys to be filled out by their respective teachers every two weeks.



- These studies will be used as a blueprint for the Government, donors and other development partners for future growth and interventions. While SDI will be contained on one site, the study will be regional during Phase I and expanding countrywide during Phase II to ensure that diversity is paramount for how this superfood can combat malnutrition.
- We are framing conversations with the National Drug Authority and Uganda Standards Body to bring spirulina to the national level of safety regulation and standardization. During Phase II once we have expanded our capacity, we will be creating a standards lab on-site at SDI.
- Our farmer trainings will offer insights into benefits, income generation for both domestic and export markets to be perfected with opportunities for expansion beyond the proposed project area. SDI will be built to provide exchange visits for farmers, extension staff, specialists, and NGOs from other countries where malnutrition and hunger is poses a serious threat.
- SDI will increase its partnerships with schools, individuals, and food security focused organizations to increase the nutritional content via water stations or bio-fortified foods to be distributed to vulnerable populations
- As SDI grows and becomes financially self-sustaining from partnerships and domestic and international sales, our GiveBack Program will transition and create a revolving fund for new and young farm growth. BA's Scaling Up Local Agriculture (SULA) Grant will be offered via SDI and managed by the SDI leadership team and community board of which BA will retain a seat. Through trainings and financial input, we are strategically creating this project to enhance sustenance and continuity of our goal to create more food security in the region during and after phasing out.

JUSTIFICATION

Through our project we will create a baseline survey over Phase I to develop a comprehensive nutritional footprint that can be addressed by the innovative and climate smart farming practices of growing the superfood spirulina as a supplement and food source to combat wastedness, stuntedness and malnutrition. Through our pilot project SDI, we will show the effectiveness of the superfood as well as develop a market for a high value product that could supplement not only their wellbeing but also their income.

This project is in response to the need for an influx in a food that can be grown in a closed-loop system, conserving water and adaptable in a constantly changing climate. Spirulina was chosen due to high nutritional profile and spatial efficiency. This project will provide us with a sustainable model that could be replicated strategically to work in areas to combat malnutrition world-wide while demonstrating economic viability and resilience for farmers.

OBJECTIVES

- To undertake a study to develop a comprehensive result driven impact report to showcase the benefits of spirulina on combating malnutrition on vulnerable populations. Produce analyzed study results reflecting the impacts of a large scale study on diverse populations via drinking stations and bio-fortified foods. Will include a roadmap for replication in strategic areas.
- To improve the quality of life through physical, mental, and emotional health for children, pregnant women and new mothers, vulnerable groups and interested community members around Uganda.
- Phase I: Five schools of over 1800 students and teachers will be directly impacted and 7200, indirectly through their families with community outreach and informational talks hosted by the community board of SDI, along with another 12-15 individuals for our case study. We also begin to work with food programs to utilize spirulina in bio-fortified maize.
- Pilot SDI as an innovative farm and training center to provide spirulina to vulnerable communities across Uganda and establish it as a regional training center.
- Create a network of partnerships that will include the Government, developmental organizations, and schools to spread awareness, participate and provide the supplement to children, interested businesses and individuals through sales and those participating in our case study.

Budget Justification

Here is a detailed description of the budget phases. An excel sheet will also be provided from extreme budget detail.

Project Administration

The project will be administered by The Blue Atlas Project and the costs categorized include availing finance for the implementation, ensuring the reporting to the donor(s) is done timely and accurately and working with project management to make sure all executables will be carried out efficiently.

Logistics:

- The Blue Atlas Project will provide vehicles for product deliveries and transporting consultants and trainers, they will be for outreach to school programs and community events, and for the invariable other supplies that may be needed to ensure that the project is successfully completed within the timelines for production during Phase I. Further it will serve in transporting inputs, monitoring officers and farmers.

Transport:

- Phase I: For outreach and deliveries and continued work; two motorcycles are requested

Project Supplies: See the detailed description of funding requesting in the attached budget

- Ponds: 7m x 15m cement ponds with liners
 - Phase I: 2 ponds
 - Phase II: 4 additional ponds
- Harvest House: One per two ponds
 - Phase I: 1
 - Phase II: 2 additional
- Storage/ Office/Guard Building; Three room building:
 - Accommodation for security guards 24 hours a day
 - Tool Shed
 - Office for record keeping
- Production House: Where the processing and cold storage will occur
 - One for both phases. This will include guest room on a second floor for trainers.
- Greenhouse: Providing a canopy to keep debris and rainwater from entering the ponds, along with ground prep
 - Phase I: one: Along with driveway to site, stones and cement to hold greenhouse
 - Phase II: One additional greenhouse
- Oven and Drying Station: Steel framed building wrapped in black durable plastic to utilize thermal heat to the racks of drying spirulina. One for both phases.

Budget Justification

- Fertilizers: Initial cost of fertilizers per pond along with on-going supply. (For complete financial breakdown see addendum)
- Drinking Stations for schools:
 - Creating sanitary drinking stations to infuse with dried spirulina for children and staff, will be infused with dehydrated juice powder for flavor.
- Latrine: Necessary facilities for workers and trainers/trainees on-site
- Solar: Necessary power infrastructure to power: agitators, pumps, cold storage
- Fencing: Around entire property to protect from outside disturbance or manipulation of ponds

Marketing

- Packaging: for B2B sales and samples
- Manuals: For benefits, consumption and how to mix for schools.
- Handouts: For outreach and community information sessions
- Logo design: To be included on packaging and handouts
- Signs: To provide name recognition and attribute sponsor/partner efforts
- Banners: For mobile recognition

Capacity Building for Trainers, Extension Staff and Farmers:

- Trainings: Once SDI construction is completed, we will begin hosting trainings and tours to introduce interested individuals, partners Government representatives. The trainings will be focused on sharing the how-to of developing your own farm.
- Housing for Trainer: As part of the construction of the Production House, we will have guest quarters to house trainers or extension staff and other representatives during visits.
- Exposure and Exchange Visits: As SDI is established, we will begin hosting exchange visits from the region to help share knowledge and the impacts of Spirulina on the malnutrition crisis. We will create SDI and host interested parties to share our design and project as a replicable operation.

Studies and Baseline:

- This is a crucial component of the project. Our initial and follow up surveys monitoring the effects of spirulina as an additional food source on the over-all health of children, selected case studies of various ailments/illnesses and the overall population. We will be monitoring the impacts over a 5-year period with monthly reporting requirements for all participating schools and individuals. This will continue past the implementation phase and into the monitoring phase.

Project Visibility and Monitoring & Evaluation:

- BA will be working with localized media institutions to help spread awareness of Spirulina and how this innovative approach can help meet Uganda's goals of combating malnutrition among children by 2025 as stated in the UNAP. As we establish SDI and prepare for trainings and tours; we will be reaching out to in-country and regional extension staff. We will also be hiring a videographer to grasp document the development.

Budget Justification

Project Management, Monitoring & Evaluation:

Project Management (PM)- The Blue Atlas Project is the implementing partner of the project will work closely with the Government agencies including the Ministries of Education, Health and Agriculture and sector partners to implement the project. The PM will work with the SDI technical team to oversee the implementation.

BA will be working with the technical team and the community of the project to create a community board to oversee the long-term operations of SDI. This will include providing support to the board for outreach and awareness campaigns.

Project Monitoring- Periodic monitoring will be in the hands of BA and the SDI Technical team on a continuous basis and will involve stakeholders from partners. BA will ensure that SDI and trainers get the support they need to implement the project well. SDI tech team will provide monthly reports to the BA PM

Reporting- BA will orchestrate quarterly meetings with all stakeholders to review progress, monitor health survey results and impact studies and provide advice on steps forward. BA will analyze results and share at large. BA will also carry out scheduled site visits for streamlining implementation.

Evaluation- There will be a mid-term project evaluation after Phase I and at end of year 1 on project deliverables and impact studies. There will also be follow up and final implementation reports. Monitoring will continue for an additional 18 months for research to continue and be analyzed. This will be conducted in accordance with the donor recommendations.

Sustainability- SDI will itself be established to become financially self-sustaining over the first 24 months of the project. They will do that over partnership creation with Government and NGO's, along with Business-to-Business sales. BA's project management will over the period be absorbed into the organization's operating structure; all on-going project components will be incorporated into SDI's regular operations. This includes continued data analysis of the impact of spirulina.



Alignment with United Nations Goals



The United Nations Development Program created Sustainable Development Goals (SDGs). The 17 SDGs are integrated - that is, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

The Blue Atlas' mission, vision and current project objectives are in line and directly support two key goals:

UNDP Goal 2: Zero hunger:

The number of undernourished people has dropped by almost half in the past two decades because of rapid economic growth and increased agricultural productivity. Many developing countries that used to suffer from famine and hunger can now meet their nutritional needs. Central and East Asia, Latin America and the Caribbean have all made huge progress in eradicating extreme hunger. The SDGs aim to end all forms of hunger and malnutrition, ensuring all people have sufficient and nutritious food. This involves promoting sustainable agricultural and supporting small-scale farmers and equal access to technology and markets.

SDI focuses on combating malnutrition among children in Uganda, providing analyzed results and educating the community on sustainable, high yield, nutritionally dense growing techniques to be replicated by individuals and small farms; promoting access to the system technology while expanding yield to market.

UNDP Goal 12: Responsible consumption and production:

Achieving economic growth and sustainable development requires we urgently reduce our ecological footprint by changing the way we produce and consume resources. Agriculture is the biggest user of water worldwide, and irrigation now claims close to 70 percent of all freshwater for human use. A large share of the world population is still consuming far too little to meet even their basic needs. Halving the per capita of global food waste at the retailer and consumer levels is also important for creating more efficient production and supply chains. This can help with food security and shift us towards a more resource efficient economy.

BA's utilization of climate smart growing techniques such as spirulina greatly reduces water usage while pulling more green house gas emissions from from the air than terrestrial plants. Spirulina also provides a complete nutritional profile that could be instrumental in fighting malnutrition to all vulnerable people.

Uganda Nutrition Action Plan

2019-2025

Excerpt from Page 70 & 71:

"Strategy 2. 8: Increase trade, industry and investments in scaling up nutrition Priority actions

- Build capacity of local industries to adopt appropriate technologies for industrial food fortification and processing of nutrient dense foods.
- Support industrial uptake and value addition of bio-fortified crops.
- Enforce surveillance for enhanced compliance of the mandatory food fortification regulations.
- Build capacity of Micro, Small and Medium Sized Enterprises (MSMEs) in the food sector with compliance to quality and standards.
- Support traders and processors of foods to form viable cooperatives.
- Mitigate non-tariff barriers that affect food and nutrition.

Objective 3: Strengthen the enabling environment for scaling up nutrition specific and nutrition sensitive services

Strategy 3.1: Strengthen nutrition governance at central and local government levels.

- Priority actions
 - Strengthen nutrition coordination, partnerships and accountability at all levels.
 - Improve planning, resource mobilization, financing and tracking nutrition investments.
 - Support development and implementation of capacity development framework for nutrition at all levels.
 - Strengthen advocacy, commitment and leadership for nutrition at all levels. 70
 - Strengthen systems to promote multi-sectoral Social Behavior Change Communication (SBCC) for nutrition at levels.
 - Strengthen coherent policy, legal and institutional frameworks for nutrition at all levels.
 - Strengthen implementation convergence for multi-sectoral nutrition actions.

Strategy 3.2: Mechanism for nutrition evidence and knowledge management along with multi-sectoral nutrition information system strengthened and institutionalized for effective decision making

- Priority actions
 - Design and implement a Monitoring Evaluation Accountability and Learning (MEAL) Plan for UNAP II.
 - Develop a functional information platform for nutrition at national and local government level.
 - Strengthen and scale up early warning systems, survey and surveillance on food and nutrition from community to national levels.
 - Develop, disseminate and enhance use of evidence based nutrition knowledge products at all levels.
 - Support development of sector specific research and assessment Plans for UNAP II."

ANNEX 2 - Community Board Biographies

SDI Community Board:

1. Byamukama, Robert:

Robert is a business man and community leader, respected in the community. He is involved on boards of several community level savings groups and school boards .He brings to the board his understanding of the community where he will be a link between the organization and the community.

2. Karungi, Veronica:

Veronica is a nurse by professional and has dedicated her life to serving the community. She established a clinic and drug store in the community where every day she works with the sick to provide care.

3. Boonabana, Everyln:

Everyln is a farmer and respected woman leader in the community. Because of her experience and elderly status, she provides counseling to community members. She also works on a couple of women savings groups as a treasurer in the community.

4. Tumwine, Annet:

Annet is a farmer and church leader, she is interested in spirulina because of expected benefits it will bring to the sick. She has two kids with sickle cells and she hopes, it will tremendously help them

5. Kabaseveni, Aida:

Aida is a local businesswoman and a farmer. She is engaged in goat farming and runs a successful store.

6. Arimpa, Lydia:

Lydia is a nurse by training and she too, like veronica runs a drug shop alongside doing subsistence farming.

ANNEX 3 - Phase I Productivity Breakdown

Phase I Partner Schools

1. Trinity Nursery & Primary School: Student Population : 187 students
2. Muhangi Primary School: Student Population: 722 students
3. Kyaburungi Nursery & Primary: Student Population: 220 students
4. St. Jude Primary: Student Population: 200 students
5. Westville Secondary: Student Population: 460 students

Total Students + Teachers = **1834 individuals**

Phase I Spirulina Needs

*Based on 3 grams/day per person

*Based on 5 day school week

*Based on 9 months a year (39 weeks)

$1834 \times 3 = 5502\text{g/day} = 27,510\text{g/week} = \mathbf{1,073\text{kg/ School year}}$

Phase I Production

2 Ponds x 8kg (dry)/day = 40kg/week = **2080kg/ year**

Phase II Spirulina Projections

Fifteen schools = 5496 (Students + Teachers)

Needs: 3,215kg/ school year

Production (6 ponds): 6240kg/ year

ANNEX 4 - Fertilizer

Fertilizer: = \$2225 for startup and 6 month supply

- Sodium Bicarbonate: 101662 @ 25kg =\$28USD
- Magnesium Sulphate: 111193 @ 25kg = \$30USD
- Potassium Sulphate: 101662 @ 25 kg = \$28USD
- Potassium Nitrate: 111193 @ 25 kg = \$30USD
- Phosphate: 190616 @ 50kg = \$51USD
- Urea: 177908 @ 50kg (carbamide – frequently found in mammalian urine) =\$48
- Salt: 5000 @ kg = \$1.35 USD

Pond Start: for each (x4)

- Sodium Bicarbonate: 125 kg = \$140 USD = \$560
- Salt: 100 kg = \$135 USD = \$540
- Potassium Nitrate: 44 kg = \$60 = \$240
- Potassium Sulphate: 4Kg = \$4 = \$28
- Phosphate: 2 Kg = \$1 = \$51
- Iron: 200 g = \$110 for 25KG
- Magnesium Sulphate: 4 kg = \$4 = \$30

Daily Fertilizer needs per pond:

- Sodium Bicarbonate: 2.5kg = 6 months = 455 kg = \$532
- Potassium Nitrate: 200 g = 6 months = 37 kg = included in quantity to start
- Potassium Sulphate: 60 g = 6 months = 11 kg = \$28
- Magnesium Sulphate: 60 g = 6 months = 11 kg = \$30
- Phosphate: 80 g = 6 months = 15 kg = included in quantity to start
- Urea: 400 g = 6 months = 73 kg = \$96

Annex 5 - Nutrient Profile of Spirulina

Spirulina Nutrient Breakdown:

Here we will breakdown the nutrient content to: Protein, Amino Acids, Fatty Acids, Micronutrients and Phytonutrients.

It is worth noting that the dry weight of Spirulina has a protein content of 64.24%. This is substantial compared to the most plant-based foods which have a protein content of 35%.

Amino Acids:

- Spirulina has 9 out of 9 of the essential Amino Acids. Here we will provide a breakdown of the amount of each amino acids that is contained per 1 gram of dried spirulina compared to the Recommended Daily Value (RDV) from the World Health Organization (WHO) of each per 1kg of body weight. This will show that there is substantial amounts of each in each serving of 3 grams of Spirulina.

Amino Acids	mg/ 1 g of dried Spirulina	RDV per 1 kg of body weight
• Luecine	55mg	42mg
• Tryptophan	10mg	5mg
• Methionine	14mg	19mg
• Phenylalaline	28mg	33mg
• Lysine	30mg	38mg
• Threonine	33mg	20mg
• Isoluecine	36mg	19mg
• Valine	45mg	24mg
• Hystidine	10mg	8-12mg

Why are amino acids important?

- Essential amino acids are necessary to obtain from your diet as your body does not make them. They are the main component of all tissue in the body and regulate vital processes such as building proteins, hormones, neurotransmitters, muscles, and your immune system. All of this is to say they play in important role in your physical, cognitive, and emotional well-being.

What do these Essential Amino Acids do?

- Phenylalanine
 - Creates neurotransmitters such as: tyrosine, dopamine, epinephrine, and norepinephrine. Plays an integral role in the structure and production of proteins, enzymes and other amino acids.
- Valine
 - Helps stimulate muscle growth, repair and coordination. It is involved in energy production; including mental energy and emotional regulation.
- Threonine
 - Important component of many proteins such as: tooth enamel, collagen and elastin. Vital for nervous system regulation and can alleviate anxiety and mild depression. Helps regulate intestinal disorders and indigestion while metabolizing fat (prevents fatty build up on liver).
- Tryptophan
 - The precursor to serotonin (a feel-good chemical in the brain) which is an important neurotransmitter that is essential for mood, sleep and appetite.

ANNEX 5 - Continued

- Methionine
 - Required for tissue growth and repair. Involved in detoxification by protecting cells from pollutants by aiding in the absorption of vital minerals zinc and selenium and excreting the harmful heavy metals such as lead and mercury
- Leucine
 - Critical for protein creation and bone and muscle repair, protecting the muscle from breakdown after trauma or severe stress. Helps regulate blood sugar, wound healing and produces growth hormones.
- Isoleucine
 - Has diverse physiological functions such as; wound healing, detoxification, immune support and helps secrete several hormones. Necessary for hemoglobin production and energy regulation.
- Hystidine
 - Necessary for histamine production which helps regulate allergic reactions, protects nerve cells and enhances the growth and repair of damaged tissue.
- Lycine
 - Required for growth of tissue repair and production of collagen and elastin. Strongly promotes immune function.

What does a deficiency in Essential Amino Acids look like?

1. Decreased immunity
2. Digestive problems
3. Depression & Anxiety
4. Fertility issues
5. Lower mental alertness/ Hard time concentrating
6. Slowed growth in children
7. Muscle loss
8. Slower healing time

There are also non-essential amino acids. These are amino acids your body can produce but may need to be enhanced conditionally during specific circumstances: illness, pregnancy, infancy, and trauma.

There are 11 non-essential amino acids and the amount of mg/dried g of Spirulina:
Spirulina has 9 out of the 11.

Non-Essential Amino Acids	Amount present in Spirulina	Conditionally Vital
• Alanine	47mg	No
• Arginine.	44mg	Yes
• Aspartic Acid	60mg	No
• Cysteine	7mg	Yes
• Glutamic Acid	92mg	No
• Glycine	32mg	Yes
• Proline	27mg	Yes
• Serine	33mg	Yes
• Tyrosine	30mg	Yes

ANNEX 5 - Continued

Fatty Acids:

Fatty acids are the byproduct of your body breaking down fat, this provides numerous benefits and will demonstrate why healthy fats are important to the body. Below are examples of why they are important and what deficiencies look like.

Benefits:

1. Formation of healthy cellular membranes
2. Proper development and functioning of the brain and nervous system
3. Proper thyroid and adrenal activity
4. Hormone production
5. Regulation of blood pressure, liver function, immunity, and inflammation response
6. Regulation of blood clotting omega 6's and 3's which need to stay in balance
7. Supports healthy cholesterol levels
8. Support healthy skin and hair

Deficiencies:

1. Dry skin/dry rashes
2. Decreased growth in infants and children
3. More susceptible to infection
4. Poor wound healing
5. Fatigue
6. Poor memory
7. Poor circulation
8. Mood irregularity
9. Heart problems
10. Intellectual disability in children

Minerals, Vitamins & Pigments:

Minerals are inorganic micronutrients that are not produced in the body and come from the Earth. Here are the amounts present per 1g of dried spirulina.

Mineral	Amount present/1 g of dry Spirulina
Potassium	16mg
Calcium	15mg
Phosphorus	10mg
Manganese	3mg
Zinc	70ug
Magnesium	3.7mg
Sodium	2.5mg
Iron	1.7mg

Here are what deficiencies in these minerals look like in the body:

1. Constipation/bloating and abdominal pain
2. Decreased immunity
3. Diarrhea
4. Irregular heartbeat
5. Loss of appetite
6. Muscle cramping
7. Nausea and vomiting
8. Tingling or numbness in fingers
9. Feeling weak or tired (anemia)
10. Slowed growth
11. Slow social or mental development

Vitamins are organic micronutrients that come from plants and animals and spirulina offers a wide variety of them.

Pigments or Phytonutrients are an important part of antioxidants. Spirulina provides a good source of beta-carotene.

Due to these studies, Spirulina is categorized as a superfood which is why BA and SDI have chosen it to carry out this expanded project in Uganda.



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