

HARVEST FOR HEALTH BREAKTHROUGH CROP CHALLENGE

Pioneered by the Foundation for Food & Agriculture Research ([FFAR](#)) and the Global Alliance for Improved Nutrition ([GAIN](#)), Harvest for Health (H4H) aims to accelerate the development of underutilized crops and to increase the diversity of nutritious foods in the marketplace. There have been many public investments to develop underutilized crops in an effort to increase farmer income, provide more nutritious diets, increase resiliency within the food system, and increase biodiversity. However, meeting these goals will require substantially more investments from the private sector. To attract more private sector investment in underutilized crop development, FFAR and GAIN are investing in a predictive model that can help identify nutritious underutilized crops that demonstrate the most market potential as functional ingredients.

Key Dates

Concept Note Seed Funding Application Open:
Wednesday, March 16, 2022 at 12PM EST

[Create a new Application](#)

[Access saved Application](#)

Concept Note Seed Funding Application Due:
Wednesday, July 20, 2022 at 5PM EST

Seed Funding Announcements: Spring 2023

All recipients of the Seed Grant must apply for the Challenge.

Challenge Application Open: December 6, 2023

Challenge Applications Due: February 14, 2024

The H4H initiative consists of two phases:

- **Phase I: Breakthrough Crop Challenge** — this will focus on building a predictive model to identify underutilized crops with properties of interest to food and ingredient companies.
- **Phase II: Commercial Development of Select Crops** — this will focus on using the developed predictive model to prioritize underutilized crops for commercial development based on their potential for increased public and private investments.

This Challenge will focus explicitly on Phase I of the initiative.

The purpose of the Breakthrough Crop Challenge is to develop a predictive model to determine crop potential as a source of functional ingredients. The Challenge consists of two independent parts:

- Seed Funding: Predictive Model Concept Note (up to five awards of US \$75 000 each)
- Challenge: Predictive Model Development and Validation (US \$1.0 million*)

Once the Challenge winner is selected, the predictive model will be used for the commercial development of select crops to the stage that warrants investment by the private sector.

*FFAR and GAIN reserve the right to not issue funds if no predictive model meets all criteria outlined.

BACKGROUND

There are over 50 000 edible plant species in the world, yet only four crops comprise 60 percent of our global diet. Underutilized plant species contain a vast array of nutritional, agroecological and genetic traits that can contribute to food and nutritional security, improve biodiversity, and serve as sources for novel food and food ingredients. Moreover, there is growing consumer demand for more sustainable products, made from fewer refined ingredients, and using natural alternatives rather than synthetic food additives. As many food ingredients are derived from plant-based sources, the 50 000+ edible plant species that exist in the world present a tremendous opportunity to identify new foods and food ingredients. Prioritizing the development of underutilized crops with potential to succeed in today's market will be of utmost importance to ensure that we capture the rich diversity of edible plants for both human and planetary health.

The H4H initiative is interested in identifying promising underutilized crops that can be used as new sources of nutritious, functional, and sustainable food and food ingredients. The public sector alone cannot invest, develop, and integrate these new crops into the food system. It will require investment from both the public and private sectors. Little is known about how underutilized crops could be used in the food industry and, thus, pose a significant economic risk to the private sector. To attract more private sector investment in underutilized crops, H4H aims to take an innovative approach by investing in a predictive model that can help identify promising underutilized crops with characteristics that the food industry finds attractive and consumers find desirable.

BREAKTHROUGH CROP CHALLENGE DESCRIPTION

This Challenge aims to de-risk future investment in underutilized crops by developing a tool that can screen thousands of potential crops through a predictive model to determine a crop's usefulness as a functional ingredient. The predictive model must use currently available data and also be able to use data that will be available in the future, including genomic sequences and biochemical data as inputs for prediction. For example, see [African Orphan Crops Consortium](#), [Bioversity International](#) and [The Periodic Table of Food Initiative](#), some of which already are or will be publicly available resources. Using information from public resources, in addition to knowledge of specific properties of ingredients, applicants must be able to predict which crops will be of interest to the food industry and supply information on the specific criteria used for the prediction and demonstrate the use of the predictive model.

Challenge Overview

The Challenge is open to individuals from all organizations worldwide. Contestants do not need to participate in Seed Funding to participate in the Challenge or potentially receive US \$1.0 million*. The Challenge winner will be involved with FFAR in the utilization of the predictive model in Phase II of the program, which will be used to prioritize underutilized crops for commercial development based on their potential for increased public and private investments.

The H4H Breakthrough Crop Challenge consists of two independent parts:

- Seed Funding – Predictive Model Concept Note: Applicants will submit a predictive model concept note based on criteria outlined in the Application Details section below. Up to five (5) seed grants of up to US \$75 000 each will be awarded to most promising concept notes describing the development and validation of a predictive model to be used in Challenge applications. Applications for seed grants will be due on July 20, 2022. All recipients of the seed grant **must** apply for the Challenge.

- **Challenge – Predictive Model Development and Validation:** Applicants will develop and submit a validated predictive model outlined in the Application Details section below. All applications will be reviewed by an expert review panel and US \$1.0 million* will be awarded to the predictive model that meets all outlined criteria and receives the highest score from the detailed review. Applications for the Challenge will open Dec 6, 2023 and be due February 14, 2024. FFAR and GAIN reserve the right to not issue a prize if no predictive model meets all criteria outlined.

Eligibility

Any US and non-US public or private institution, consortium, non-profit organization, for-profit company, tribal government entity or any combination of the above is eligible to apply.

SEED FUNDING – PREDICTIVE MODEL CONCEPT NOTE: APPLICATION DETAILS

The Breakthrough Crop Challenge is requesting concept notes for predictive models to identify crops with market potential as a source of one or more of the following functional ingredients:

- A. Thickeners, emulsifiers, and stabilizers
- B. Bulking agents
- C. Taste and flavor enhancers
- D. High nutrient density (specific nutrients to be proposed by applicants)

Proposed models will be assessed and prioritized based on the number of functionalities addressed and the accuracy of their predictive abilities.

Ingredient functionality is dependent on specific physicochemical properties of molecules and, for less refined ingredients, the complex mixtures from which they are derived. For example, hydrocolloids are a class of compounds that include polysaccharides, such as starches used as thickening agents that can be found in a wide variety of crops, including potatoes, cassava, corn, lentils and cereals. Different hydrocolloids, often derived from different sources, have distinct physicochemical properties (e.g., solubility in cold or hot water, gelation, viscosity) that determine how well they function as thickeners, in addition to other functional ingredient properties such as stabilizers or emulsifiers.

For seed funding, applicants must state their hypothesis and outline a detailed plan to develop a predictive model using data that currently exists or is likely to exist for underutilized crops as model inputs. This includes, but is not limited to, compositional, genetic, and biochemical data. Applicants must provide descriptions of the volume and accessibility of data that will be used to build the predictive model. The predictive model may also consider advancements in processing and product development. Ideally, the predictive model will provide limited, reasonable predictions or inferences of functional properties using publicly available data on known ingredients that correlate the measured properties (see section on Examples of Important Measurements for Ingredients with Different Functional Properties below) with the potential applications and processing methods used to predict the desired quality and composition.

Seed Funding Submission Requirements

To submit concepts, applicant(s) must submit an [online application](#) using FFAR'S Grant Management System. Concepts must include:

- Principal Investigator (PI) contact information
- Title of concept note

- Clear description of which functionality(-ies) is/are being considered (up to 750 words)
- Approach to developing the predictive model and rationale for this approach (up to 3 000 words):
 - Description of the modeling technique
 - Model development methodology
 - Hypothesis of candidate variables that will be important aspects of the predictive model
 - Set(s) of data that will be used for calibration and internal validation of the predictive model, including a justification for the use of this/these data set(s)
 - Validation methodology plan using a range of crops and measured properties
 - Describe possible barriers and approaches for overcoming them.
- Qualifications of the Research Team
- Budget request amount (up to US \$75 000) and itemized budget justification

Examples of Important Measurements for Ingredients with Different Functional Properties

Thickeners, Emulsifiers, and Stabilizers

1. Solubility in aqueous and non-aqueous solution
2. Viscosity at standard concentration and shear rates
3. Particle size
4. Texture and gelation
5. Volatiles (aroma), non-volatiles, taste components (sweetness, bitterness, saltiness, umami, sourness)
6. Emulsification
7. Ingredient compatibility and unique interaction/mechanism in product formation
8. pH, acid/base compatibility, and functionality
9. Quality of protein – amino acid composition
10. Fiber (both soluble and insoluble)

Bulking Agents

1. Solubility in aqueous and non-aqueous solution
2. Melting range
3. pH
4. Saponification value, and ester value
5. Organoleptic qualities
6. Total sugars and reducing sugars
7. Ingredient compatibility and interaction/mechanism in product formation

Taste and Flavor Enhancers

1. Organoleptic qualities; Flavonoids
2. Solubility; ethanol, water, etc.
3. Molecular weight
4. Melting range and boiling point
5. Volatiles (aroma), non-volatiles, taste components (sweetness, bitterness, saltiness, umami, sourness)
6. pH
7. Refractive Index
8. Specific gravity

High Nutrient Density

1. Macronutrient (amount present. e.g., quality of protein [amino acid composition, bioavailability, etc.])
2. Fiber (both soluble and insoluble)
3. Micronutrient (vitamin and mineral composition)
4. Known or novel phytochemicals of value, e.g., anthocyanins

Seed Funding Review Criteria

Applicant submissions will undergo expert review. Reviewers will consider the following criteria when evaluating each Concept Note:

- ✓ Technical merit,
 - ✓ Technical approach and validation strategy,
 - ✓ Expertise and qualifications of the team, and
 - ✓ Appropriateness of data sets selected for developing the predictive model.
- ***Technical merit (25%)***
 1. Does the concept note clearly describe functional properties to be considered?
 2. Are the goals and objectives of the concept note clear?
 3. Are possible barriers addressed and approaches for overcoming them proposed?
 - ***Technical approach and validation strategy (30%)***
 1. Is the technical approach to developing the predictive model reasonable and scientifically feasible?
 2. Does the concept note describe the modeling technique to be used?
 3. Does the concept note hypothesize candidate crop variables that will form important aspects of the predictive model?
 4. Does the concept note describe the model development methodology?
 5. Are the validation strategies described reasonable and scientifically feasible?
 - ***Expertise and qualifications of the team (15%)***
 1. How well qualified is the individual, team, or organization to conduct the proposed activities?
 2. Does the concept note demonstrate that the applicant would have adequate resources to build a predictive model?
 - ***Selection of data sets (30%)***
 1. Are the data sets appropriate for developing the predictive model?
 2. Can the data set(s) be used to predict the selected properties of interest?

All reviewers are required to read and acknowledge acceptance of FFAR's [Conflict of Interest Policy](#) and [Non-Disclosure Agreement](#). We make reasonable efforts to ensure that applications are not assigned to reviewers with a real or apparent conflict with the applicant or project personnel. Reviewers with a conflict of interest are recused from evaluating or participating in the discussions of applications with which they have a conflict. Each stage of the review is conducted confidentially.

Seed Funding Application Submission Guidelines

Applications must be submitted by the deadline date through FFAR's online application [Grant Management System](#). Applications submitted outside of this System will not be considered.

If you are a new user, register for an account by clicking “Create Account” button located under the email address field on the left side of the home page. Once you log in, you may begin working on your application. Please be sure to save your work often by clicking on “Save and Finish Later”. To access a saved application, please do so through your [Grant Management Account](#).

CHALLENGE – PREDICTIVE MODEL DEVELOPMENT AND VALIDATION: APPLICATION DETAILS

All individuals from organizations worldwide that wish to apply for the Challenge, including those that did not participate or were not awarded a seed grant, are required to submit a validated prediction model that predicts a subset of the functionalities outlined above. The application will include:

- Clear description of which functionality(-ies) is/are being considered.
- A description of the predictive model, candidate variables, and all source code.
- Documentation of tool validation through prediction of one (1) known crop and three (3) underutilized crops chosen by the applicant, which have not been used previously as commercial sources of functional and/or nutritional ingredients. Documentation should list measurements for validation in a range of conditions/products, including the methods used to verify those measurements, and testing the functionality of the ingredient(s) in a food product.
- A prioritized and justified list of 10 –15 predicted crops that have the market potential for commercial development.
- Submit a narrated PowerPoint presentation (up to 3 minutes) on the proposed predictive model.

More details on the Challenge application will be provided after seed grants have been awarded in Spring 2023.

Challenge Review Criteria

The US \$1.0 million* will be awarded based on the predictive capability of the model and the outcome of the external peer review conducted by an external expert panel representing industry and academia. Demonstration of the predictive capability will be based on measurements provided by the applicant that highly suggest the potential of the ingredient as a source of functional property of interest and are confirmed through the validation process.

Important Note: The Challenge will open to receive full applications after the Seed Funding is completed. The Challenge application review criteria will be announced when it opens for submission on December 6, 2023.

TERMS AND CONDITIONS

Specific intellectual property (IP) terms for the Breakthrough Crop Challenge include the following definitions:

- “**Research Team**” refers to each applicant or team of collaborators that applies for and/or receives seed funding or US \$1.0 million*.
- “**Data and Technology**” means any and all trademarks, service marks, brand names, certification marks, trade dress, assumed names, domain names, trade names and other indications of origin, the goodwill associated with the foregoing, creations, inventions, discoveries, designs, know-how, technology, algorithms, procedures, processes, methods, techniques, software, websites, content, images, graphics, text, photographs,

artwork, audiovisual works, sound recordings, graphs, drawings, reports, analyses, writings, data, and other information.

- **“Software”** means all types of computer software programs, operating systems, application programs, software tools, firmware (including all types of firmware, firmware specifications, mask works, circuit layouts and hardware descriptions) and software imbedded in equipment, including both object code and source code, and all written or electronic data, documentation and materials that explain the structure or use of software or that were used in the development of software, including software specifications, or are used in the operation of the software (including logic diagrams, flow charts, procedural diagrams, error reports, manuals and training materials, look-up tables and databases).
- **“Intellectual Property Rights”** means any and all intellectual property and proprietary rights associated with Data and Technology arising under the laws of the United States and any other relevant jurisdiction, whether registrable or not, or comprising an application for registration or certification or regulatory approval, including without limitation, all: (a) rights with respect to patents, patent applications and similar rights (including utility patent, design patent, plant patent, plant variety protection and utility model rights); (b) copyrights, copyright registrations and applications for copyright registrations; (c) rights to authorship and moral rights; (d) invention rights, rights to trade secrets and rights to know-how and expertise, discoveries, information, data and material, and all derivatives, modifications and improvements thereof; (e) rights to trademarks (including goodwill), databases, and mask works, and any applications, registrations, and other rights with respect thereto; and (f) all other intellectual property rights and all rights and forms of protection of a similar nature or having equivalent or similar effect to any of the foregoing.

1. Each Research Team must own the right, title and interest in and to their proposed technology, which is used by such Research Team in the Breakthrough Crop Challenge, including the Intellectual Property Rights associated therewith and elucidate plans to protect any Intellectual Property Rights. Any intentionally false representation to this effect may result in revoking the Challenge funds.

2. Each Research Team will own the Data and Technology made, created, authored, invented (whether conceived or first reduced to practice or both) or developed by such Research Team during such Research Team’s participation in the Breakthrough Crop Challenge or resulted from the seed funding or US \$1.0 million* granted to it under the Breakthrough Crop Challenge and all Intellectual Property Rights associated therewith (collectively, the **“Project Results”**).

3. Each Research Team agrees to grant and hereby grants to each of FFAR and GAIN (each, a **“Licensee”**) a non-exclusive, fully paid-up, royalty-free, irrevocable, worldwide, perpetual license, with the right to grant sublicenses, to practice and use the Project Results for any and all lawful purposes, including any research, educational or testing purposes (the **“Non-Exclusive License”**). Each Licensee has the right to use or disclose the Project Results to any of its partners or collaborators for purposes of exercising the Non-Exclusive License granted to it hereunder.

4. Each Research Team shall make the predictive model available for research and academic purposes through non-exclusive, royalty-free licenses;

5. Subject to the Non-Exclusive License above, each Research Team shall have the right to commercialize the predictive model, either itself or through one or more commercial licensees, for the purposes of further development of the predictive model toward the goal in accordance with the following:

- (a) Entities who intend to develop a predictive model for commercial sale (whether a Research Team or a commercial licensee of a Research Team) (each, a "Developing Entity") must:
- (i) not grant exclusive licenses for Project Results (or any technologies resulting or derived from Project Results) to any end-users in a manner that would prohibit the applicable technologies from being broadly accessible to end-users; and
 - (ii) agree to use commercially reasonable efforts to make the predictive model (and any technologies resulting or derived from Project Results) broadly accessible to potential end-users.
- (b) Research Teams may impose royalties or other financial terms in association with their grant of commercial licenses;
- (c) If a Developing Entity intends to grant an exclusive license to the predictive model (or any technologies resulting or derived from Project Results), such entity shall allow FFAR to provide input on potential partners and licensees, and shall reasonably consider FFAR's input on such potential partners and licensees, provided that any grant of any exclusive license to potential end-users for such technologies that would prevent other potential end-users from using or accessing such technologies shall require FFAR's prior written approval and shall not adversely affect the grant of the Non-Exclusive License to each Licensee as provided above.