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Agriculture & Food Research Initiative: Food Security Challenge Area (USDA-NIFA-AFRI-004875)

Project Title: "Innovative Crop Production/ Food Security for Arid Regions"

Program Code: A5160 ... Agricultural Production Systems CAP (Coordinated Ag Project)

for research, education, & extension by NPI & University of Arizona for \$50,000.00 (.for 12 mo.)

Conference Grant: Request funding for bringing together project scientists for collaboration. .

Project Narrative

Previous Reviews: None

Rationale & Significance: As noted in the summary, one-third of the world is desert and a reported 822 million people living in or near those deserts are living on the brink-of-starvation (U.N. data). Increasing deforestation, desertification, and populations, along with prolonged drought in some areas (like California), water shortages and limited resources make food security issues a top priority.

The proposed project objectives are to research, test, develop, and demonstrate, as well as educate and provide extension services, for innovative means to develop and utilize limited water resources in support of new counterdesertification technologies providing the means for safe, efficient, and economical production of food, feed, fiber, niche, tree, and green energy crops on desert lands as well as drought-stricken areas ... to enhance U.S. and global food security and thereby reduce hunger-related conflicts.

By providing the means to produce higher crop yields with less water, on arid and desert lands as well as drought-stricken areas, the sustainability of U.S. agriculture and food systems shall be greatly increased. The following novel ideas will be developed during the subject project: 1) Use of the desert vegetable Facai (Fa Cai) as a new desert crop also providing ground cover and water conservation; 2) Forage improvement areas, for desert livestock & wildlife, based on plantings of tall, clump-type Napier grass as quality forage and protection of sand/ soils from wind; 3) Demonstration of the Bantu breed of cattle, Nguni, to provide proof of their very high productivity with poor forage, extreme heat, and limited amounts of water; 4) Innovative means of desert crop production using counterdesertification means as outlined in the project summary; 5) use of tubal-algalculture to grow crops of algal lipids and algal solids on desert lands while conserving and recycling production water; 6) Intensive, rotational grazing and forage improvement programs to produce more livestock efficiently on less land; 7) New means of harvesting, storage, conservation, and subsurface, micro-drip irrigation of water; and 8) Demonstration of the advantages of integrated, symbiotic planting of arid region food, feed, fiber, niche, tree, and green energy crops.

Approach: Conferencing and collaboration will take place, to plan and prepare for subject project, under direction of the PD (David Nuttle from NPI) and the co-PD (Dennis Ray, Ph.D., from The Univ. of Arizona). Included in this effort will be NPI's staff, and university researchers, educators, and extension personnel. Conferencing will also occur with: a) The Chinese Academy of Sciences (P.R. China), as regards Chinese research on Facai (Fa Cai) production; b) GOK (Govt. of Kenya) Ministry of Livestock Development, as regards the development of Napier grass as a forage crop; and c) Nguni Cattle Breeders' Society of South Africa, as regards the use of Nguni cattle for beef production on hot, water scarce, desert lands having poor forage. In addition, the PD and co-PD will conference with Hays Engineering & Manufacturing as regards the design, engineering and eventual manufacturing of water harvesting/ storage systems, water transport systems, subsurface, micro-drip irrigation, and artificial ground covers as well as windbreaks.

Activities will include the detailed planning of research, testing, development, education, and extension to include actual demonstration of crop production projects on desert lands. The sequence of events will generally be in the order given above following detailed conferencing, collaboration, and project planning between all the parties. An Arizona rancher/ farmer, with desert range and some farmland will be recruited and contracted for the U.S. demonstration project to follow development of project crop production models on the extension farms of The University of Arizona. Since food security is a global issue, an overseas project demonstration is planned for a desert area of Kenya, just east of Lake Turkana (In Kenya). Water for the Kenyan demonstration would come from Lake Turkana.

Scientific methods will be used throughout the project being planned, and each aspect of the effort will be segmented and tested alone before being combined with other elements of the project system. In the case of Nguni cattle, it is assumed that USDA will require that initial imports be in the form of fertile embryos only. There appear to be no USDA or other restrictions on the import of seed stock for Facai or Napier grass, but this fact will be confirmed as part of the project planning process. The eventual project will be a CAP (coordinated ag project) effort to include research, education, and extension in support of improving food security with an emphasis on deserts, arid regions, and drought-stricken areas of the U.S., w/ possible global program expansion. The project to be planned will be a \$4 million effort over a 3 year period.

The expected outcome of the requested conference grant is a project proposal, to USDA, to fund the work proposed in order to achieve stated objectives. An assessment of conferencing will be the successful completion of a project plan. Subject project itself will later be evaluated on the ability to produce large quantities of crops/ foods in a safe, efficient & economical manner that greatly increases food security in the U.S. and overseas.

Approach (Part II): Results of the planned project will be released to the media, USDA, and a number of agricultural publications, worldwide, as well as being posted on websites operated by participants. Potential pitfalls may be project and/or technical assumptions that prove to be in error. In some areas, security issues may be a limitation. For the project demonstration in Kenya, secure housing and alternative energy systems, as well as potable water and sanitation will need to be provided for the labor and security forces located in the crop production area.

The PD (Nuttle) has undertaken extensive prior research on all the components of subject project ... and there are no known materials, procedures, situations, or activities related to the project being planned that have a potential hazard to project personnel/ participants. The only exceptions are those overseas desert areas where terrorist, insurgent, or bandit activities may be taking place, or may take place in the future.

Our timeline to complete conferencing is 12 months. The project timeline will be detailed in the NPI & University of Arizona project proposal to be presented to USDA at the time of grant funding application. Overseas travel is anticipated in order for the PD to conference with Facai (Fa Cai) researchers at The Chinese Academy of Sciences (P.R. China). The Chinese require a direct face-to-face meeting to review their research on Facai, and view field trials on their Facai production. Conferencing with the Kenyans and South Africans will take place via email and telephone exchanges over the stated planning period.

Subject project is integrated and will include research, education, and extension, by highly qualified individuals in each of these categories. Resumes will be provided with the actual grant application to fund subject project. The effort will be planned to have sufficient resources to complete all stated objectives, and about one-third of the overall budget will be expended for each program area; i.e. research, education, and extension. A detailed plan for project analysis and evaluation shall be a part of the applicants grant application for full project funding. This request, again, is for conference funds only.

The Project Director (PD), David Nuttle, has consulted with potential stakeholders of subject project over the course of five decades of agricultural and national security project work in 42 developing nations. He hold patents, patents pending and trade secrets on all components of subject project, and consulted with potential stakeholders during the course of that work. Some examples include his U.S. Patent No. 5,121,708 on algal production, and U.S. Provisional Patent No. 61/744,995 on tubal-algalculture, as well as U.S. Provisional Patent No. 61/795,914 on an innovative food production system. The work being planned builds upon all this prior effort, and organizes a university support effort to help commercialize technologies and make them available to the public in support of increasing food security in the U.S. and overseas. A dissemination plan for distribution of project results shall be included as part of the full project application ... and that will include eXtension as well as distribution to 4-H and FFA youth.

Conference Grant Application Justification(s)

- A) Justification:** Subject project is complex and the planning requires inputs from a number of experts, with different backgrounds, all coming together to design the effort(s) and work as a team.
- B) Recent Meetings/ Conferences:** The PD (Nuttle) has had extensive email exchanges with the co-PD (Ray), the Chinese, the Kenyans, and South Africans, as well as Hays Engineering, regarding specific inputs they are planning to make in support of said efforts. (Planning conferences are now needed, directly between all the parties in separate groups due to location differences.)
- C) Names & Affiliation of Organizing Committee:** Chair is David Nuttle, President and Chairman of Needful Provision, Inc., as well as PD. The co-Chair and co-PD is Dennis Ray, Ph.D., Dean of Plant Sciences, The University of Arizona.
- D) Proposed Conferences Agenda:** The PD will have a series of three conferences, two months apart with the co-PD and university project team at The University of Arizona (the first meeting will be within one month of the requested conference grant funding). Within one month of funding, the PD will conference with Hays Engineering, in Oklahoma, as regards their project support as indicated herein.

Conferencing with the participating Kenyans (A.B. Orodho's Napier Research Team) and South Africans (Nguni Cattle Breeders Society and its staff) will occur several times over the Internet and by telephone conferences. In the case of The Chinese Academy of Sciences and Dr. Zheng Yu Hu's Facai Research Team, the PD must conference with them directly in Hubei, P.R. China (with the timing at the convenience of the Chinese). On the PD's return from China, he will stop in New Delhi, India to conference with the GOI (Govt. of India) Task Force on Deserts and its Chair Dr. Panjab Singh. The co-PD, Dr. Ray and other team members at the University of Arizona will participate by means of video-conferencing. Announcements of these meetings will be via emails to the parties.

Seed Grant Consideration: This conference grant request might also be considered a seed grant. If so, funds will be used to allow applicants to become competitive for future funding in support of the proposed effort(s).

Center of Excellence (COE) Justification: The University of Arizona may be considered as a COE, and that request will be made with our full grant application.

Bibliography & References: As presented with this application for a conference grant.

Facilities & Other Resources: NPI has a research farm, lab, office facilities, and global distance education center (operated in cooperation with Unlimited Learning, Inc.), in Montezuma

County, Colorado. In addition, NPI has an urban farming training facility in Greensboro, NC operated in cooperation with Hero Farms, Inc. (a refugee farmer-producer cooperative). Overseas, NPI has an African Division with a staff of 9 based in Kenya ... in Afghanistan, Tanzania, and Rwanda, NPI is preparing the broadcast extensive educational programming by means of distance education. NPI did have a large training center/ model farm where NPI's staff trained refugee farmers relocated to the U.S. That facility has been closed, and training is now provided by means of NPI's distance education programming. Communications support is provided to NPI by GIT Satellite and Singtel. Specialized transportation support is provided to NPI by Millennium Aerospace Corp. (MAC), a company with STOL-type cargo aircraft designed for operations in harsh and hostile environments.

The University of Arizona has extensive facilities and resources typical of a major university; e.g. classrooms, labs, computers, shops, research farms, assorted equipment, tools, and machinery as needed to support major research projects. Details on these facilities will be provided with the full grant application to follow this conference grant application.

Equipment: No equipment is required for this conference grant. Considerable equipment will be needed for the research project to follow, and that equipment will be listed in our full grant application. USDA Rural Utility Services just provided a \$400,000. Grant in the form of very advanced distance education equipment that will allow NPI to broadcast subject research results worldwide, to help all arid region farmers' increase crop production on desert lands.

Other Documents: None are required for this conference grant application.

"Key" Personnel:

The Project Director (PD), David Nuttle, has a farming background, BS degree in Agriculture, advanced training in tropical, desert, and urban farming, as well as being a published author and inventor in the sustainable agriculture area. Nuttle has five decades of agricultural and national security development projects in Africa, Asia, Latin American, the Middle East, and the U.S. A history of one of his early projects may be found in a study entitled "Buon Enao Experiment ... JP Harris," as now posted on Google. As noted above, Nuttle has prior research on the herein proposed efforts, and has patents, patents pending, and trade secrets related to the proposed project. For example, Nuttle's first research with Napier grass was in S. Vietnam, in 1960 in support of a forage development program for a Vietnamese Murrah Buffalo Dairy, at Hung Loc, Vietnam. Nuttle has worked with the GOK (Govt. of Kenya) on planning a unique counterdesertification project for Kenya as well as possible replicate project for the Navajo Nation, in Arizona (USA). (The proposed research effort will help make these projects possible.)

The co-Project Director (co-PD), Dennis Ray, Ph.D., is Associate Dean of the College of Agriculture & Life Sciences, The University of Arizona (2000 to Present). Ray has a history of

excellence in teaching, research, extension support, and scientific publications. His academic background is in zoology, genetics, plant sciences, and arid lands development. Dr. Ray will direct a team of researchers, educators, and extension personnel, all from The University of Arizona, who will be working in support of subject effort(s). Dr. Ray is qualified to take the lead on subject project, but has agreed that Nuttle has the relevant prior research, experience, and critical personal contacts to provide the effective project lead needed.

Logic Model: To be provided with the full application to follow this conference grant request.

Project Management & Data Management Plans: Same response as above.

Documentation of Collaboration: Letters of support and collaboration agreements are presented herewith from Needful Provision, Inc. (NPI), The University of Arizona, and Hays Engineering & Manufacturing.

For the pending full grant proposal letters of support will be added from: 1) The Chinese Academy of Sciences (for Facai research & seed stock); 2) A.B. Orodha and Quick Lift Two (QL2) for Napier grass seed stock and research; 3) Nguni Cattle Breeder's Society for fertilized Nguni embryos; 4) Unlimited Learning, Inc. (ULI) for support of distance education programming, worldwide, to educate farmers/ ranchers on research results; 5) Preparedness Systems Intl., Inc. (PSI) for manufacturing & delivery of project support systems; e.g. water harvesting, storage & transport devices, subsurface, micro-drip irrigation means, and artificial ground covers as well as windbreaks; 6) GOI (Govt. of India) Task Force on Deserts for lessons learned during the GOI's Thar Desert counterdesertification project; and 7) A yet to be identified farmer/ rancher, in Arizona, to undertake a demonstration project.

Expanded Background Info on the PD & co-PD: To be provided with our full grant application along with details on all current as well as pending support for other projects.

Budget & Budget Period: \$50,000.00 for a 12 month conferencing project as outlined herein.

Budget Justification: The proposed project is complex and requires a number of participants in the U.S. as well as in China, India, South Africa, and Kenya. Extensive conferencing is required to perfect the project plan to include research, education, and extension as needed to develop, demonstrate and teach new crop production and food security options for arid regions.

Funding Options: Both P.R. China and Kenya have extensive desert regions that are partly the cause of repeated food shortages. China and Kenya have both expressed a possible interest in funding subject project if USDA does not, for whatever reason. China has the funds, and Kenya plans to request funds from the World Bank. These options will be considered only if USDA is unwilling to fund subject conferencing grant, and/or later unwilling to fund our proposed

project. The Everglades Foundation may fund the tubal-algalculture portion of subject project for a demonstration of this technology, in Florida, to remove/ recover excess nutrients from waterways (before they pollute the Everglades), and as a carbon sequestration demonstration to help slow global warming. Of course, this effort does not relate to counterdesertification ... but it does show more than one use of a technology under development.

Overview of Possible Project Benefits

- 1) The innovative harvesting, storage, and transport of water for efficient/ water-conserving subsurface, micro-drip irrigation facilitates crop production on desert lands.
- 2) Where brush is plentiful and needs to be removed, biochar kilns may be used to make a bioactivated biochar that will typically double crop yields when blended with topsoil/ sand at a rate of 10 percent.
- 3) Addition of filtered livestock manure effluent to irrigation water provides the nutrients needed to enhance crop production.
- 4) Intensive, rotational grazing for livestock and wildlife has long been proven to greatly increase forage availability. By also planting Napier grass, irrigated and fertilized by the above said means, quality forage availability is greatly increased.
- 5) The planting of integrated mixes of food, feed, fiber, niche, tree, and green energy crops tolerant of arid conditions and planting of same in symbiotic relationships was proven to facilitate extensive economical crop production during the GOI (Govt. of India) Thar Desert counterdesertification project. (The subject project will greatly advance Thar crop production technologies.)
- 6) Nguni cattle, a Bantu breed, are highly productive and produce quality meats as well as colorful hides under harsh arid conditions with high temperatures, limited water, poor quality forage, and significant insect/ parasite problems. These cattle are probably the best livestock option for counterdesertification systems, and the manure they produce helps provide nutrients for crops via the above said means.)
- 7) Algal production on desert lands provides lipids (for biofuels), edible oils, and high protein food/ feed supplements as well as other algal products without requiring any productive farmlands to accomplish same. The use of tubes conserves production water and allows it to be recycled at harvest time. Innovative water development systems may be used to provide the water needed to make such production viable even on desert lands.

Submitted by: David A. Nuttle

David A. Nuttle, President; Needful Provision, Inc. & Project Director