The International Treaty
ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Full Project Proposal Guidelines

Third Call for Proposals under the Benefit-sharing Fund

Deadline for submitting full project proposal: 5th of December 2014
at Treaty-Fund@fao.org and PGRFA-Treaty@fao.org

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PROJECT PROPOSAL COVER SHEET

Project No.CFP 2014/2015-W2A-PR-35-Ghana (*For Treaty use. Do not write anything here)*

Project Title: **Sustainable Utilization of Cowpea genetic Resources for Enhanced Food Security and Poverty Alleviation in the Dry Savannah Northern Regions of Ghana**

Project duration: 3 years

Target crops: Cowpea [*Vigna unguiculata* (L.) Walp.]

Targeted developing country/ies Ghana

Other Contracting Party/ies involved __

Project geographic extension (km²) 10, 753, 000

Total requested funding $198, 792

Total co-funding $ 180,000 - In kind support by the University of Cape Coast

Please select the type of project you are applying for:

☒ Single-country Immediate Action Project (Window 2)
☐ Multi-country Immediate Action Programme (Window 2)
☐ Single-country Co-development and Transfer of Technology project (Window 3)
☐ Multi-country Co-development and Transfer of Technology project (Window 3)

Applicant

Name of Organization: University of Cape Coast

Type of organization Government Educational and Research Institution

Project Contact: (*name and position)* Dr. Aaron Tettey Asare

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SECTION A: EXECUTIVE SUMMARY

1. Executive summary

Cowpea [*Vigna unguiculata* (L.) Walp] is a vital source of cheap and affordable plant protein in the diet of not less than 80 % of the population of Ghana (25.9 million) especially in the rural communities and among school children. However, there are serious spreading adverse effects of the parasitic weed; *Striga gesnerioides* in the major cowpea production zones of the dry savannah ecosystem of the Upper East, Upper West and Northern regions of Ghana, resulting in 80–100 % yield losses of cowpea at times. Therefore, on-farm conservation of cowpea by the rural resource-poor farmers is seriously under threat. This negatively affects cowpea production and income of rural farmers resulting in food insecurity and abject poverty in the affected communities. The impact of the parasitic weed invasion occupies 41% (9,770,000 ha) of the 23,853,900 ha of agricultural land in Ghana. Coupled with the menace of the parasitic weed are the effects of drought, supra-ultimal temperatures or heat, insect pests and poor soil fertility, which also result in reduction of cowpea yields. The average annual rainfall in the *Striga*-affected dry savannah areas is as low as 1,000 mm compared with 2, 200 mm of the rainforest. The rainfall pattern is also erratic.

In fact, all attempts by farmers to use cultural practices, chemical and conventional biological control methods to combat the parasitic weed have proved ineffective, expensive and labour-intensive. However, the most cost-effective and environmentally friendly control measures to mitigate *Striga gesnerioides* invasion and infestation to promote sustainable cowpea production at no cost to the farmer is to develop more adaptable *Striga*-resistant varieties of cowpea, which are also early maturing, drought-tolerant and high yielding for farmers to cultivate. The cultivation of *Striga*-resistant and drought-tolerant varieties of cowpea will increase yield by 80% towards food security, rural poverty reduction and efficient soil fertility management.

We have identified GH3684, a local cowpea to have resistance to the parasitic weed in Ghana. However, it is not widely tested or accessible to farmers and breeders. Currently, we have also introduced an exotic source of *Striga*-resistance (IT97K-499-35) from IITA genebank into two locally preferred cowpeas; SARC-LO2 and Apagbaala through cross breeding. We have advanced the recombinant inbred lines (RILs) to F_8 and F_9 generations with target resistance to the cowpea-parasitic weed in Ghana. In all 120 RILs have been screened and conserved out of initial population of 534 lines through pre-limnary phenotypic tests and DNA analysis.

The 120 RILs and GH3684 require complete genetic characterization involving marker-assisted selection protocols and evaluation for stable and consistent *Striga*-resistant marker-traits, desirable phenotypes and adaptability to diverse soil, drought and heat conditions. In all 30 RILs that are promising will be selected based on phenotypic and genetic data for further evaluation in on-farm trials involving 300 local farmers in the hotspots of the parasitic weed in the three northern regions of Ghana which will be replicated in the coastal savannah and transitional zones where the parasitic weed do not exist but cowpea cultivation is not popular and poverty is prevalent. The on-farm trials will enhance seed multiplication and selection of acceptable *Striga*-resistant cowpea genotypes that are high yielding, early maturing, and tolerant to drought and heat. Palatability with good cooking-ability and nutritional quality are also vital traits to consider to meet consumer preference for specific cowpea genotypes.

Finally, a protocol will be developed to release at least 6 *Striga*-resistant cum drought-tolerant cowpea novel varieties and made available to farmers, consumers, breeders, seed producing companies (for certified seed production) to multiply seeds for distribution. The new varities of cowpea will be made accessible to the multi-lateral system through our National Genebank, the Plant Genetic Resource Research Institute at Bunso, Ghana. Collaboration with the Ministry of Food and Agriculture (MoFA) and Food and Agriculture Organization (FAO), Ghana will enhance dissemination of information through seminars and public lectures, as well as publications in scientific journals with wide circulation. A genebank will be established in the University of Cape Coast as back-up for the National genebank to enhance cowpea germplasm conservation, research, training and routine plant breeding activities.

SECTION B: PROJECT DESCRIPTION AND CONTENTS

2.1. Problem definition

The production and on-farm conservation of cowpea as cheap source of protein in the dry savannah ecosystem of Ghana is challenged by the parasitic "witch"-weed, *Striga gesnerioides*. The infestation of cowpea by the parasitic weed in the major production areas of Upper East, Upper West and Northern Regions of Ghana is associated with poor sandy soil, low and erratic rainfall (1,000 mm per annum) coupled with daily maximum temperatures that can be as high as of 41 ^{o}C, besides insects and diseases. The *Striga* alone can cause 83-100% yield losses in cowpea by imposing physiological stress and scorching effects on the cowpea plant. This discourages and pushes farmers and traders out of business and, subsequently, increases poverty and hunger among the predominantly rural-resource-poor farmers (affecting 15 million people in Ghana who cannot afford adequate animal protein in the diet). Since cowpea is the most affordable source of protein consumed in the diet by most Ghanaians, about 65% of the affected communities have become poor with increasing malnourished children. Currently, Ghana imports cowpea from Burkina Faso, Nigeria and Niger to supplement local production.

Attempts by farmers to employ cultural practices to control infestation of the parasitic weed on cowpea have proved unreliable and expensive making it impossible to conserve cowpea on-farm. To combat *Striga* infestation in the dry savannah ecosystem, resistant cowpea varieties, which target the parasitic weed in Ghana and adaptable to drought have to be developed and made available to farmers to cultivate to enhance on-farm conservation, cost-effective and sustainable production of the crop towards food security and poverty reduction. However, the 120 RILs and GH3684 (local resistance source) which we have developed, and identified respectively, lack comprehensive genetic data. Evaluation of the cowpeas in multi-location trials involving farmer participatory activites and on-farm conservation are necessary to enhance harnessing the genetic resources of the crop to develop a protocol for release of at least 6 *Striga*-resistant and drought-tolerant varieties of cowpea for farmers to cultivate to boost cowpea production by 60%. It is expected that cultivation and on-farm conservation of *Striga*-resistant, drought-tolerant, early-maturing and high yielding cowpea would increase farmers income by 60%. Moreover, adequate, quality and preferrable seeds will be available to both rural resource-poor farmers and consumers at affordable prices Therefore, the findings of this work will contribute towards food security, poverty reduction and prevention of malnutrition among children, particularly, in homes.

2.2. Project objectives: Overall and specific objectives

- Overall Objective

  The main objective of this work is to phenotype and genotype 120 recombinant inbred lines of cowpea and GH3684 for selection of farmer and consumer preferred *Striga*-resistant, drought-tolerant and more adaptable varieties in multi-location trials to enhance on-farm conservation and sustainable production of the crop in the savannah ecosystem towards food security and poverty alleviation among re-source- poor and small-holder farmers in Ghana.

- Specific objectives

1. To evaluate 30 cowpea genotypes on-farm in *Striga*-hotspots at the Manga Station of SARI in Bawku, Upper East Region (dry savannah) and compare with findings at UCC Teaching and Research Farms (dry coastal savannah) and Plant Genetic Resource Research Institute-Bunso (semi-deciduous forest) (no parasitic weed) and the to multiply the seeds.

2. To genotype and phenotype 120 RILs and GH3684 cowpeas and assess diversity, harness useful alleles associated with SSR and SNP markers to identify *Striga*- resistant and drought-tolerant traits in the germplasm.

3. To conduct comparative multi-location on-farm trials and conservation of 30 cowpea genotypes in the *Striga*-hotspots of the Northern Regiongs, dry coastal savannah and transition zone of Ghana for adaptability to pests, dieases, soil, temperature, rainfall, nitrogen-fixing and organic matter retention abilities among 100 resource-poor and replicate for 300 farmers.

4. To assess the nutritional properties, cooking-ability and palatability of 10 selected cowpeas, document a protocol and release 6 *Striga*-resistant and drought-tolerant cowpea varieties for farmers, breeders and genebannks for cultivation and conservation.

2.3. Targeted outputs, activities and related methodology of implementation

Targeted output	Activities	Outcome
1. 120 RILs and GH3684 cowpea germplasm characterized and Striga-resistant, drought-tolerant traits with useful alleles identified. .	a) Phenotypic screening and Analysis of DNA of cowpeas using SSR to assess diversity and establish30 genotypes for stable *Striga*-resistant and drought- tolerant markers by Dr. Aaron T. Asare, UCC, Ghana. **Duration: April 2016 – August 2016** Mother to daughter trial: On-Station /famer pre-trial: b)- Pre-testing of cowpea on-station and on-farm at the hotspots of the parasitic weed (dry savannah zone) at SARI, Manga-Bawku by Dr. Francis Kusi, SARI, Ghana -Evaluation of cowpea in the dry coastal savannah, UCC Teaching and Research farm by Dr. Aaron T. Asare **Duration: June – September 2016** - Evaluation of cowpea in the semi-deciduous forest ecological zone at PGRRI-Bunso by Dr. L.M. Aboagye **Duration: October -December 2016**	-30 *Striga*-resistant and drought- tolerant cowpeas with diverse genetic and phenotypic traits identified

2. Multi-*Striga* race resistance among the 120 RILs and GH3684 identifie using SNP markers	SNP analysis of cowpea genome and determination of multiple-race *Striga*-restance among cowpeas by Prof. M.P. Timko, University of Virginia, USA. **December 2016 – May 2017** (One MPhil student trained)	-Genetic traits of cowpeas and *Striga* race or races to which resistance was developed determined.
3. 30 RILs and GH3684 conserved on-farm and cowpea seeds appropraitely stored to retain viability.	a) -Multi-location trials with 100 farmers in *Striga*-hotspots in the three Northern Regions compared with the coastal savannah using 30 RILs and GH3684 and storage of seeds at community level; Establshment of inspection plots at SARI, UCC and PGRRI by Dr. Francis Kusi, Dr. Aaron T. Asare and Dr. L.M. Aboagye 1st Inspection by varietal released committee **June -November 2017** b) Conservation of Cowpea seeds using solar energy, conventional and traditional protocols by Prof. B.A. Mensah **November 2017-May 2018** c) i. On-farm trials repeated with 300 farmers in all the hotspots of *Striga* compared to coastal and transition agro-ecological zones of Ghana to assess growth and yield of cowpea Inspection plots established for 2nd inspection by National Variety Release Committee. Dr. Francis Kusi (SARI), Dr. Aaron T. Asare and Prof. Elvis Asare-Bediako (UCC) ii. Rate of Photosynthesis and yield analysis; by Prof. Isaac, K.A. Galyuon, (UCC). iii. Soil analysis by Dr. Kwame Adjei-Frimpong (UCC). iv. Diseases and insect pests surveillance and assessment of virus resistance status of cowpea by Prof. Elvis Asare-Bediako and Dr. Sheila Tagoe, UCC.	Cowpeas well adapted to hotspots and with high yields identified and seeds stored to retain quality and viability. Cost-effective system developed for cowpea conservation on-farm in *Striga*-hotspots.

	v. Adaptation of cowpeas to temperature/heat, rainfall and evapotranspiration determination: Crop model (GLAM) nested in CORDEX output to investigate the yield of cowpea by Mr. D.C. Adukpo, UCC, Ghana. Two MPhil students trained. 10 Agriculture extension officers trained **June-December 2018**	
4. 6 Most preferred *Striga*-resistant and drought tolerant cowpea genotypes documented and released as varieties to farmers, seed producing companies breeders and genebanks.	a) Establishment of genebank in UCC to conserve cowpeas with passport data by Dr. L.M. Aboagye **Duration: Dec. 2018-January 2019** b) Physiochemical and functional properties of cowpeas determined, cooking-ability and palatability tests (One MPhil Student trained) by Dr. Genevive Adukpo (UCC). **Duration: Dec. 2018– January 2019** c) Documentation of protocol for release of 6 varieties of cowpea by Dr. Aaron T. Asare (UCC) **Duration: February-March 2019** d) The release of at least 6 new varieties of cowpea by UCC and collaborators led by Dr. Aaron T. Asare and Research Team with dissemination of information by the Media/Press. **Duration: March 2019** e) Patenting of at least 6 released varieties of cowpea in UCC and made available to registered seed companies, National Gene Bank and the Multi-lateral system by Dr. Aaron T. Asare **Duration: March 2019** f). Final Report Documentation and submission by Dr. Aaron T. Asare **Duration: April 2019**	At least 6 new varieties of farmer and consumer preferred cowpeas with high nutrional properties, easy to cook and palatable identified. Information associated with *Striga*-resistance, drought-tolerance and improved yield documented and varieties conserved and released for public use.

2.4. Targeted PGRFA

-120 Advanced F_8 and F_9 breeding lines of cowpeas (*Striga*-resistant and susceptible seeds) developed and being conserved in the Molecular Biology and Biotechnology Department of University of Cape Coast and also stored the National Genebank, the Plant Genetic Resources Research Institute (PGRRI) at Bunso, Ghana

-GH3684: Local cowpea accession collected from the National Genebank, PGRRI, Bunso, Ghana and conserved in the Department of Molecular Biology and Biotechnology, UCC, Ghana

2.5. Target groups and beneficiaries

-300 Resource-poor small-holder farmers in 4 regions of Ghana will have access to *Striga*-resistant-drought-tolerant improved cowpeas to cultivate, conserve on-farm and in storage towards sustainable cowpea production.

- 300 farmers will have their income income from cowpea production increase by 60% thus, reducing poverty.

-2 million Children will have adequate cowpea as a cheap source of protein to reduce malnutrition.

-At least one seed producing company will be identified to multiply cowpea seeds for wider distribution to increase farmers access to quality seeds towards increasing productivity and sustainability.

- The National and UCC Genebanks to conserve novel cowpea germplasm for research, preservation of genetic resources for enhanced accessibility to the multi-lateral system.

-Plant breeders will have access to cowpea seeds for further improvement of the crop

-2 students trained at the master's (MPhil.) level

- 10 Agricultural Expension Officers trained

-15 Scientists and Technicians exchange knowledge to build capacity for futher research.

2.6. Impact and impact pathways

Developed *Striga*-resistant and drought-tolerant improved varieties of cowpeas evaluated, documented and made available to farmers to cultivate and conserve on-farm and stored appropriately to maintain quality viable seeds. Trained Agricultural Extension Officers will educate farmers to cultivate the new cowpea varieties to increase yield of the crop and facilitate distribution of seeds. Seed producing companies will have access to produce quality certified seeds of the new varieties of cowpeas for distribution to farmers through the Ministry of Agriculture and Agro-shops. The FAO, Ghana and the National Genebank would also serve as channels to disseminate information to make the cowpeas accessible to the multi-lateral system. Education through the media, videos, websites, and serminars will also inform farmers and consumers on the new varieties of cowpeas for effective and sustainable utilization of the cowpea genetic resources. Journal publications will make information available to other scientists for further research and development of cowpea forimproved yields.

2.6.1. Food security and poverty alleviation

Seed multiplication and distribution of 6 released varieties of *Striga*-resistant and drought-tolerant cowpeas by resource-poor farmers, seed-producing companies and the Ministry of Food and Agriculture will increase productivity of the crop; adequate cowpeas will be available for sale to consumers towards food security and poverty reduction. On-farm conservation and storage of cowpea seeds would sustain productivity. Trained Agricultural Extension Officers and the media will

continue to disseminate information to farmers to cultivate *Striga*-resistant cum drought-tolerant cowpeas for high yield.

2.6.2. Adaptation to climate change and environmental sustainability

The cultivation of *Striga*-resistant and drought-tolerant cowpeas will combat the parasitic weed without any adverse effect on the environment in the dry savannah ecosystems; The cowpeas will rather improve soil fertility to enhance cultivation of other non-leguminous crops to boost food production and protect the environment, particularly, in mixed-cropping systems. Increased food production will make it affordable and available to the poor and the vulnerable in rural communities. There will be less use of herbicides and insecticides, thus reducing environmental pollution; and since solar energy treatment is used to store cowpea seeds, the use of chemical insecticides and the adverse effects on food and environment will be avoided. The use of a crop model (GLAM) nested in the CORDEX models for local climate change information will help further investigate the impacts of present changes in the local climate on cowpea production in Ghana.

2.6.3. Scientific impact

The development of recombinant inbred cowpeas, invoving conventional and DNA technology tools for harnessing genetic resources leading to the release of novel *Striga*-resistant and drought-tolerant cowpeas will be a great scientific research achievement in Ghana towards food security and poverty reduction. Resource-poor farmers will control the parasitic weed at no cost and cultivate cowpea with increase yield to boost productivity. Identification of useful alleles, traits, cowpea seed storage system involving solar radiation treatment will sustain cowpea production and a healthy environment. Publications in sscientific journals,, serminars, presentations at conferences, websites publications and the media are various modes for dissemination of information to educate the wider scientific community. Information exchange and technology transfer will enhance continuous improvement of cowpea and other crops using a combination of morphological descriptors and DNA-based technologies.

2.6.4. Capacity development and empowerment

300 Resource-poor farmers trained to multiply seeds, conserve cowpeas on-farm and in storage will serve as trainers of their colleagues.. 10 Agricultural Extension Officers trained to extend training and educate farmers to cultivate the new cowpea varieties.

At leats two MPhil graduates trained to augment the human capacity for Teaching and Reseach.

15 Research Scientists and Technicians collaborate and exchanged knowledge and skills.

2.7. Relevance to national or regional priorities in its plans and programmes for PGRFA

The release and cultivation of *Striga*-resistant and drought-tolerant cowpea varieties involving farmers will increase cowpea production, thus providing cheap protein to those who need it most and contribute towards food security. The sales of preferred

cowpea seeds by farmers will generate income and reduce rural poverty. Climate change may lead to increases in temperatures, long droughts with less rain and more erratic distribution. Therefore, the new cowpea varieties will be adapted to drought thus sustaining yield. The storage of cowpeas in genebanks will facilitate biodiversity conservation. On the whole, the outcome of the project will complement the Millennium Development Goals towards:

1. Eradication of extreme poverty and hunger in rural resource-poor farming communities and
2. Ensure environmental sustainability

Striga-resistant cowpeas adaptable to drought can be cultivated without the use of chemicals to control parasitic weeds in dry savannah regions, thus contribute towards realization of Ghana's action plan on poverty reduction, food security; mitigating climate change and to enhance environmental sustainability.

SECTION C: OPERATIONS

3.1. Methodology of project implementation

DNA of 120 RILs of cowpea and GH3684 will be isolated and analyzed in PCR reaction and the products resolved in agarose and polyacrylamide gel electrophoresis involving SSR markers to generate genetic data. Marker-assisted selection protocols will be used to establish *Striga*-resistant genotypes of cowpeas at the University of Cape Coast. Molecular markers (SSR and SNP) will be used to genotype 120 RILs and GH3684 cowpea germplasm. SNP analysis and multiple-race *Striga* resistance status test of the cowpeas will be carried out in Prof. Timko's Laboratory. University of Virginia, USA. Additional molecular marker loci linked to *Striga gesnerioides* resistance in Ghana will be identified and many more reliable polymorphic SSR loci published to enhance cowpea breeding in Ghana. A dendrogram derived from the molecular genetic data will be used to eliminate clones or close relatives and facilitate selection of promising candidate RILs for field trials to phenotype the cowpeas.

In all, 30 most promising RILs with desirable agronomic and *Striga*-resistant traits and GH3684 will be selected for on-farm testing at the *Striga* hotspots at SARI, Manga-Bawku and replicated at the Teaching and Research Farms of the University of Cape Coast (UCC) and the Plant Genetic Resource Institute of Bunso to multiply the seeds in 2016: About 10 selected farmers will be involved at this stage (Mother-daughter pre-trial). The cowpeas will be evaluated on-farm in all the most *Striga*-infested hotspots of the Upper East, Upper West and Northern Regions of Ghana in 2017 involving 100 farmers. This will be replicated in the Coastal Savannah and the Transitional zone (mix Savannah and forest ecology) of the Central Region, where the parasite does not exist to facilitate evaluation of the RILs for adaptability to the parasitic weed, as well as viral, bacterial and fungal diseases and, insect pests. Adaption to varied soil, rainfall and temperature conditions will also be evaluated. Growth, physiological and yield parameters will be determined. Nitrogen fixing ability of the cowpeas and organic matter generation will be determined towards soil fertility management. The evaluation will be repeated in 2018 involving 300 resource-poor farmers. A farmer-friendly seed preservation system involving solarisation, organochemicals and insecticides as a sources of sterilant to prevent seed damage by insects in storage will also be investidated. In all, 300 farmers (100 females and 200 males) involved in the evaluation will be trained to multiply and conserve cowpea seeds for further distribution. Ten of the most promising RILs and the local cowpea, GH3684, will be tested for palatability and cooking-ability. Applicable statistical tools and software will be used to analyze the data generated for both laboratory and field experiments.

A genebank will be established at the University of Cape Coast in 2019 to conserve all the cowpea genotypes under low temperature conditions as a back-up for the National Genebank to enhance sustainability and utilization of the cowpea genetic resources for routine research and cowpea breeding and selection for improved productivity of the crop towards food security and poverty alleviation. Phytochemical and nutritional analysis as well as sensory test will be carried out on the promising cowpea lines. A protocol will be developed and at least the best 6 selected cowpeas will be released as varieties for farmers to cultivate and made accessible to seed-producing companies to produce certified seeds, breeders and genebanks to enhance research and germplasm exchange. At least three MPhil students will be trained. Besides, 15 reseach scientists and 6 Technicians and Research Assistants will have acquired knowledge and skills through seminars/workshops, multi-disciplinary and collaborative research activities. Ten (10) Agricultural Extension Officers will be trained not only to cultivate cowpea but also to conserve the crop on-farm and in safe storage to maintain quality seeds. At least, four cowpea-grower farmer-associations will be formed. Education of the public on the new varieties of cowpea

released will be facilitated through seminars, publications in the daily news papers television and radio programmes, videos, internet, and Agricultural Extension Officers.

3.2. Partnerships and collaboration arrangements

This research is in line with an existing collaboration between the Department of Molecular Biology and Biotechnology of the University of Cape Coast and Prof. M.P. Timko, a Plant Molecular Biologist of the University of Virginia, USA aimed at training and transfering of technology to build capacity in Ghana under the auspecies of the Kirkhouse Trust of U.K. Prof. Timko has a special licenced *Striga* laboratory with collections of all the seven known races of *Striga-gesnerioides* in West Africa. His laboratory then should be able to assess the multi-race resistance status of at least 30 of the promising cowpea RILs and GH3684 and to establish the race to which resistance is developed in Ghana. He also has the an up-to-date laboratory for cowpea genomic analysis and development of primers for molecular marker analysis. SNP analysis of 120 RILs in Prof. Timko's laboratory will facilitate determination of specific genetic traits and useful alleles to facilitate wider use of the cowpeas and germplasm conservation. Besides, this will offer training of at least one MPhil student to enhance transfer of technology to build capacity in the Department of Molecular Biology and Biotechnology, University of Cape Coast, Ghana. In addition we also have collaboration, locally, with the Savannah Agriculture Research Institute (SARI) and the Plant Genetic Resources Research Institute (PGRRI) of the Council for Scientific and Industrial Research, Ghana. Further collaboration with the Ministry of Agriculture and the Food and Agriculture Organization will facilitate dissemination of information locally and in the multi-lateral system.

3.3. Project management team

A staff including Dr. Aaron T. Asare (Plant Biotechnologist and Breeding, UCC), an Administrative assistant, two field officers will be responsible for overall coordination, planning and management of the project. Dr. Aaron T. Asare has previous record of having oversight responsibility of coordinating and management of cowpea project sponsored by the Global Crop Diversity Trust, Rome in 2011-2012.

The University of Cape Coast (UCC) is an accredited government institution established by an ACT of Parliament, with Training and Research focus. The University has good international relations. One of the major components of the University is the College of Agricultural and Natural Sciences (CANS), which has a broad research expertise in diverse scientific disciplines. In respect of the current project, UCC has capacity and expertise in Plant Biotechnology and Molecular Biology, Breeding and Genetics, Plant Science, Soil Science, Atmosperic Physics and crop modelling for climate change, Plant pathology, Entomology, Organic Chemistry/Natural Products and Food Sciences among others. Indeed, the University of Cape Coast has track records of managing International Projects under Food and Agriculture Organization (FAO), United Nation Development Project (UNDP), United Nation Environmental Related Project (UNERP), Global Environment Facility (GEF), Global Crop Diversity Trust among others. Community development is an integral component of University of Cape Coast programme of activities. Hence, the University of Cape Coast conducts community-based researches to help solve problems within its communities. All scientists in the University spent 60% time in Lecturing and 40% on Research; but depending on demand drift, an expertise may be permitted to increase time for research. The University administrative staff also assist in project management as directed at the Departmental level when necessary.

The Directorate for Research and Innovation Centre of the University of Cape Coast will register the project in our institution and facilitate monitoring for effective implementation.Collaboration with the Savannah Agriculture Research Institute (SARI), which is closely located in the regions affected with the parasitic weed, the target of this project and connected with the affected communities, will enhance the multi-location field

trials. In addition, the Plant Genetic Resources Research Institute of Ghana has the expertise in biodiversity conservation in genebanks to establish a genebank at the University of Cape Coast, which underscores the need for our collaboration. To enhance capacity building and technology transfer, collaboration with the University of Virginia, USA will facilitate cowpea genomic analysis to identify useful alleles and multi-race *Striga* resistance status of the crop.

The Research Team:

Prof. Isaac K.A. Galyuon (Plant Physiologist, Biostatistician, Molecular Biologist, UCC), Dr. Sheila Tagoe (Microbiology/Molecular Biologist), Mr. D.C. Adukpo (Atmosperic physicist/Climate change, UCC), Prof. Elvis Asare-Bediako (Plant Virologist/Agronomist, UCC), Dr. K. Adjei-Frimpong (Soil scientist, UCC), Prof. B. A. Mensah (Entomologist, UCC), Dr. (Mrs) Genevive Adukpo (Organic Chemist, Natural products, UCC), Mr. Francis Kusi (Agronomist/Molecular Entomologist, SARI), Dr. Lawrence M. Aboagye (Plant Physiologist/Biodiversity conservationist, PGRRI), and Prof. Michael. P. Timko (Molecular Biologist, University of Virginia, USA). Dr. Aaron T. Asare (Plant Biotechnologist and Breeding, UCC) will be the project coordinator and contact person. Three technicians and three research assistants will be involved in the research.

The following reviewed publications in relation to the current project proposal constitute relevant track records of previous achievement in the Department of Molecular Biology and Biotechnology, University of Cape Coast and collaborators:

1. Asare, A.T., Gowda, B.S., Galyuon, I.K.A., Aboagye, L.M., Takrama, J.F., Padi, F.K. and Timko, M.P. (2010). Assessment of the genetic diversity in cowpea [*Vigna Unguiculata* (L.) Walp.] germplasm from Ghana using simple sequence repeat markers. Plant Genetic Resource: characterization and utilization; 1479-2621: 1-9

2. Aaron T. Asare, Bhavani S. Gowda, Isaac K. A. Galyuon, Lawrence M. Aboagye, Jemmy F. Takrama, Francis K. Padi, and Michael P. Timko (2013). Identification of potential sources of *striga* resistance in cowpea [*Vigna unguiculata* (L.) walp.] accessions from Ghana**.** J. Microbiol. Biotech. Res., 3 (1):14-22

3. Asare, A.T., Galyuon, I.K.A., Padi, F.K., Otwe, E.P. and J.F. Takrama (2013). Responses of recombinant inbred lines of cowpea [(*Vigna unguiculata* (\L.) Walp] to *striga gesnerioides* infestation in Ghana. Proceedings of 1st Annual International Interdisciplinary Conference, *AIIC 2013*, 24-26 April, Azores, Portugal.

4. Asare, A.T., Akrong, C.K., Gowda, B.S., Galyuon, I.K.A., Aboagye, L.M., Takrama, J.F. and Timko, M.P. (2011). Evaluation of agro-morphological diversity in some segregating lines of cowpea (*Vigna unguiculata* L. Walp). Journal of Ghana Sc. Assoc. 13 (2): 1-11

5. Aaron T. Asare, Robert Agbemafle, Genevieve E. Adukpo3, Emmanuel Diabor and Kingsley A. Adamtey (2013). Assessment of functional properties and nutritional composition of some cowpea (*vigna unguiculata* l.) genotypes in Ghana. ARPN Journal of Agricultural and Biological Science. 8 (6), 1990-6145.

3.4. Sustainability

Before the research, an existing collaborative arrangement will be formalized with the Ministry of Food and Agriculture (MoFA), the Food and Agriculture Organisation (FAO), Ghana and a seed producing company to ensure information dissemination, application of the findings in quality seed multiplication and distribution of true-to-type *Striga*-resistant drought-tolerant varieties of cowpea to farmers to cultivate. This will ensure sustainability of continous supply and cultivation of the *Striga*-resistant cowpeas. Sustainability effort will be achieved through seminar presentation to educate partners on the need to promote

cultivation of *Striga*-resistant cowpeas. Establishment of a Genebank for the Department of Molecular Biology and Biotechnology at the University of Cape Coast, Ghana as a back-up to the National Genebank of the Plant Genetic Resources Research Institute will conserve all variable genotypes of cowpea. The University of Cape Coast will continue to support the staff to collaborate with others for further development of cowpea germplasm for improved yield and adapted to the various agro-ecological zones.

The released varieties of cowpea will be patented but made available upon request under conditions as determined by the University of Cape Coast. There will also be regular education through the media on the importance, health and nutritional benefits of cowpea and the need to cultivate *Striga*-resistant drought-tolerant cowpeas to conserve the crop on-farm to combat the parasitic weed. Consequently, most farmers in the *Striga*-affected regions will have access to adequate quality cowpea seeds to cultivate to increase productivity and store seeds for subsequent cultivation after sales.

The cowpea germplasm will be duely registered in the Global International System and made available to the multilateral system through the Plant Genetic Resource Research Institute (the National gene bank of Ghana) and FAO, Ghana.