# Value Added Bean Technologies for Enhancing Food Security, Nutrition, Income and Resilience to cope with Climate Change and Variability Challenges in Eastern Africa

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**Amount:** **US $ 1,000,000**

## Abbreviations and acronyms

| | |
|---|---|
| ACOS | Agricultural Commodity Supply |
| APVC | Agricultural Product Value Chain |
| ASARECA | Association for Strengthening Agricultural Research in East and Central Africa |
| AU | African Union |
| AYT | advanced yield trial |
| BecA | BioSciences for Eastern and Central Africa |
| CAADP | Comprehensive African Agricultural Development Programme |
| CBO | community-based organizations |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT | International Centre for Tropical Agriculture |
| COMESA | Common Market for East and Southern Africa |
| DUS | distinctiveness, uniformity and stability test |
| ECAB | Eastern and Central Africa Bush |
| ECABREN | Eastern and Central Africa Bean Research Network |
| EIAR | Ethiopian Institute for Agricultural Research |
| FAO | Food and Agriculture Organization |
| FARA | Forum for Agricultural Research in Africa |
| GMOs | genetically modified organisms |
| IGAD | Inter-Governmental Authority for Development |
| ILRI | International Livestock Research Institute |
| IP | Innovation Platform |
| ISABU | Institut des Sciences Agronomiques du Burundi |
| ISAR | Institut des Sciences Agronomiques du Rwanda |
| KAPAP | Kenya Agricultural Productivity and Agribusiness Project |
| KARI | Kenya Agricultural Research Institute |
| MoA | Ministry of Agriculture |
| NARS | national agricultural research systems |
| NEPAD | New Partnership for Africa Development |
| NGO | non-governmental organizations |
| NPT | national performance trial |
| PABRA | Pan-African Bean Research Alliance |
| PME | participatory monitoring and evaluation |
| R4D | Research for Development |
| SARI | Selian Agricultural Research Institute |
| SIMLESA | Sustainable Integrated Maize-Legumes for Eastern and Southern Africa |
| SMTA | Standard Material Transfer Agreement |
| SUA | Sokoine University of Agriculture |
| UoN | University of Nairobi |

## 2. Executive Summary

The objective of this research project is to contribute to improved food and nutritional security and incomes through increased bean productivity, value addition and marketing, while conserving the environments in drought-prone areas of Burundi, Ethiopia, Kenya, Rwanda and Tanzania. Common bean (*Phaseolus vulgaris* L.) is a small-scale farmer crop in Eastern Africa, where it is often cultivated in unfavourable conditions and with minimal inputs. It is a major staple in this where it is recognized as the second most important source of human dietary protein and third most important source of calories of all agricultural commodities produced (Pachico, 1993). They provide the crucial proteins (20%), energy (32%) and generous amounts of micro-nutrients especially iron and zinc, and vitamins A and B complex to over 50 million resource poor rural and urban consumers in eastern Africa. Common bean is major source of income for poor farmers especially women. Iron deficiency causes anemia whose consequences are numerous and grave. Zinc deficiency leads to poor child growth, delayed maturation, poor appetite and impaired immune function. Micronutrient rich common bean cultivars offer unique opportunities for alleviating these disorders in eastern Africa. However, bean productivity is constrained by moisture and heat stresses, declining soil fertility, poor crop management practices, limited access to quality seed and markets. Climate change and variability is one of the most complex challenges that humankind has to face in the next decades. As the change process seems to be irreversible, it has become urgent to develop sound adaptation processes to the current and future shifts in the climate system. The use of drought tolerant and diseases/pests resistant bean varieties combined with suitable agronomic management practices is probably the most efficient and sustainable strategy for alleviating the adverse affects of drought stress and declining soil fertility in low input production systems in semi arid regions of eastern Africa. National breeding programmes in partnership with regional bean networks and the private sector propose to develop and disseminate drought tolerant, micronutrient-rich bean varieties with good canning characteristics and market preferred grain types from available germplasm. Field screening under drought stress will be performed to evaluate these varieties for yield potential through participatory plant breeding and marker assisted breeding for biotic stresses. Physiological differences in drought tolerance among the varieties, resilience related plant attributes will be measured through destructive sampling at mid-pod filling and harvesting growth stages. Seed samples will be analyzed for micronutrient concentration following standard procedures (AOAC, 1981; Zarcinas *et al.*, 1987). Agronomic trials will be conducted to determine the effects of soil fertility, cropping patterns and water harvesting technologies on the levels of iron and zinc concentration in selected varieties. Market linkages among actors along the bean value chain will be established through an innovation platform. Efforts will be made to link producers directly to markets to spur increased production and adoption of the improved bean varieties. Proven seed dissemination models will be adopted to avail seeds of promising varieties to 1,400,000 households in three years. Result based indicators will be used to monitor and evaluate project's achievements and progress. Results will be disseminated through field days, electronic and print media, workshops and publications. The proposed project will contribute to the BioInnovate Programme for using bioscience innovation systems to improve crop productivity and resilience to climate change and variability in small-scale farming systems (Theme 1) and enhance efficiency of bean agro-processing industry so as to add value to the local bean commodity and bio-resources in a sustainable manner (Theme 3). The project builds on previous bean research and complements current bean research for development activities in the region. This multidisciplinary project (breeders, agronomists, soil scientists, socio-economists, nutritionists, and seed specialists) seeks to contribute to two of the four pillars of Comprehensive African Agricultural Development Programme (CAADP) and Forum for Agricultural Research in Africa (FARA) and millennium development goals adopted by governments in this region.

**3. Background and rationale for the proposed project**

Common bean (*Phaseolus vulgaris* L.) is a major staple food in eastern and southern Africa where it is recognized as the second most important source of human dietary protein and third most important source of calories of all agricultural commodities produced in the region (Pachico, 1993). Bean is a near-perfect food (CIAT, 1995) and the "meat" of the poor (Sperling, 1992). It is a major source of crucial proteins (20%), energy (32%), vitamins A and B complex and generous amounts of micro-nutrients such as iron and zinc which are deficient in diets among the poor, particularly pregnant women and children in Africa. Iron deficiency causes anemia whose consequences are numerous and grave. In infants and children, iron deficiency is associated with impaired physical and cognitive development while, lack of zinc leads to poor child growth, delayed maturation, poor appetite and impaired immune function (CIAT, 1995; United Nations, 1997). Micronutrient rich common bean cultivars offer unique opportunities for alleviating these disorders in eastern Africa because bean is widely grown and consumed particularly by medium and low income households which are the majority in the region.

Climate change and variability is one of the most complex challenges that humankind has to face in the next decades. As the change process seems to be irreversible, it has become urgent to develop sound adaptation processes to the current and future shifts in the climate system. In particular, it is likely that the biggest impacts of changes will be on agricultural and food systems. Lobell *et al*. (2008) reported that climate change is likely to reduce food availability because of a reduction in agricultural production. Evidence provided by the Intergovernmental Panel for Climate Change (IPCC) shows that higher frequency and diffusion of climate fluctuations is likely to produce more severe and frequent droughts leading to short-term fluctuations in food production in semiarid and sub-humid areas.

Effects of climate change are most frequently cited in terms of risk of drought, whose effects on common bean are dependent on the intensity, type and duration of stress (Muñoz-Perea *et al*., 2006). An estimated 60% of the bean crop is cultivated under the risk of either intermittent or terminal drought (Thung and Rao, 1999). Moderate to severe drought stress reduces biomass and seed yield (from 25-90%), harvest index, number of pods and seeds, seed weight, and days to maturity (Terán and Singh, 2002). According to recent climate change predictions, several regions in eastern Africa are expected to be drier and hotter while a few are expected to have higher rainfall by 2020 to 2050 (Kimani *et al.*, 2010; Beebe *et al.*, 2010). Higher temperatures and greater evaporation, combined with lower rainfall is expected to exacerbate drought in most bean producing areas, reducing root growth and accelerating decomposition of soil organic matter, thus making effects of drought stress even more acute.

Typical bean yield in farmers' fields in eastern Africa are only 20-30% of the genetic potential of modern improved varieties. Yield losses are associated with drought and heat stress, diseases, insect pests and low soil fertility (Wortmann *et al*., 1998). Numerous options have been recommended to control and manage these losses. These options include growing bean under irrigation, band applications of fertilizers, rhizobia inoculants, manure and other soil amendments. However, unavailability and cost-effectiveness have made the above practices unfeasible for the majority of small-scale resource-poor farmers in drought-prone bean production environments. The use of drought tolerant and diseases/pests resistant bean varieties combined with suitable agronomic management practices is probably the most efficient and sustainable strategy for alleviating the adverse affects of drought stress and declining soil fertility in low input production systems in semi arid regions of eastern Africa.

Recent studies indicated that there is considerable genetic variation in iron and zinc concentration in bean landraces and breeding lines from eastern Africa and other countries (CIAT, 2008, 2010; Blair *et al*., 2010). This implies that the mineral density of local varieties can be enhanced by more than 80% for iron and 60% for zinc by transferring genes controlling grain mineral accumulation to these varieties. Studies in humid and sub-humid environments have shown that agronomic management practices such as application of macro and micronutrients, organic amendments and supplemental irrigation can further enhance nutrient accumulation in grain (Rengel *at al*., 1999; Okonda *et al*., 2007; Felix, 2009).

However, the genetic potential and agronomic management practices for enhancing mineral density have not been tested in drought-prone environments and have yet to be validated under farmers' conditions. We therefore propose to determine the role of agronomic management factors in enhancing the concentration of iron, zinc and protein in the grain and leaves.

Although canning beans have been grown in eastern Africa since early 1950s, little work has been done to develop improved bean varieties that combine tolerance to biotic and abiotic stresses with canning quality. Consequently, bean varieties such as Mexican 142 (one of the 'ruling varieties') still dominate production despite its susceptibility to rust, anthracnose, common bacterial blight and drought. Preliminary studies suggest that agronomic management practices may influence the canning quality and productivity ( Loggernberg, 2004; Teshale, 2010). The potential of many new bean varieties for canning is still unknown due to lack of capacity in the region to assess their canning characteristics during variety development. This is now urgent due to changing eating habits, preference for fast cooking off-shelf products and high cost of cooking fuel. We therefore propose to develop capacity for assessing canning quality of new and existing bean varieties, and breeding lines in partnership with the canning industry. Additionally, we seek to identify new bean genotypes which combine high yield potential, tolerance to drought and major biotic stresses with high canning quality to determine the influence of agronomic management on canning quality.

Development of improved varieties in eastern Africa has traditionally followed classical breeding methods (Kimani and Mwang'ombe, 2007). This approach resulted in long periods of cultivar development (up to 12 years) and heavy reliance on unpredictable environmental conditions. Marker technology has presented new opportunities to accelerate cultivar development with more precision and reduce duration to release of improved bean varieties (Miklas *et al*., 2006). Integration of marker-aided breeding with conventional approaches can speed up, increase precision and effectiveness of bean breeding and facilitate pyramiding of desirable genes. Several markers linked to resistance genes for major diseases in eastern Africa have been identified (Buruchara *et al*., 2007; Mahuku *et al*., 2007). These include scars linked to genes for resistance to angular leaf spot such as $OPE4_{709}$ for in Mex 54, SAS 13 and SBB-14 for resistance to anthracnose in G2333, ROC-11 and SW 13 for resistance to BCMV/BCMNV in various advanced lines; OPAA19 and OPY20 for resistance to *Pythium* root rot in RWR 719 (Buruchara *et al*., 2007). These and other markers are available for use in the proposed work.

Formal breeding programs hardly involve stakeholders in cultivar development except in the final stages. Recent studies have shown that lack of stakeholders' involvement may contribute to rejection of new cultivars or very low adoption rates (Sperling *et al*., 1993; Witcombe *et al*., 1996). Participatory approaches facilitate the identification and addressing farmers' and consumer needs, produce heterogeneous varieties adapted to local conditions and are generally faster in releasing new varieties (FAO, 1996). Cultivars developed with stakeholders are more likely to be disseminated, adopted faster and have higher impact than those developed in formal systems. The fundamental rationale for using participatory and innovation platforms approaches is that joint effort will deliver more than when each actor works alone.

Untimely availability of seeds of improved bean varieties, poor access and/or underutilization of improved agronomic management technologies are probably the most severe bottlenecks to impact realization (Rubyogo *et al*., 2009). These constraints are even more severe in drought-prone environments because of low productivity, limited purchasing power, limited access to input and output markets and relevant information, resulting to low adoption of new improved technologies condemning millions of resource poor farmers to perpetual vicious cycle of poverty (Sperling, 2002). The situation is further compounded by limited interest in production and dissemination of seeds of grain legumes by private seed companies due to low profit margin. Although the informal seed sector have been instrumental in dissemination of bean seed, it has not been efficient for wider dissemination outside their localities (Rubyogo, 2004). Recent studies have shown that the use of small packets can greatly enhance access and utilization of improved bean varieties and complementary technologies because they are more affordable, facilitate farmers especially women and other marginalized groups to experiment with new technologies with minimal risks, and buildup of effective demand which can be stimulate new investment in seed industries (Phiri *et al*., 2003; Rubyogo *et al*., 2007; TL II, 2010). We therefore propose to develop effective linkages and capacities of key actors in the seed delivery value chain to improve access to breeder, foundation, certified and other quality seed using innovative, affordable small seed packet approach supported by adequate information.

## 4. Adding value to existing efforts (relevance and quality of content of the proposal*)*

The proposed project will contribute to the BioInnovate Programme for using bioscience innovation systems to improve crop productivity and resilience to climate change and variability in small-scale farming systems (Theme 1) and enhance efficiency of bean agro-processing industry so as to add value to the local bean commodity and bio-resources in a sustainable manner (Theme 3). This project will have strong emphasis on active involvement of market actors and practitioners. For example, in Kenya, Trufoods Limited, one of the leading bean processors and with a wide range of bean based products in local supermarkets, shops and other outlets will participate in testing new bean varieties for suitability for industrial canning and sensory evaluation with potential clients. The company will provide multiple outlets for pilot testing of new products and eventual commercialization of successful products. In Ethiopia, Agricultural Commodity Supply (ACOS), a strategic partner with Ethiopian bean program and with vast experience and a global network will evaluate new and existing canning bean varieties for export markets and contract farmers to produce quality grain. In Burundi – Complexe Agro Industiel Rugambo and Rwanda – Entreprise Kubumwe and Imbarago farmers Union will be crucial in linking farmers to markets.

For seed supply and dissemination, project partners will strengthen links with well established private seed companies, farmer cooperatives/organizations, country wide extension services and media houses to create awareness, stimulate demand and facilitate rapid dissemination of seeds and information. In Burundi, the project partners will collaborate with Rugofarm in seed production and dissemination. Rugofarm is a private seed company with experience of more than three years in production and marketing bean seeds. The project will partner with Kenya Seed Company which has a regional seed distribution network in Kenya, Ethiopia, Tanzania and Rwanda, and more than 6o years in seed trade. This will be based on existing agreements with public breeding institutions and agro-input dealers and small emerging seed companies. In Ethiopia, the project will also strengthen existing linkages with Lume Adama farmers' cooperative union. This cooperative has vast experience in input-output markets and has more than 18,000 farmer members in Central Rift Valley region. In other participating countries, the project will strengthen similar links with partners established through Pan African Bean Research Alliance (PABRA) in the last 15 years.

### *Previous work and complementarities with regional programmes*

For the last four years, regional bean research for development networks under the umbrella of PABRA which is affiliated to FARA's Research for Development (R4D) and African Union/New Partnership for Africa Development (AU)/NEPAD's CAADP have identified drought as a major bean productivity constraint (PAAP, 2010). Development of drought resistant crop varieties was one of the two strategies for coping with adverse climatic changes common among action plans proposed by governments in eastern Africa (PAAP, 2010). Recently, the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) identified common bean as the most important grain legume with high potential for improving productivity, nutrition and incomes of households in semi-arid areas

(ASARECA, 2010). The proposed project will contribute to two of the four pillars of CAADP and FARA, which are linked to ASARECA. All the five National Agricultural Research Systems (NARS) (Burundi, Ethiopia, Kenya, Tanzania and Rwanda) are members of ASARECA. Besides, ASARECA implements activities through NARS which are backstopped by ECABREN, PABRA and International Center for Tropical Agriculture (CIAT). Additionally, Ethiopia and Kenya are members of the Inter-Governmental Authority for Development (IGAD) which focuses on effect of drought and desertification on food security issues in the horn of Africa through Dryland Agricultural Research and Technology Programme (www. igad.org, 2010). All participating countries are members of Common Market for East and Southern Africa (COMESA) which spearheads cross-border trade for both seed and grain. The project outputs will spill over to other countries which are members of PABRA. BioSciences for Eastern and Central Africa (BecA) will assist in the application of available markers to incorporate resistance genes for priority biotic stresses, finger printing of varieties and students thesis research.

The proposed activities in this project will support national and regional efforts on germplasm exchange, harmonization of plant variety protection, testing and release. This project therefore complements national, regional and international initiatives for combating adverse effects of climate change and variability and also promotes regional trade activities. East Africa customs union which became operational on 1st July 2010 will further strengthen regional integration and cross-border trade.

**5. Potential for economic and social impact**

Common bean is the most important food grain legume in East and Central Africa (CIAT, 1995). It is grown in approximately two million hectares and provides health sustenance through provision of proteins, minerals and vitamins to low income rural and urban communities. Bean is a major source of income and employment to more than 50 million people, the majority being women (Sperling *et al.*, 1993; FAO, 1996). Recent studies have shown that high bean productivity significantly contributes to improved household incomes, livelihoods, enhanced national economic output and regional trade. For instance, in Ethiopia, bean productivity increased from less than 500 kg ha-$^{1}$ in 2002 to about 1,000 kg ha-$^{1}$ in 2009 (Setegn *et al.*, 2010). This led to improved overall living standards reflected in higher household incomes and better housing, as well as improved capacity to meet other family and health needs at farm level. At the national level, value of bean exports rose from less than US$23 million in 2002 to more than US$60 million in 2009. Additionally, increased bean productivity resulted in higher private sector investment in agro-processing and export, thereby creating employment for thousands of young women and men. Recent studies in Rwanda and western Kenya have shown that increased utilization of micronutrient rich beans reduces the high incidence of iron deficiency anaemia (IDA) and widespread zinc deficiency especially children, pregnant and lactating mothers and other nutritionally challenged groups (PABRA, 2009). We therefore propose to facilitate broader access and utilization of micronutrient rich bean varieties by the most vulnerable groups in the targets countries.

Beans are second most important crop in Burundi after banana. The country has one of the highest average annual bean consumption of over 60kg/per person. In year 2007, the estimated area and yield were 252,000 ha and 878 kg/ha respectively. Bean is both a food and main cash crops for most of the small scale farmers in Burundi particularly women. For instance about 50% of the bean production by an average household is market for cash income. Farmers are strongly influenced by market preferences when choosing the varieties to plant. The bean classes in Burundi are red kidney, whites, and yellows. Beans are grown in the 11 agro-ecological zones across low, medium and high altitudes. The major common bean growing areas are Ngozi, Gitega, Makamba, Imbo and Kayanza.

Burundi has emerged from more than fifteen years of social-political conflict. Most early efforts were focused on humanitarian aid at the expense of the agriculture development.

In spite of this, the bean program with minimal PABRA/CIAT support has been dynamic and has released several bean varieties both climbers and bush beans. What is still missing is to establish a sustainable and efficient to get these varieties in the hand of the farmers. Due to inexistence of the formal seed systems, initially the partnership to delivery seeds will rely on non- market seed actors such as development project partners (NGOs/GOs) and farmer organizations but at the same time build the capacity of professional and sustainable small and medium scale suppliers.

The common bean is one of the most important crop in Rwanda. For instance in 2008, the crop occupied 22% of crop land on an area estimated at 320,000 ha with an average 750 kg /ha (MINAGRI, 2008) with Beans are staple food, source of cash and N for agro-ecosystems improvement. Beans supply chain (production to consumption) is owned by small scale producers/traders who are predominately women who benefit from beans as food and cash. It estimated that 1/3 of Rwanda bean production is marketed. In recent past, the bean market demands are increasing differentiated and require different types of bean market classes. For instance, the Rwandan urban bean market which represents about 35% of national bean market is slowly getting differentiated e.g. yellow, white and red-mottled are sold at highly priced compared to mixtures. This emerging market may be a market opportunity for farmers. However, the use of the preferred varieties for both household consumption and market is still low. Increasing entrepreneurs are investing in bean value chains. For instance, Enterprise Kubumwe in Butare processed 200 tons of r*eady to eat beans* per month and the products are already available in the market. At national level, beans contribute to diet of Rwandans to about 39%, 13% and 18.72 of proteins, carbohydrate and lipids respectively. Therefore this makes beans the best nutrient source for poor (both rural and urban).

The ISAR Bean Programme with support from the Eastern and Central Africa Bean Research (ECABRN) of the Pan Africa Bean Research Alliance has released a range of bean varieties adapted to various agri-ecologies and responding to consumers' preferences/ demands. Some of those bean varieties are early maturing improved varieties with a short-duration (as short as two and half months to mature with a least two potential plantings per year), would fill the gaps and be a key for helping to shorten the hunger periods and for providing quick cash for rural poor. However those newly released varieties have not reached the majority of farmers. In Tanzania the importance of beans is not only expressed by the large area grown, but also by their role in the fight against protein-calorie and micronutrient malnutrition. Without beans, protein malnutrition would probably be prevalent in the country, as meat is a rare luxury for the majority of people in rural and many urban areas in a country, where 51% of the population live below the poverty line (Teverson and Hayden, 2002).

Common bean (*Phaseolus vulgaris* L) is the leading leguminous crop in Tanzania. It is grown for food and income generation. Beans account for 71% of leguminous protein in diets. It complements maize and other starches to form the basic diet of both the rural and urban populations. To a larger extent, the crop is grown by smallholder farmers under quite diverse farming systems and agro-climatic conditions; both for household food requirements and income generation. Major bean producing areas in the country include Tanga, Kilimanjaro, Arusha, Manyara, Kagera, Kigoma ,Mbeya, Rukwa, Iringa and Morogoro regions. However, bean production in the country is limited by several biotic and non-biotic constraints. Major constraints include: genetically low yielding varieties, diseases, insect pests and poor soil fertility; especially low soil nitrogen & phosphorus. In view of both the diversity of the constraints and the fact that common bean is largely a "resource -poor farmer's crop"; development and dissemination of improved bean lines is considered to be the most viable option for promoting bean productivity in Tanzania.

Frequent droughts in most of East and Central African countries have led to food shortages, malnutrition, social instability and reliance on food aid (IGAD, 2007). This scenario has underscored the need for improved crop varieties and associated technologies which assure farmers of a reasonable harvest in rapidly changing production environments. Due to high demand for beans, partly as a result of rapid population growth, its demand has outstripped supply, with some countries in the region becoming net bean importers. For example, Kenya has been importing about 200,000 tons (50% of national demand) for the last 10 years from Uganda and Tanzania (Ministry of Agriculture Economic Survey, 2008; KIPPRA/KARI/Ministry of Agriculture, 2009).The proposed technologies will make only minimal additional cost for inputs, mainly the cost of seed and therefore unlikely to increase production cost which would negate the economic viability of the new innovations. In addition, the envisaged improved access to markets is expected to increase returns to investment by farmers

The proposed project will contribute to improved food and nutrition security, better incomes and environmental sustainability through development and dissemination of high yielding, drought adapted, nutritionally superior bean varieties with market and consumer preferred grain characteristics. This project aims to increase bean yield in drought-prone areas by 20% e.g. in Kenya from the current 430 kg/ha to 515 kg/ha and to disseminate the technology packages to approximately 1,400,000 households (200,000 in Burundi, 300,000 in Ethiopia, 500,000 in Kenya, 200,000 in Rwanda and 200,000 in Tanzania) over the three year period.

## 6. Regional and international collaboration

Since 1985, the Eastern and Central Africa Bean Research Network (ECABREN), which comprise nine ASARECA countries in a collaborative R4D programme, demonstrated that a regional approach is far more effective and efficient in the development and dissemination of technologies compared to individual national programmes (Kimani *et al*., 2009). For example, climbing beans developed by Institut des Sciences Agronomiques du Rwanda (ISAR), were made available to farmers and have been adopted by millions of small scale farmers in all nine countries, without each country having to develop fully fledged breeding programme (Musoni *et al.,* 2010). Drought resistant bean varieties developed in Kenya have been pre-released in Burundi, which has no breeding programme. It has been demonstrated that a technology developed in one country can be fast tracked, out-scaled and up-scaled to several countries that have similar agro-ecological zones, production constraints and user-systems. This proposal brings together six core public and private institutions from five ECABREN member countries, CIAT, and other in-country partnerships.

## 7. Project goal and purpose

***Project goal***

Contribute to improved food and nutritional security and incomes through increased bean productivity, value addition and marketing while conserving the environment.

***Project purpose***

Develop and promote integrated and efficient bean value chains for increased productivity, nutritional value, commercialization and competitiveness of common beans as a commodity.

## 8. Objectives

Specific objectives linked to achieving the stated development goal are to:

1. Select canning bean varieties that meet the requirement of processing industry,
2. Determine the effects of soil fertility, water harvesting technologies and cropping patterns on the levels of Fe and Zn concentration in market preferred bean varieties,
3. Disseminate drought tolerant varieties and complementary agronomic management technologies in drought-prone environments, and
4. Strengthen capacities and linkages among the actors along the bean value chain.

## 9. Outputs

1. Two canning bean varieties that meet the requirements of processing industry developed

2. Effects of two soil fertility, water harvesting technologies and cropping patterns on the levels of Fe and Zn concentration in market preferred bean varieties determined
3. Two hundred tonnes of seed of drought tolerant varieties and complementary agronomic management technologies disseminated to 1,400,000 households in drought-prone environments
4. Capacities and linkages among the actors along the bean value chain strengthened in the five participating countries.

**10. Outcomes**

Intermediate observable and measureable changes that will contribute to economic and social development in the region include:

1. Increased access to seed of high yielding disease resistant and drought tolerant, and market preferred bean varieties in medium potential and drought-prone environments.
2. Market preferred canning bean varieties available to processing industry.
3. One innovation platform established to enhance functional linkages among actors along the bean value chain.

**11. Methodology and description of project activities**

**Output 1**: Canning bean varieties that meet the requirements of processing industry developed.

*Activity1.1 Evaluate existing and new bean populations and advanced lines for canning qualities*

A working collection of 200 traditional canning (navy) and new bean genotypes (red mottled, red kidney, speckled sugar, yellows, and large whites) gaining importance in local canning industries will be constituted. The collection will include selections from regional small and large white nurseries, ECAB (East and Central Africa Bush) lines, landraces, introductions, advanced lines combining bruchid resistance and canning characteristics and segregating populations. The working collection will be increased at Kabete and subsequently evaluated for laboratory canning quality at the Department of Food Science and Nutrition, and Technology, University of Nairobi (UoN) using standard laboratory canning evaluation procedures (Loggerenberg, 2004). Canning parameters to be assessed include water uptake, hydration coefficient, percentage washed drained weight, visual appearance, texture, splits, size, clamping, colour retention and viscosity.

*Validation for resistance to diseases*. Lines with acceptable canning quality will be evaluated for resistance to major diseases including angular leaf spot, anthracnose, bean common mosaic virus (BCMV), common bacterial blight and rootrot using standard disease phenotyping procedures and validated with markers available at the molecular breeding laboratory at Kabete while validation for rusts will be done at KARI Katumani biotechnology laboratory and at BecA. For angular leaf spot, marker $OPE4_{709}$ will be used to select resistant advanced ($F_{2.9}$) lines derived from populations KAB 02, KAB 12, KAB 13 and KAB 39. KAB (Kabete Bush) lines were developed at the University of Nairobi from populations segregating for resistance to major biotic stresses. These populations had Mexico 54 as one of the parents. KAB 02, KAB 12 and KAB 13 lines have *large red mottled* grain type popular in Kenya, Tanzania and other countries in eastern and southern Africa. KAB 39 lines have *red kidney* grain type, the second most important market class in eastern Africa, and for angular leaf spot. For anthracnose, three markers: SAB-3, SAS 13 and SBB-14 linked to resistance genes in G2333 will be used to validate resistance in lines derived from populations KAB 04 and KAB 14.These populations were derived from G2333. They have small red and red mottled grain types, determinate, semi-determinate and indeterminate growth habit and resistance to anthracnose. For *Pythium* root rot, two markers (PYBA08 and PYAA 19) in RWR 719 will be used to validate resistance in advanced lines derived from populations KAB 07, KAB 11, KAB 76 and KAB 77. These populations have resistance to root rots derived from RWR 719. KAB 07 and KAB 11 lines have large mottled grain types. KAB 76 and KAB 77 lines have red kidney grain types and resistance to root rots. For BCMV/BCMNV, ROC 11 (Johnson *et al*., 1997) and SW 13 will be used identify lines with resistance to $bc_3$ genes (Markers for Rust) Primers and pre-mixes for these markers will be obtained from BecA using sequences obtained from CIAT-Kawanda. About 80-90 lines with acceptable canning quality/and resistance to diseases will be distributed to partners in Ethiopia and Rwanda for drought and disease screening.

*Activity 1.2 Identify advanced bean lines that combine good canning qualities with drought and disease tolerance*

Test genotypes which meet canning criteria will be evaluated for drought resistance in trial sites in Ethiopia and Kenya. Lines will be evaluated in stressed and non-stressed field conditions at Kabete, Kiboko and Melkassa following drought screening procedures described by Rao *et al*. (2010). Data will be recorded on shoot traits and yield components, and their association with grain yield and canning quality determined. About 30-40 genotypes combining canning quality with disease and drought resistance will be selected.

*Activity 1.3 Conduct participatory variety selections across agroecological zones (AEZ)*

Lines combining drought resistance and canning quality will be subjected to participatory variety selection under drought stressed conditions at two locations each in Ethiopia and Kenya. Farmers, exporters and processors will selected and their perceptions on productivity, adaptability and preferences for new canning beans recorded using the ribbon method for participatory germplasm evaluation. Promising lines will also be evaluated for industrial canning by Trufoods Ltd in Kenya and for export by ACOS in Ethiopia.

*Activity 1.4 Conduct AYT and NPT to identify candidate bean varieties for release*

About 16-20 genotypes which meet farmers, exporters and industrial canning criteria will be evaluated in AYT in three contrasting environments in three countries. The candidate lines will be subjected to a final laboratory canning evaluation. Appropriate commercial checks will be included in canning and drought evaluations. Statistical analyses will be used to determine the influence of environment on canning quality and genotype x environment interactions. The best ten genotypes combining canning quality with drought tolerance and high yield potential will be submitted for national performance trials and DUS tests. Nucleus seed of candidate varieties will be produced after the first NPT evaluation.

**Output 2:** Effects of soil fertility, water harvesting technologies and cropping patterns on the levels of Fe and Zn concentration in market preferred bean varieties determined

*Activity 2.1 Determine the influence of inorganic macronutrients on grain and leaf mineral concentration*

Trials to determine the effect of phosphorus, nitrogen and potassium on grain and leaf mineral concentration will be conducted in different agroecological zones (AEZ) in Kenya, Ethiopia, Tanzania, Rwanda and Burundi. Soils at these sites are deficient in phosphorus and nitrogen, and are typical of nutrient deficiencies in bean producing regions in eastern Africa. Four levels of each macronutrient will be evaluated in stressed (rainfed) and non-stress (irrigated) conditions. Sprinkler and/or drip irrigation systems will be used to induce moisture stress levels. Four levels of each macronutrient will be evaluated under rainfed conditions..At each level of micronutrient, two water harvesting techniques (pitting and tie ridging) will be used in the same cropping pattern to enhance the effect of fertility improvement. Test materials will include three lines with high mineral density and a low iron check variety. Soils at each trial site will be sampled and analyzed for physical and chemical properties at KARI, in Kenya and in the appropriate laboratories in the other countries. Iron, zinc and protein concentration in grain will be analyzed at the UoN in the case of Kenya and SUA for Tanzania, following standard procedures (SSA Handbooks; AOAC, 2000).

*Activity 2.2 Determine the influence of inorganic micronutrients on grain mineral concentration*

The effect of foliar and soil zinc and iron application on grain mineral concentration and yield will be determined in trials conducted in different AEZ in Kenya, Ethiopia, Tanzania, Rwanda and Burundi. Test genotypes will include three micronutrient dense lines and a low iron check variety. The trials will conducted under irrigated (non-stress) and rainfed (moisture stressed) conditions. Sprinkler or drip irrigation will be used to induce moisture stress levels. Commercially available sources of zinc (zinc sulphate) and iron chelate will be used. Treatments will include four levels of each nutrient and irrigation treatment laid out in a split-plot plot design. Leaf samples for mineral analyses will collected at flowering and grain samples at harvest. Standard procedures will be followed for soil, plant tissue and mineral analyses (Zarcinas *et al*., 1987).

*Activity 2.3 Determine the influence of water harvesting techniques, soil type and organic amendments on grain iron and zinc concentration and yield of market preferred bean varieties using participatory Learning Action Research (PLAR)*

Trials will be conducted using appropriate field experimental designs to determine the effect of two water harvesting techniques and three levels of manure (0, 5 and 10 ton $ha^{-1}$) in the two major soil types on grain iron, zinc and leaf concentration. Water harvesting will entail construction of water harvesting structures in farmlands, such as pits (1metre by 1metre) and tie ridges, created from furrows opened by oxen. Where necessary water will be harvested from the road and diverted into the water harvesting structures. The structures will retain water in the rhizosphere. One cropping pattern will be used to avoid making the experiment too complex. The experiment will use market preferred bean varieties and will be compared with growing beans without water harvesting in both soils in 3 agro-ecological zones in Kenya and Tanzania. Standard procedures will be used to determine the level of iron and zinc in the plant tissues (Zarcinas *et al*., 1987) and for statistical analyses (Steel *et al*., 1997). Economic assessment of fertilization or crop management options will be determined.

2.3.1 Determine the effect of cropping patterns on the iron and zinc concentration of the market preferred bean varieties

Trials to determine the effect two cropping patterns in two different soil types on grain and leaf mineral concentration of iron and zinc will be conducted in different agro-ecological zones in Kenya, Ethiopia, Tanzania, Rwanda and Burundi. Manure will be applied at the rate of 5t/ha in pits measuring 1m by 1m under rainfed conditions. Test materials will include three lines with high mineral density and a low iron. . Leaf samples for mineral analyses will be collected at flowering and grain samples at harvest. Standard procedures will be followed for soil, plant tissue and mineral analyses (Zarcinas *et al*., 1987). Economic assessment in each cropping system and AEZ will be determined.

**Output 3**: Drought tolerant varieties and complementary agronomic management technologies disseminated in drought-prone and medium potential environments

*Activity 3.1 Produce breeder, basic and or quality declared seed of moderately drought tolerant bean varieties*

Each country will identify 3 to 6 recently released varieties with moderate levels of drought tolerance for dissemination. Approximately 400 kg of breeder and/or quality declared seeds will be produced for each variety per season to ensure regular supply of certified breeder seed to seed producers. Breeder seed will be used to produce about 4,000 kg basic or foundation or quality declared seed per season per variety.

*Activity 3.2 Develop and use diverse promotional materials to create awareness on drought tolerant bean varieties and crop management technologies*

Identified technologies will be promoted and scaled-up using diverse promotional materials (leaflets, brochures for farmers, extension agents, policy makers and researchers). Awareness campaigns will be mounted through radio and television programs and other appropriate dissemination channels (e.g demonstrations, field days) in partnership with public broadcasters, extension officers and community based organizations. Cross-village visits will be organized to enhance information exchange between communities. Participatory monitoring and evaluation of technology verification and dissemination will be conducted.

*Activity 3.3 Produce and disseminate certified/quality declared seeds and associated technologies though various dissemination pathways*

A multi channel seed supply strategy will be established in which a range of seed producers will be supported to access parent material to produce certified and quality declared seed (QDS) (Rubyogo *et al*., 2009). Multi-media information channels for both literate and illiterate farmers and other users will be used to support and promote improved bean based technologies. Seed will be packed in affordable small packs (80-100 g) for rapid dissemination through partners. Farmers will be organized in production cells which in turn form production clusters that can produce adequate marketable quantities of beans. The production cells will be trained on production technologies, produce aggregation and marketing.

*3.3.1 Link farmer groups to the bean grain market*

In most situations lack of market may reduce adoption of varieties. To spur increased production and reach more farmers, efforts will be undertaken to link production groups to the market. Those areas supplied with the seed will be linked to the market via grain traders for the produced grain. In Kenya the grain traders are Trufoods, SMART Logistics and PISU, Ethiopia – ACOS and Lume Adama cooperative Union, Burundi – Complexe Agro Industiel Rugambo and Rwanda – Entreprise Kubumwe and Imbarago farmers Union. Each country will also collaborate with other organizations that purchase seed and or grain of beans and supply especially to farmers in stressed environments. Surveys on consumer issues will be carried to assist in promotion of the various bean products.

*Activity 3.4Enhance the skills and knowledge of seed producers (both formal and informal) in pre- and post harvest seed management and agronomic practices*

To enhance the skills and knowledge of implementers, training sessions will be carried in partnership with development partners already involved in the delivery of bean varieties and technologies delivery or nutrition/health centers supporting/working with farmers' groups. Efforts will be made to enhance linkages and interactions with bean grain producers and the market as well as improving farmers marketing skills.

*Activity 3.5 Conduct ex-ante and ex- post impact assessment of the disseminated technologies*

Baseline surveys will be conducted in target areas during the first year of the project to establish the status of production activities, constraints, coping strategies and to develop community action plans. An early adoption survey will be conducted during the third year of the project. KARI and PABRA economist will develop the survey tools and guide implementation.

*Activity 3.6 Develop and implement participatory monitoring and evaluation (M&E) for the project*

To track changes, partners will develop tools to monitor indicators and to compare changes to benchmarks established at project onset. Each partner will monitor achievements based on performance measurement framework (indicating type of data to be collected, where, when, how and by whom) to be developed with partners and PABRA's M&E specialist during the first year of the project. Seasonal in-country review and planning sessions will be conducted through partners' owned innovation platform (IP) to assess progress towards milestones, generating lessons learned and actions to intensify or adjust work packages, or other corrective measures. At regional level, representatives of country teams will also meet annually to review progress.

**Output 4**: Capacities and linkages among the actors along the bean value chain strengthened.

*Activity 4.1 Conduct training of trainers (ToT) for seed producers and seed technologists*

Seed production and business management training for ToTs will be conducted for seed producers for each partner country. Training in seed production and business management will be conducted in partnership with the pan-African seed technology and research training institute at the University of Nairobi (SEMI). Each country to do a one week training for trainers of trainers (ToTs). The trained ToTs each to conduct at least 1 farmer/farmers group training in the respective countries.

*Activity 4.2 Improve skills of actors along the bean value chain*

Skills and knowledge of actors along the bean value chain will be enhanced through training in drought phenotyping, community nutrition (including food baskets and relationship between agriculture and health), marketing, evaluation procedures and breeding for canning quality, seed production and seed business management, participatory monitoring and evaluation tools and processes, and integrated crop management. Training modules will be based on knowledge and skills gaps identified along the value chains. Training sessions will also facilitate knowledge and information exchange among the actors.

*Activity 4.3 Train graduate students in drought and nutrition sciences and impact assessment*

The project will support degree courses at MSc levels and thesis research in fields related to project outputs. Graduate students will be registered in local universities during the first year of the project. Each country to train one MSC student as per their priority needs. There may be need for these students to do research projects that address project objectives.

*Activity 4.4 Improve existing physical infrastructure*

The project has made provision to improve research infrastructural capacities of partners through acquisition of equipment to facilitate laboratory screening of canning quality, DNA extraction and amplification, irrigation, computing, greenhouse repairs and small tools. This project will build on recent improvements of laboratory, greenhouse and field infrastructure in project sites.

## 12. Pathway to impact, applicability of the results in practice, potential impact and dissemination

This project aims at developing varieties and complementary technologies with users along the supply and demand chain. This participatory approach will improve technology uptake and provide opportunities at various levels for farmers to better market their bean varieties, thus facilitating farmers to interact with other actors along the bean value chain. Fig 1 illustrates innovation pathway that demonstrates the necessary linkages along the innovation chain to ensure delivery of results to identified end users. To facilitate downstream linkages the project will convene an innovation platform (IP) of key stakeholders in the bean sub-sector in each of the five partner countries (ALINe, 2009).

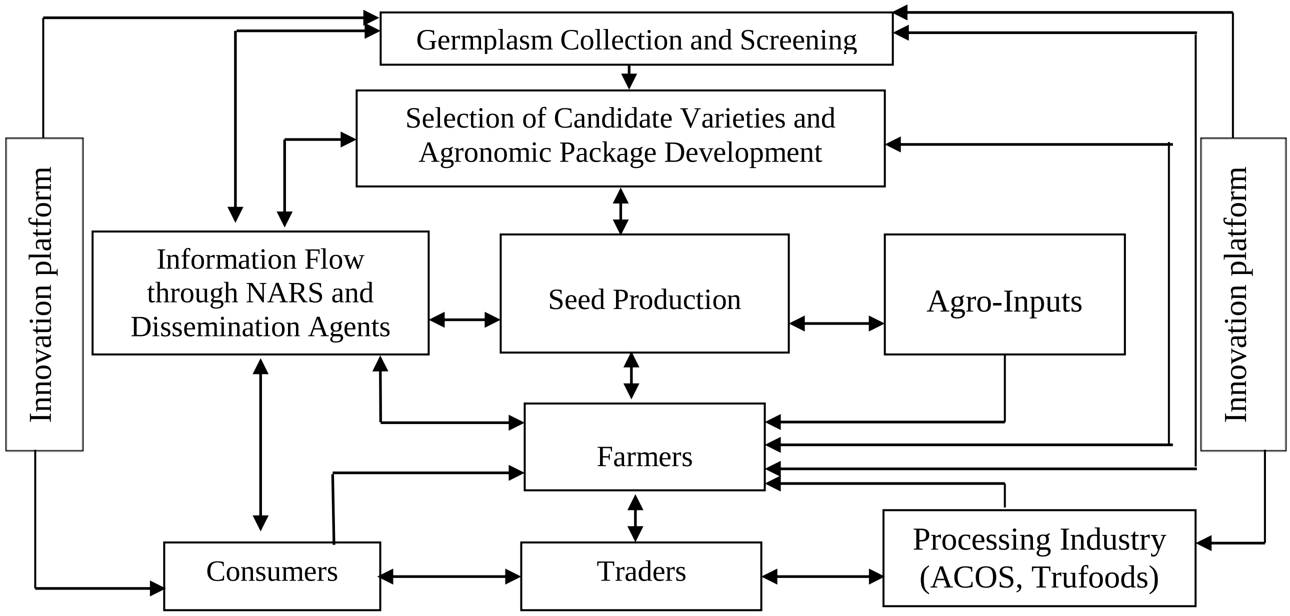


Fig. 1: Partners linkages along the bean value chain to address climate change and variability

Fig 2 shows the potential impact and outcomes of the project and its outputs on target groups and contribution towards attainment of millennium development goals (MDGs).

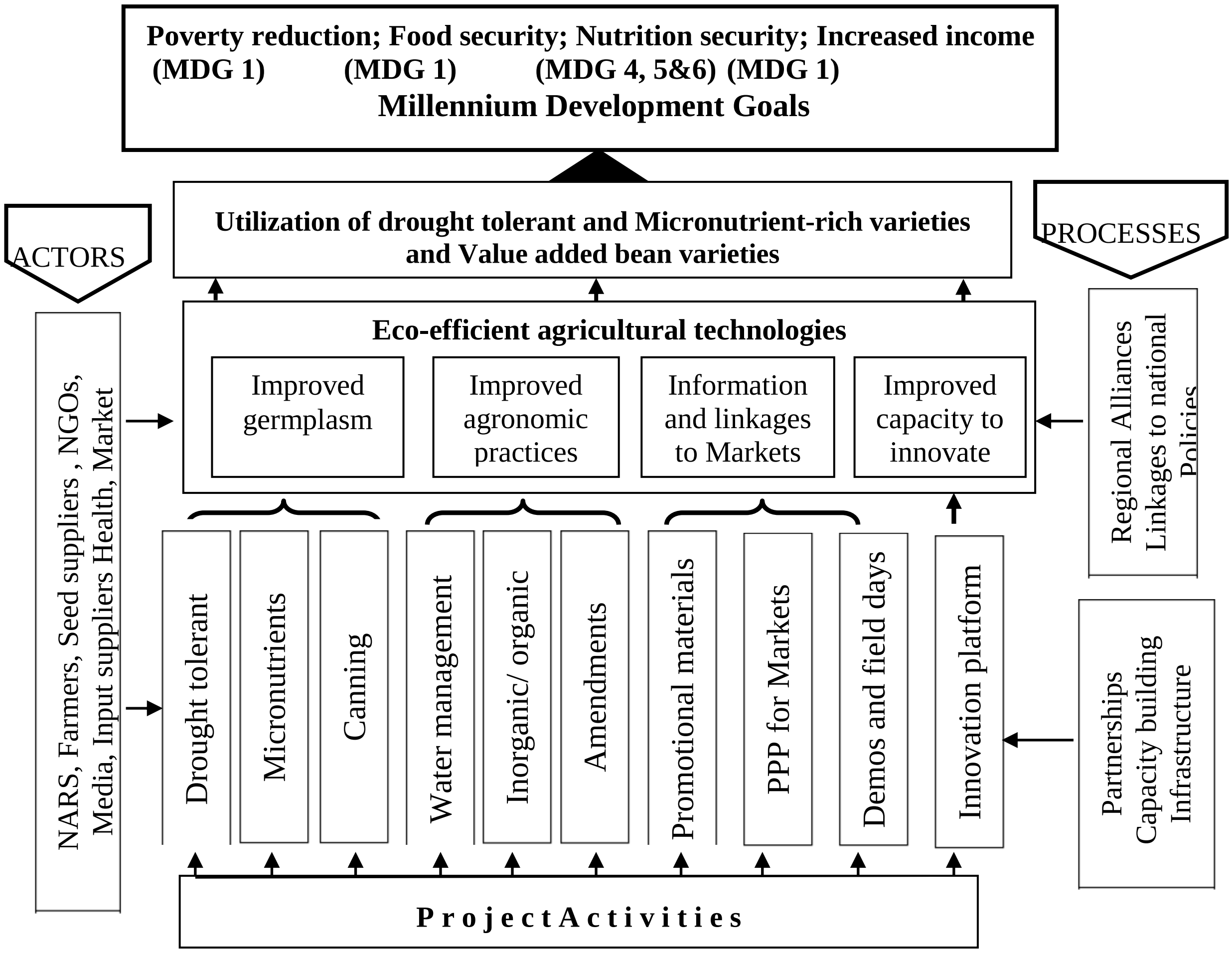


Fig 2: Impact pathway for coping with climatic change and variability with bean based technologies.

## 13. Quality and organization of the consortium

*Research for development partners.* The six institutions involved in the proposed project implementation are the Kenya Agricultural Research Institute (KARI), Ethiopian Institute for Agricultural Research (EIAR), Institut des Sciences Agronomiques du Burundi (ISABU), University of Nairobi (UON), Trufoods Kenya Limited and Pan-African Bean Research Alliance/International Centre for Tropical Agriculture (PABRA/CIAT). Three other institutions that have agreed to collaborate through PABRA/CIAT include Selian Agricultural Research Institute (SARI), Sokoine University of Agriculture (SUA) and Institut des Sciences Agronomiques du Rwanda (ISAR). KARI, the lead institution will co-ordinate the project, provide experimental fields, laboratory facilities and office space for the project secretariat. KARI will be responsible for preparation and submission of semi-annual and annual technical and financial reports. KARI will also organize project review meetings and training for extension officers, non-governmental organizations (NGOs), community-based organizations (CBOs) and other partners. EIAR will co-ordinate research activities in Ethiopia and provide leadership in drought phenotyping and contribute to assessment of canning quality for export markets. ISABU will co-ordinate research activities in Burundi especially participatory evaluation of germplasm under drought conditions. The University of Nairobi will coordinate regional breeding activities, provide expertise in laboratory canning techniques, marker assisted breeding and drought phenotyping under irrigated and rainfed conditions. UoN will also provide training facilities and supervision of graduate students. KARI and UoN will co-ordinate constitution, distribution of germplasm nurseries for regional evaluation and participatory on-station and on-farm evaluation in Kenya. Trufoods will undertake industrial assessment of canning quality, consumer preferences, promotion, marketing and contracting farmers to produce grain for canning. PABRA/CIAT will provide expertise in seed delivery systems, participatory monitoring and evaluation, community nutrition and partnerships. PABRA/CIAT will also provide technical backstopping of activities at SARI and SUA in Tanzania and ISAR in Rwanda. SARI will be responsible for germplasm screening sites in northern Tanzania under controlled drought conditions at their new site. SARI will provide expertise in agronomic management including soil fertility and water harvesting techniques. SUA will provide expertise and facilities for mineral analysis and nutritional evaluation. ISAR will be responsible germplasm evaluation and seed production in drought-prone medium altitude in eastern Rwanda.

*Roles and responsibilities of development and delivery partners*. This project will involve extension staff in dissemination and promotion activities including field days, demonstration plots and training in participating countries. It will also utilize existing collaborative linkages with seed companies such Kenya Seed Company, Freshco and Dryland Seed Companies, farmer groups, agro-input dealers, community based organizations and NGOs including CARE, Catholic Relief Services, World Vision and Catholic Dioceses. In Ethiopia key partners will include farmers’ cooperative unions such as Lume Adama and private seed companies (Alemayehu PLC and Tercha Farm). In Burundi, key partners will be Concern Burundi and government extension services. Promotional activities will involve information officers of the public and private broadcasting media houses.

## 14. Competence and skill track record of principal Investigator

David Karanja (agronomist and national bean program coordinator, Kenya) will be responsible for overall project coordination, production of breeder and basic seed and distribution to partners. Mr. Karanja has successfully managed KARI Seed unit for seven years. He has considerable experience in seed production and dissemination activities He is also the team leader for the Agricultural Product Value Chain (APVC) project which is a public-private sector partnership for commercializing sorghum. The project brought together East African Breweries, small-scale growers, traders, three banks, dissemination agents (MoA and NGOs), researchers (KARI) and Provincial administration in Eastern Province of Kenya in an innovation platform approach. This model has been successful and will be adopted in this project (Referee: Dr Ochieng, KARI Assistant Director for Food Crops (JAWochieng@kari.org). KARI has experience in dryland agricultural R4D including development of drought tolerant varieties and integrated crop management. It has national mandate in dryland research with emphasis on developing technologies for semi-arid regions. However, technologies developed by KARI such as Katumani maize and bean varieties, have been adopted in drought-prone areas outside Kenya.

**15. Proposed consortium project management**

*Matching funds and commitment from host institution.* Projects in the region that will provide matching funds include PABRA, Tropical Legumes II, Kenya Agricultural Productivity and Agribusiness Project (KAPAP), Global Crop Diversity Trust and Sustainable Integrated Maize-Legumes for Eastern and Southern Africa (SIMLESA) and governments of collaborating countries.

*Institutional support.* This includes staff salaries and other emoluments of the collaborating scientists and technical support staff. Additional support will include local germplasm, laboratory equipment, fields, irrigation, transport, electricity, water, office and storage space. All partners were consulted in development of this proposal and expressed willingness to collaborate during the partner's workshop held at BioInnovate-BecA, ILRI from 20-22 September 2010.

*Monitoring and Evaluation, dissemination and communications plans.* A participatory monitoring and evaluation (PME) plan based on the logical framework indicators will be developed in consultation with PABRA's monitoring and evaluation specialists. A PME committee will be organized to facilitate data collection and analyses. The stakeholder groups will derive lessons, make necessary design adjustments in projects and the PME system based on data analyses. This information will also be fed back to communities participating at each sites and project managers. New cycles of PME will be initiated as necessary. Representatives of country team will meet annually to review progress made. These cumulative analyses will result in data base accessible to project partners and other parties.

*Intellectual property and other policy issues.* Germplasm developed in collaboration with NARS and Consultative Group on International Agricultural Research (CGIAR) Centers will be exchanged. In all cases Standard Material Transfer Agreement (SMTA) of the International Treaty of Plant Genetic Resources of Food and Agriculture Organization (FAO) shall regulate the exchange and distribution of the plant germplasm contributed by a given party and collaborating organizations. Any material including biological material and germplasm, know-how, ideas, information, techniques and methods that is created and developed or discovered independently by a given party remains the property of that party. This project will not conduct any genetic transformation or utilize any genetically modified organisms (GMOs).

## 16. Milestones and time frame

| | | | Proposed Project Milestones** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Year 1 (2011) | | | | Year 2 (2012) | | | Year 3 (2013) | | | | |
| **Activity** | ***Partners** | **Budget (USD)** | *Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **1.1** | P1,P2,P4,P7 | 11,900 | | 1 | | | | | | | | | | |
| **1.2** | P1,P2,P4,P7 | 41,650 | | | | 2 | | | | | | | | |
| **1.3** | P1,P2,P4,P6,P7 | 47,600 | | | | | | 3 | | | | | | |
| **1.4** | P1,P2,P4,P7 | 17,850 | | | | | | | | 4 | | 5 | | 6 |
| **2.1** | P1,P2,P3,P4,P7,P9 | 53,550 | | 7 | | 8 | | 9 | | | | | | |
| **2.2** | P1,P2,P4,P9 | 47,600 | | | | | | | | 10 | | | | |
| **2.3** | P1,P4,P8,P9 | 17,850 | | | | | | | | | | 11 | | 12 |
| **3.1** | P1,P2,P3,P4,P7,P8 | 23,800 | | 13 | | 14 | | 15 | | | | | | |
| **3.2** | P1,P2,P3,P4,P7,P8 | 35,700 | | | | | | 16 | | | | | | |
| **3.3** | P1,P2,P3,P4,P7,P8 | 71,400 | | | | | | | | 17 | | 18 | | 19 |
| **3.4** | P1,P2,P3,P4,P5,P7,P8 | 11,900 | | 20 | | | | 21 | | | | | | 22 |
| **3.5** | P1,P2,P3,P5,P7,P8 | 71,400 | | 23 | | | | | | | | | | |
| **3.6** | P1,P2,P3,P5,P7,P8 | 23,800 | | 24 | | | | | | | | 25 | | |
| **4.1** | P1,P2,P3,P5,P7,P8 | 23,800 | | 26, 27 | | | | | | | | | | |
| **4.2** | P1,P2,P3,P7,P8 | 23,800 | | | | 28, 29 | | 30, 31 | | | | | | |
| **4.3** | P1,P2,P3,P4,P7,P8,P9 | 41,650 | | | | | | | | 32 | | 33 | | 34 |
| **4.4** | P1,P2,P3,P7,P9 | 29,750 | | | | | | | | | | | | 35 |

***Legend 1: Partners, activities and timelines:** Obj=Objective; Act=Activity; Q1 = Quarter 1 (January March); Q2 = Quarter 2 (April-June); Q3 = Quarter 3 (July September); Q4 = Quarter 4 (October-December); P1=KARI, P2=EIAR, P3=ISABU, P4=UoN, P5=PABRA, P6=Trufoods, P7=ISAR, P8=SARI, P9=SUA

Fig 4: Project's objective, activities, partners, milestones and timelines.

### **Legend 2: Objectives and Milestones

**Objective 1 Milestones:** 1 = A hundred lines constituted into a regional working collection of canning beans. 2 = Regional nursery (100 lines) evaluated for canning characteristics. 3 = Twenty lines of good canning quality evaluated for drought tolerance on-station and on-farm. 4 = Ten lines combining canning and drought tolerance evaluated for yield potential in AYT, 5 = Five high yielding, drought tolerant lines with preferred canning characteristics evaluated in NPTs. 6 = Two candidate varieties acceptable to canning industry recommended for release.

**Objective 2 Milestones:** 7 = 20 kg each of 10 released fast tract varieties produced. 8 = Effects of fertilization with macro-elements and soil moisture on Fe and Zn concentration and yield validated. 9 = Effects of micronutrient fertilization and soil moisture on grain and leaf Fe and Zn concentration and yield validated. 10 = Effects of cropping systems and soil type on mineral concentration and grain yield documented. 11 = Regional (genotype x environment) trials to determine effects of environmental factors on micronutrient density conducted. 12 = Recommendations of agronomic management practices for enhancing micronutrient density documented.

**Objective 3 Milestones:** 13 **=** 400 kg of breeder/quality declared seed per variety produced (2-6 per varieties country) per season. 14 = 4000 kg of basic seed per variety produced per season. 15 = 40 tonnes of certified seed per variety or quality declared seed produced. 16 = Promotional materials produced and training in canning quality carried out. 17 = Certified seed distributed to 400,000 farmers. 18 = Certified seed/ quality seed distributed to additional 400,000 farmers. 19 = Certified or quality declared seed distributed to additional 600,000 farmers. 20 = 20 extension officers per country trained on bean production and marketing, 21 = 10 ToT courses for farmers carried out per country, 22 = Three ToT course on nutrition carried out for farmers and extension, 23 = 10 production cells linked to markets, 24 = One *ex-ante* report produced, 25 = One *ex-post* report produced.

**Objective 4 Milestones:** 26 = Inception meeting. 27 = Business plan developed and agreed on and innovation platform established. 28 = Graduate students registered and seed production and management training conducted. 29 = Drought phenotyping training conducted. 30 = Training on participatory monitoring and evaluation tools and processes conducted. 31 = Training in nutrition carried out. 32 = Training in integrated crop management. 33 = Project review by partners. 34 = Graduate students complete studies. 35 = Laboratory and field equipment maintained.

## 17. Indicators of progress towards results

| Outcomes | Annual indicators | | | Outcome indicators |
|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | |
| 1. Market preferred canning bean varieties available to processing industry. | About 80 lines with acceptable canning quality distributed to partners in Ethiopia and Rwanda for drought screening | About 30 genotypes combining canning quality with drought resistance selected. | About 16 genotypes which meet farmers, exporters and industrial canning criteria evaluated and 10 best candidate varieties identified | At least one canning bean variety available in each of two countries |
| 2. Soil fertility and water management technologies for enhancing micronutrient density in diverse bean cropping systems validated | Effect of macronutrients and water management on micronutrient concentration evaluated | Effect of micronutrients and water management on grain mineral concentration evaluated | Best bet agronomic practices for enhancing micronutrient concentration validated | At least two soil fertility and water management technologies for enhance grain micronutrient density included in extension recommendations |
| 3. Increased access and utilization of drought tolerant varieties and complementary agronomic management technologies | At least 4000 kg of basic seed per variety produced; At least two training of trainers (ToT) courses held | At least 80 tonnes of certified / quality declared seed distributed to 800,000 households; At least 4 ToT courses held | Certified seeds/quality declared seed distributed to additional 600,000 households in drought-prone areas;<br>Four marketing groups are functional | At least 1,400,000 farmers utilizing drought tolerant varieties and/ or complementary management technologies;<br>Four marketing groups formed. |
| 4. Enhanced capacities and stronger linkages among the actors along the bean value chain. | Innovation platform constituted.<br>Participatory monitoring and evaluation system operational | Diverse actors along the value chain trained in various bean production and marketing skills | Actors along the value chain utilize acquired skills and linkages.<br><br>Graduate students complete their studies | At least one functional platform of actors along the bean value chain operational in each participating country by 2013 |

## 18. Project Activity Plans

The planned activities to be implemented by different partners are summarized in Fig 4 (above).

## 19. Summary project budget (USD)

| | YEAR 2011 | ISABU | EIAR | KARI | ISAR | UoN | SUA | TRUFOODS | SARI | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Budget Catagories** | | | | | | | | | |
| A | Equipment | 1,341 | 1,427 | 9,310 | 2,146 | 14,073 | 7,300 | - | 4,800 | 40,397 |
| B | Consumables (B) | 3,854 | 10,157 | 11,235 | 4,735 | 31,888 | 9,611 | - | 3,351 | 74,832 |
| C | Field Costs | 19,043 | 29,465 | 45,562 | 23,790 | 28,233 | 4,731 | 440 | 19,663 | 170,925 |
| D | Regional Travel | 1,400 | 1,400 | 25,350 | 1,400 | - | 1,200 | - | 1,400 | 32,150 |
| E | Training/dissemination costs | 8,332 | 8,953 | 14,521 | 12,367 | 2,924 | 340 | 150 | 9,260 | 56,848 |
| F | Tuition within the Region | 7,500 | - | - | 7,500 | - | - | - | - | 15,000 |
| G | Management/coordination Costs | 5,644 | 8,196 | 12,760 | 4,744 | - | - | - | 4,290 | 35,634 |
| H | Unforeseen | 940 | 1,000 | 1,000 | 660 | - | - | - | 940 | 4,540 |
| I | Overheads-(10%, 7.5%) | 4,805 | 6,060 | 10,530 | 5,734 | 5,784 | 2,292 | 250 | 4,370 | 39,825 |
| | **Sub total** | **52,860** | **66,658** | **130,268** | **63,076** | **82,901** | **25,474** | **840** | **48,074** | **470,151** |

| | YEAR 2012 | ISABU | EIAR | KARI | ISAR | UoN | SUA | TRUFOODS | SARI | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Budget Catagories** | | | | | | | | | |
| A | Equipment | 2,920 | 1,269 | - | 1,270 | - | - | - | 3,226 | 8,685 |
| B | Consumables (B) | 3,280 | 6,440 | 3,265 | 8,459 | 16,086 | 8,543 | 10,379 | 3,552 | 60,004 |
| C | Field Costs | 14,431 | 29,701 | 40,926 | 16,430 | 19,254 | 3,316 | 1,217 | 16,072 | 141,348 |
| D | Regional Travel | 1,400 | - | 30,950 | 1,400 | 1,250 | 1,250 | - | 1,400 | 37,650 |
| E | Training/dissemination costs | 4,390 | 12,610 | 10,461 | 6,465 | 2,148 | 340 | 150 | 4,320 | 40,884 |
| F | Tuition within the Region | 7,500 | - | - | 7,500 | - | - | - | - | 15,000 |
| G | Management/coordination Costs | 2,080 | 1,472 | 9,360 | 1,144 | - | - | - | 1,680 | 15,736 |
| H | Unforeseen | 800 | 1,000 | 1,000 | 660 | - | - | - | 800 | 4,260 |
| I | Overheads-(10%, 7.5%) | 3,680 | 5,249 | 9,360 | 4,333 | 2,905 | 1,309 | 150 | 3,105 | 30,092 |
| | **Sub total** | **40,482** | **57,740** | **105,322** | **47,660** | **41,643** | **14,759** | **11,896** | **34,155** | **353,658** |

| | YEAR 2013 | ISABU | EIAR | KARI | ISAR | UoN | SUA | TRUFOODS | SARI | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Budget Categories** | | | | | | | | | |
| A | Equipment | 39 | 477 | - | 480 | - | - | - | - | 996 |
| B | Consumables (B) | 1,066 | 2,263 | 1,410 | 2,839 | 1,315 | 3,204 | - | 1,627 | 13,724 |
| C | Field Costs | 8,369 | 12,197 | 19,948 | 10,841 | 15,014 | 1,244 | 143 | 15,321 | 83,075 |
| D | Regional Travel | 1,350 | 5,400 | 20,180 | - | 1,200 | 1,200 | - | 1,350 | 30,680 |
| E | Training/dissemination costs | 3,240 | 5,057 | 4,324 | 3,768 | 1,168 | 340 | 150 | 3,240 | 21,287 |
| F | Tuition within the Region | - | - | - | - | - | - | - | - | - |
| G | Management/coordination Costs | 676 | 552 | 8,160 | 372 | - | - | - | 630 | 10,390 |
| H | Unforeseen | 260 | 500 | 500 | 660 | - | - | - | 260 | 2,180 |
| I | Overheads-(10%, 7.5%) | 1,500 | 2,645 | 3,510 | 1,896 | 1,402 | 614 | 50 | 2,243 | 13,859 |
| | **Sub total** | **16,500** | **29,090** | **58,031** | **20,856** | **20,099** | **6,601** | **343** | **24,671** | **176,191** |
| | **Total** | **109,841** | **153,489** | **293,622** | **131,592** | **144,643** | **46,834** | **13,079** | **106,900** | **1,000,000** |

**Notes:**

**Equipments =** Seed packaging, laptops, desktop, printers, laboratory canning, PCR machine**,** Mattson cooker
**Consumables =** Includes: Fertilizers, laboratory and field chemicals.
**Travel =** Local travel for experimental sites management
**Field Costs** = Transport operating and vehicle maintenance, per diem, casual labour, plant maintenance.
**Subsistence in EA** = Two students' training expenses.
**Tuition inside the region**
**Subsistence in Sweden**
**Management costs** = Planning meeting of project team members, in-country workshops and planning meetings, Air-fares, office assistants, office supplies.
**Unforeseen** = Inflation costs, unexpected expenditure costs.
**Overheads** = Project supporting costs.

## 20. Log frame for the Project

**Title of consortium Project:** Value Added Bean Technologies for enhancing Food Security, Nutrition and Income and Resilience to cope with Climate Change and Variability Challenges in Eastern Africa.

**Goal of the project:** Contribute to improved food and nutritional security and incomes through increased bean productivity, value addition and marketing while conserving the environment

| Outputs | Outcome | Performance Indicators of Outcome | Data Source | Collection Method | Assumption. Assessment of the Progress/ Achievements |
|---|---|---|---|---|---|
| **Project specific objectives** | | | | | |
| **Objective #1:** Select canning bean varieties that meet the requirement of processing industry | | | | | |
| Canning bean varieties that meet the requirements of processing industry developed | Market preferred canning bean varieties available to processing industry | At least one canning bean variety available in each of two countries | Bean programme reports; Bean processors reports; Institutional reports; Project reports. | Breeding scheme and germplasm evaluation; Laboratory and industrial evaluation of canning quality | Continued favourable policy environment for local canning industries |
| **Objective #2:** Determine the effects of soil fertility, water harvesting technologies and cropping patterns on the levels of Fe and Zn concentration in market preferred bean varieties | | | | | |
| Effects of soil fertility, water harvesting technologies and cropping patterns on the levels of Fe and Zn concentration in market preferred bean varieties determined. | Soil fertility and water management technologies for enhancing micronutrient density in diverse bean cropping systems validated | At least two soil fertility and water management technologies for enhancing grain micronutrient density included in extension recommendation. | Bean programme reports; Institutional reports; Project reports; Refereed publication. | Field studies on soil fertility and water management options. | Continued government support for bean research. |
| **Objective #3:** Disseminate drought tolerant varieties and complementary agronomic and other management technologies in drought-prone environments | | | | | |
| Drought tolerant varieties and complementary agronomic and other management technologies disseminated in drought-prone environments. | Increased access and utilization of drought tolerant varieties and complementary agronomic management technologies | At least 1,400,000 farmers utilizing drought tolerant varieties and/ or complementary management technologies. | Bean programme reports; Institutional reports. | Bean productivity surveys; Early adoption studies; Commissioned studies. | Continued willingness for partners to collaborate. |
| **Objective #4:** Strengthen capacities and linkages among the actors along the bean value chain. | | | | | |
| Capacities and linkages among the actors along the bean value chain strengthened | Enhanced capacities and stronger linkages among the actors along the bean value chain. | At least one functional platform of actors along the bean value chain in each participating country by 2013. | Bean programme reports; Institutional reports. | A survey of partners' perception on the platform. | Enabling environment for public-private partnership. |

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Felix, A. 2009. 2009. Influence of supplementary irrigation, organic amendments and soil type on micronutrient density in common bean. MSc Thesis, University of Nairobi.

Kimani, P.M. and A. Mwang'ombe. 2009. Development and release of new speckled sugar bean varieties with multiple resistance in eastern Africa. *In: Improved beans for the Developing World*. Cali, Colombia, p139-145.

Kimani, P.M. and M. Pyndji. 2009. Evolution of ECABREN's Breeding Strategy. PABRA-TL II Breeding Strategy Workshop 9-10 February, Lilongwe, Malawi.

Kimani, P.M., R. Chirwa, S. Beebe, R. Buruchara, M. Pyndji and M. Blair. 2009. Breeding micronutrient dense bean varieties for Africa: 2009 – 2013. PABRA- TL II Breeding Strategy Workshop 9-10 February, Lilongwe, Malawi.

Loggerenberg, van Magdalena. 2004. Development and application of a small-scale procedure for the evaluation of small white beans (*Phaseolus vulgaris* L.). PhD Thesis. University of Free State, Bloemfontein, South Africa.

Mahuku, G.M., C. Montoya, M.A. Henrquezn, C. Jara, H. Teran and S. Beebe. 2004. Inheritance and characterization of angular leaf spot resistance gene in common bean accession G10474 and identification of an AFLP marker linked to the resistance gene. Crop Science 44:1-8.

Miklas PN, Kelly JD, Beebe SE, Blair MW. 2006. Common bean breeding for resistance against biotic and abiotic stresses: from classical to MAS breeding. Euphytica 147(1–2):105–131.

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Musoni, A, P.M. Kimani, R. D. Narla, R. Buruchara and J. Kelly. 2010. Inheritance of fusarium wilts (*Fusarium oxysporum* F. sp. *phaseoli*) resistance in climbing beans. *African Journal of Agricultural Research 5: 399-404.*

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Witcombe, J.R., A. Joshi, K.D. Joshi and B.R. Sthapit, 1996. Farmer participatory crop improvement: I. Varietal selections and breeding methods and their impact on biodiversity. *Exp Agri* 22:443-460.

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## Annex 1: Summary of Curriculum Vitae of PI and Co-PIs

### 1. Mr. David Karanja (PI, Kenya)

Project Role: Team Leader (PI)

**Educational Qualifications**

- MSc in Agriculture, University of Queensland, Gatton College - Australia, 1994
- BSc in Applied Science in Rural Technology, University of Queensland, Gatton College – Australia, 1990
- Diploma in General Agriculture, Egerton University, Njoro Kenya, 1986
- Diploma in crop management research, CIMMYT regional programme at Egerton University, Njoro, Kenya, 1994
- Course on Development Oriented Research in Agriculture, Wageningen, Netherlands, 1998
- Course on Social Science Research methodology, Addis Ababa, Ethiopia, 2000
- Sensitisation on Gender in Agricultural Research and Extension, 1998.

**Summary of work experience**

| | |
|---|---|
| 2008 to date: | Principal Investigator and Team Leader white sorghum commercialisation project |
| 2003 to date: | National Coordinator of Grain Legumes Programme under KARI |
| 2005 to date: | Acting National Coordinator of KARI Seed Unit |
| 2002 to date: | Head of KARI Seed Unit Katumani: production, processing and seed marketing<br>Lead scientist in four CBOs activities in the Agricultural Technology and Information Response Initiative Programme of KARI.<br>Lead scientists in the Eastern province traditional food crops project funded by IFAD |
| 2000 –2001: | (a) Lead agronomist sorghum and millet programme<br>(b) Centre gender advisor<br>(c) Deputy Head of KARI Seed Unit |
| 1994 – 1999: | (a) Sorghum and millet research program. Lead scientist in Agronomic work for water stressed situations<br>(b) Regional Research programme<br>(i) Evaluation of sorghum production guidelines<br>(ii) Sorghum adoption and technology transfer project in Eastern Kenya |
| 1987 – 1998: | Technician - ACIAR Project KARI Katumani. Agronomic on-station/-farm research. |

**Selected publications**

1 D. R. Karanja, C.M. Githunguri, L. M'Ragwa, D. Mulwa and S. Mwiti (2006). Variety Characteristics and Production Guidelines of Traditional Food Crops. Manual funded by IFAD

2 Karanja D. R. (2004). Wider impact for the bean program in Kenya. In the proceedings of the Kenya Bean research programme participatory monitoring evaluation and wider impact workshop held on 26th – 29th May 2004 at Kunste Hotel Nakuru.

**2. Dr. Setegn Gebeyehu Endire (Co-PI, Ethiopia)**

e-mail: setegng@yahoo.co.uk or s.gebeyehu@daad-alumni.de

**Educational Background**

PhD, 2006: Agriculture (Physiological Genetics), University of Geissen, Germany

**Experience of Agricultural Research / Teaching**

| | **Duration (Month and Year)** | | |
|---|---|---|---|
| **Position** | **From** | **To** | **Field of Work** |
| Junior Research Officer | Feb 1992 | Mar 1995 | Crop Improvement |
| Assist. Research Officer | Mar 1995 | Oct 1995 | Crop Improvement |
| Assistant Researcher II | Nov 1997 | Aug 1998 | Crop Improvement |
| Lecturer | Sep 1998 | Dec 2000 | Agronomy |
| Associate Researcher I | Dec 2000 | Mar 2007 | Agronomy/Physiology |
| Associate Researcher II | Apr 2007 | Present | Breeding/Physiology |

**Key Leadership Role**

| | **Duration (Month and Year)** | |
|---|---|---|
| **Positions held** | **From** | **To** |
| Coordinator, Research & Extension Office/ACA/ | Mar 2000 | Dec 2000 |
| Coordinator, National Bean Research Program | Mar 2007 | July 2010 |
| Coordinator, Pulses, Oilseeds and Fiber Crops Research Case Team of EIAR | Sep 2008 | Mar 2009 |
| Director, Melkassa Agricultural Research Center | Mar 2009 | July 2010 |

**Other roles/participation**

a) Member, Crop Science Society of Ethiopia
b) Member, German Society of Plant Nutrition
c) Teach courses such as Stress Physiology, Advanced Plant Physiology, Advanced Crop Physiology (MSc) and Physical Components and Chemical Patterns of Photosynthesis and Plant Stress Physiology (PhD) - Haramaya, Jimma and Mekelle Universities in Ethiopia
d) Supervisor, MSc and PhD thesis research by students at different universities in Ethiopia

**Selected Recent Publications Journal Articles**

**Gebeyehu, S**., Wiese, H., Schubert, S. (2010): Effects of drought stress on seed sink strength and leaf protein patterns of common bean genotypes. African Crop Science J. 18 (2): 75– 88

**Gebeyehu, S**., Wiese, H., Schubert, S. (2010): Effects of drought stress on growth, water-use efficiency and leaf gas-exchange of common bean (*Phaseolus vulgaris* L.) genotypes differing in drought resistance. Ethiopian Journal of Crop Science (accepted)

Fikere, M., T., Tadele, **Gebeyehu, S**., Hundie, B. (2010): Agronomic performances, disease reaction and yield stability of field pea (*Pisum sativum L.*) genotypes in Bale Highlands, Ethiopia. Aust. J. Crop Sci. 4(4): 238-246

## 3. Mrs. Capitoline Ruraduma (Co-PI, Burundi)

**Academic Qualifications**

Bachelor of Science (Biological Science), University of Burundi, 1981

**Professional Courses Attended**

1. Training on Seed Systems in the Great Lake Region, Bujumbura, 19-21st April 2010
2. Training in Research Management in leadership (Mentorship & Coaching) , SCARDA, Bujumbura (November, 7th – 11th 2009 and April 12-17th 2010)
3. Formation en Gestion du Cycle de Projet et le cadre logique organisé par la Cellule d'Appui à l'Ordonnateur National du FED à Bujumbura (26 au 28 Février 2002)
4. Training in varietal screening for tolerance to fungal bean diseases, phytopathologic unit of Gembloux, university of agronomic Science in Belgium, October 2004 / January 2005

**Summary of Work experience and responsibilities**
**Key responsibilities**

**September 1999 to date:** Head of grain legumes Program at ISABU (Bean, soybean, Peanut, Rhizobium inoculant production) roles: coordination of different Components

**November 2005- March 2006:** Member of commission in charge of preparation of National Workshop on seed production and quality control

**From 2005 to date:** Responsible of Bean Component and Member of ECABREN Steering Committee, with focus on breeding activities

**March 2001 - 2007:** Secretary of ISABU scientific commission, organ in charge of monitoring various scientific documents (research projects, publications, work-plan and scientific reports)

**From 2001 to date:** Member of ISABU scientific commission in charge of validation of scientific documents

**February 1994-2005:** Responsible of Soybean/ rhizobia component (Soybean breeding and agronomic activities

**Selected Recent Publications**

- Capitoline, Ruraduma, 2010 : Introduction et Promotion des variétés de haricot riches en micronutriments. Communication, atelier de formation sur l'importance des micronutriments en nutrition, Bujumbura, Février 9-10 ,2010

- Capitoline, Ruraduma, 2009: Importance du haricot volubile et le Tuteurage, Communication, atelier de lancement du projet ASARECA : Climbing bean Intensification system November, 2009

- Capitoline, Ruraduma, 2009: Pulses and oils Crops in Burundi, communication at ASARECA, planning meeting, Bujumbura, 2009.

- Capitoline, Ruraduma *et al*. 2009: Manuel de formation sur la culture du haricot au Burundi, Mai 2009 (en français).

**4. Prof. Paul M. Kimani (Co-PI, University of Nairobi, Kenya)**

**Project Role: Co-PI, breeding**

**Educational Qualifications**

1983: PhD in **Genetics and Plant Breeding,** University of Wisconsin- Madison, U.S.A

**Positions held**

**2000 to date:** Regional Breeder, East and Central Africa Bean Research Network
**1997 to date**: Associate professor (Genetics and Plant Breeding)
**2009-2012:** PI**,** Marker assisted breeding (Kirkhouse Trust, UK)
**2006-2012**: PI, Nutribean project (VLIR- Belgium)
**1986 to date**: Head, Genetics and Plant Breeding sub-department
**2007-2010:** PI, East and southern Africa, Tropical Legumes drought project II
**2006-2008**: Co-PI, Snap improvement bean project (ASARECA/European Union)
**2005-2008:** PI, Regional biofortification project (ASARECA/USAID)
**2001-2007**: Project Breeder: Breeding bean for resistance to root rots and angular leafspot (Rockefeller Foundation)
**2001-2004**: Co-PI, Breeding and mechanisms for aluminium tolerance (BMZ-GTZ)
**1999- 2009**: Collaborative regional bean projects (PABRA/ECABREN)

**Responsibilities**

Implementation of all project activities, coordinating activities for collaborating NARS and NGOs, student supervision, project reporting, donor relations ,dissemination, seed production and distribution for regional evaluations, technical backstopping and training NARS scientists & collaboration with other institutes and NGOs.

**2008-to date**: College representative, Graduate School, University of Nairobi
**1986-2004**: Member, College Entrepreneurship programme committee
**1983-2007**: Member, Faculty of Agriculture Board
**1986- to date**: Member, Departmental Planning committee & Board of Examiners.
**1997- to date**: Member, College of Agriculture and Veterinary Sciences Academic Board

**Summary of Publication Record**

- More than 100 referred publications
- Supervised more than 50 graduate students for PhD and MSc
- More than 22 officially released varieties in grain legumes and onions.

**Recent Journal papers**

Odeny, D.A., S. M. Githiri and P.M. Kimani. 2009. Inheritance of resistance to fusarium wilt in pigeonpea, cajanus cajan (L.) Millsp. *J. Animal and Plant Sciences 2: 89-95*

Kimani, J.M., P. M. Kimani, S.M. Githiri and J.W. Kimenju. 2007. Mode of inheritance of common bean (Phaseolus vulgaris. L) traits for tolerance to low soil phosphorus. Euphytica 155: 225- 234.

Lubanga, L., P.M. Kimani, R. Ngatoluwa, B. Rabary, G.O. Rachier, M. M. Ugen, V. Ruganzu and E. Awad Elkarim. 2007. Bean improvement for low soil fertility adaptation in Eastern and Central Africa, *pages 325-332*. *In*: Bationo *et al* (eds.). *Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and Opportunities*. Springer, Dordrecht, The Netherlands. 1094pp. [ISBN 978-1-4020-57595].

Namayanja, A., R. Buruchara, P. M. Kimani, P. Rubaihayo, G. Mahuku, S. Mayanja and H. Eyedu. 2006. Inheritance of resistance to angular leaf spot in common bean and validation of resistance linked markers for marker assisted selection outside the mapping population. *Euphytica* 151: 361-369.

**5. Mr. Jean Claude Rubyogo (Co-PI, PABRA seed systems specialist)**

Jean Claude Rubyogo is a Seed System and technology transfer Specialist at the International Center for Tropical Agriculture (CIAT) spearheading the seed system and reach end users initiatives of PanAfrica Bean Research Alliance (PABRA). He holds in MSc degree in Crop Improvement from the University of Nottingham (UK). For the last 25 years, he has been involved in agricultural research development focusing with focus on use of improved varieties and complementary technologies as means to increase small scale farmers' crop productivity and ultimately their incomes and nutrition/food security. Jean Claude served as Farming Systems Researcher (on station and on farm) in the Institut des Sciences Agronomiques du Rwanda (ISAR) between 1985 and 1993. He also served as Natural Resource Management Coordinator in the GTZ supported Integrated Food Security Programme in East Kenya with focus on the introduction of improved drought tolerant varieties and other drought mitigating technologies to increase crop productivity and food security in East Kenya (1997-2002). This programme was rated as the most successful GTZ supported in Eastern Africa region. In 2002, he supported FAO- Kenya –Emergency Unit to devise innovative approaches (seed fairs, on farm seed production and local seed supply) targeting vulnerable households in Kenya. Since 2003, he joined CIAT-Pan Africa Bean Research (PABRA) to spearhead the establishment and implementation of impact oriented bean seed systems across 24 countries. This effort culminated in considerable reach of about 7.5 millions households between 2003 and 2007. For the moment, he is catalyzing PABRA partners to facilitate the accelerated and sustainable access of improved and preferred bean varieties to about 16.5 millions using innovative approaches including decentralized seed supply (seed fairs/entrepreneurs) and stimulating private sector seed companies to expand their market of certified seeds through small seed packs. Nothing described him better than some his recent publications e.g. Rubyogo, J.C., Sperling L.; Muthoni R. and R.Buruchara (2010) Bean Seed Delivery for Small Farmers in sub-Saharan Africa: The Power of Partnership. *Society and Natural Resources* ***23(4)*** *p 285-302*

6. **William M. Mugo (Co-PI, Trufoods Limited, Kenya)**

Trufoods limited is involved in production of its raw materials through its sister company KABAZI Canners. Additionally, Trufoods is involved in processing, canning and marketing of its products with their flag ship bean canned product being marketed as Kenylon.

William M. Mugo is an agronomist with Trufoods limited in the extension and procurement department. He holds a BSc degree in Agri-business and has been working with Trufoods limited for the last 10 years. He has been involved in contracting farmers in the field and procuring raw materials. He is also responsible for ensuring the required quantity and quality are met by the contracted farmers.

7. **SOSTINE ONESMO KWEKA (SARI)**

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**E – mail:** msami652@yahoo.co.uk or sari@habari.co.tz

**B: PROFESSINAL QUALIFICATION:**

| Name of Institute | Date and qualification obtained |
|---|---|
| Sokoine University of Agriculture, Morogoro,Tz | 2002 – 2004 M.Sc. Agriculture |
| Sokoine University of Agriculture, Morogoro,Tz | 1989 – 1991 B.Sc. Agriculture |
| MATI Uyole, Mbeya, Tanzania | 1982 – 1984 Diploma in Crop in Crop Production |

**D. WORKING EXPERIENCE:**

| Date | Employer | Position held/responsibility |
|---|---|---|
| Feb 1980-Oct 1991 | Ministry of Agriculture & Livestock | Agricultural Field Officer – Working under Coffee Breeding & Production (Lyamungu Agric. Research Institute - MOSHI). |
| Nov.1991 To date | Ministry of Agriculture & Food Security | **Principal Agricultural Research Officer -** Working under Phaseolus Bean Breeding & Production (Selian Agric. Research Institute - ARUSHA). |
| March 2010 To date | Ministry of Agriculture & Food Security | **- Head/Program Coordinator** Coordinating all activities under National Bean Research Program in Northern Tanzania |
| July 2010 To date | Ministry of Agriculture & Food Security | **- National Leading Scientist** Leading all activities under National Bean Research Program in Tanzania |

**Selected Publications:**

**S. O. Kweka**, 1999. Recommended bean varieties for the medium altitude zone of Tanzania. Issue no. 1(recommended bean varieties to increase production and profit). Newsletter for Agricultural Research & Extension in the Northern Zone of Tanzania. NORTHERN LINK.

C.A. Kuwite, **S.O. Kweka**, S. Kuoko, J.W.J. Msakyi, M. Kingamkono and J.E. Saria, 2000. Particpatory Rural Appraisal in Mandachini village, Rombo District, Tanzania.

**S.O. Kweka**, P.A. Ndakidemi, C.S. Mushi, E. Nkonya & D. Soniia, 2001. Adoption of Lyamungu bean variety in Hai, Moshi Rural and Mbulu Districts in the medium altitude zone of Tanzania. PABRA Millenium Synthesis: A workshop on Bean

Research and Development in Africa over the last Decade held at Novotel Mount Meru, Arusha, Tanzania, May 28th – June 1st, 2001.

**S.O. Kweka** F.S. Ngulu**,**, S. Slumpa, P. Xavery & A. Kisamo, 2001. Participatory Plant Breeding (PPB) with women and small scale farmers in Africa and Latin America – Case Study in Tanzania. A workshop held at Alemaya University, Ethiopia, 24th – 29th September, 2001.

**S.O. Kweka,** F.S. Ngulu, 2003. Bean Dishes for Family Nutrition Enhancement.. 1st Edition. Pp15.

**S.O. Kweka.**,2005. Incorporation of Angular leaf spot (ALS) resistance into adapted common bean (*Phaseolus vulgaris* L) varieties in Tanzania. M.Sc. Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania. pp. 109.

## 8. BUTARE LOUIS (ISAR)

Contact address: Institut des Sciences Agronomiques du Rwanda (ISAR)
B.P. 138 Butare-Rwanda; Tél/Fax : (+250) 530145

**B. EDUCATION**

B1. Ph D training (on going): Jan 2007- Dec 2010
Gembloux Faculty of Agriculture (Belgium) and International Center for Tropical Agricultural, Cali, Colombia.
B2. DEA (Diplôme d'Etude Approfondie) equivalent to Master of Science (Plant Pathology/Gembloux): Feb 2004 – Sept 2005.
B3. Grants and awards:

- German Government (GTZ/BMZ) through CIAT project: Fighting drought and aluminum toxicity: "Integrating functional genomics, phenotypic screening and participatory evaluation with farmers to develop stress-resistant common bean and brachiaria for the tropics": Ph D Scholarship (Jan 2007- Dec 2009).
- IPBO's Summer course: "Modern breeding techniques for the improvement of leguminous plants", summer course at Ghent university, Faculty of sciences, Department of plant biotechnology and genetics, Institute of Plant Biotechnology for Developing Countries (17-28 August, 2009).

***D. Professional Experience***

D1. Midland Agricultural Research Center (MARC) director: Sept 2005- Jan 2007
D2. ISAR bean research program coordinator: Sept 2002 – Feb 2004 and Oct 2005 – Jan 2009.
D3: University visiting lecturer (FACAGRO/National University of Rwanda (UNR): Plant pathology (2006 – 2007), initiate and supervise student theses.
D4. Rwerere station (ISAR) research coordinator: July 1999 – Sept 2002**.**

E. Research Experience

E1. Coordinating bean research projects funded by Rwanda government and CGIAR centers network on breeding for high yielding, disease resistance, market and nutritional quality in bean; Genotype development and selection for adaptability to low soil fertility and drought for semi arid zones in Rwanda; management of soil productivity and bean pests (ISFM and IDPM options); facilitate and improve capacities of communities through bean variety selection.
E2. ASARECA (association for Strengthening Agricultural Research in Eastern and Central Africa), Bean fortification Project: Traditional and Conventional breeding for micronutrient content (Fe and Zins)

**E3. ASARECA Competitive Grant System: Enhancing Competitiveness of Snap Beans for domestic and export markets.**

E4. Dry Grain Pulses (CRSP Project): Visit to Ecuador (Southern America) to interchange experience between investigators: breeding populations management, germplasm banks, screening and crossing at different INIAP research stations; interchange of experience on participatory methods and seed production for local community small household farmer.

**F. Publications, Papers and Reports**

Blair, M.W., F.F. Gozalez, P. Kimani and L. Butare. 2010. Genetic diversity, inter-gene pool introgression and nutritional quality of Common beans (*Phaseolus vulgaris* L.) from central Africa. Theor. Appl. Genet. Springer Berlin/Heidelberg. 0040-5752.

Ferris R. B., Tuyisenge J., Rucibigango M., Mukankubana D., Ngaboyisonga C., Gatayiha C., Butare L., Kanyange C., Uwantenge C., Kagiraneza B., and Waga K. (2002). Bean sub-sector market survey in Rwanda. ATDT-CIAT/ISAT/IITA-FOODNET and PEARL Project-Rwanda. 77p.

**9. Peter Ruwaichi Simon Mamiro**

### Academic qualifications

**PhD. Applied Biological Sciences, University of Ghent, Belgium. 1999- 2003.** Title of the PhD Dissertation: Influence of Complementary Food on Growth and Iron Status of infants Aged 6-12 months in Kilosa district in Tanzania

**M.Sc. (Management of Natural Resources and Sustainable Agriculture)- Agricultural University of Norway – 1989-1991.** Title of the MSc. Dissertation: Household Food Security in Rural Tanzania: Adequacy Stability and Accessibility **-** A Case Study of Moshi and Kilosa Districts.

**B.Sc. Agriculture (Food Science Option)- Sokoine University of Agriculture – 1984 - 1986.** Title of the BSc. Special Project: Studies on Some Characteristics and Oxidative Behaviour of Sunflower and Cottonseed Oil Produced by Morogoro Oil Processing Company (MOPROCO).

### Published papers

**Mamiro, P.S., Van Camp, J., Mbithi-Mwikya, S., Huyghebaert, A.** (2001) *In vitro* extractability of calcium, iron and zinc in finger millet and kidney beans during processing. *Journal of Food Science*, 66(9), 1271-1275.

**Mbithi-Mwikya, S., Van Camp, J., Mamiro, P.S., Ooghe, W., Kolsteren, P., Huyghebaert**, **A.** (2002) Evaluation of the nutritional characteristics of a finger millet based complementary food. *Journal of Agricultural and Food Chemistry*, 50(10), 3030-3036.

**Kimanya, M.E., Mamiro, P.S., Van Camp, J., Devlieghere, F., Opsomer, A., Kolsteren, P., Debevere, J.** (2003). Growth of *Staphylococcus aureus* and *Bacillus cereus* during germination and drying of Finger Millet and Kidney Beans. *International Journal of Food Science and Technology*, 38, 119-125.

**Mamiro, P., Kolsteren, P., Van Camp, J., Roberfroid, D., Tatala, S., Opsomer, A.** (2004). Processed complementary food does not improve growth or hemoglobin status of rural Tanzanian infants from 6 – 12 months of age in Kilosa District, Tanzania, *Journal of Nutrition*, 134: 1084 – 1090.

**Mamiro, Peter S., Kolsteren, Patrick W., Roberfroid Dominique., Tatala, Simon., Opsomer Anne., and Van Camp John** (2005) Feeding practices and factors contributing to wasting, stunting, and iron deficiencyanaemia among 3-23 month old children in Kilosa District, Rural Tanzania. *Journal of Health Population and Nutrition* 23 (3) 222-230.

**Nyaruhucha C. N. M, P. S. Mamiro, A. J. Kerengi and N. B. Shayo** (2006) Nutritional Status of Under Five Children in a Pastoral Community in Simanjiro District, Tanzania. *Tanzania Health Research Bulletin* 8 (1):32-36.

**Nyaruhucha C. N. M, Msuya, J. M. Mamiro P. S. and A. J. Kerengi** (2006) Nutritional Status and Feeding Practices of Under Five Children in Simanjiro District, Tanzania. *Tanzania Health Research Bulletin* 8 (3):162-167.

**Mtebe Kaswija, Mamiro Peter, Fweja Leonard** (2006) Sensory Attributes, Microbial Quality and Aroma Profiles of Off Vine Ripened Mangoes (*Mangifera indica* L. ) Fruit. *African Journal of Biotechnology* 5 (2): 201 – 205.

**Carl Lachat, John Van Camp, Peter S Mamiro, Francis Obuoro Wayua, Anne Opsomer, Dominique Roberfroid and Patrick W. Kolsteren** (2006) Processing of Complementary Food Does not Increase Hair Zinc Levels and Growth of Infants in Kilosa District, Rural Tanzania. *British Journal of Clinical Nutrition*.

**Shayo, N.B, Mamiro, P.S. Nyaruhucha, C.N.M and Mamboleo, T** (2006) Physico-chemical and grain cooking characteristics of selected rice cultivars grown in Morogoro. *Tanzania Journal of Science 32(1) 29-35*.

**Mamiro Peter, Fweja Leonard, Chove Bernard, Kinabo Joyce, George Victor and Mtebe Kaswija** (2007) Physical and chemical characteristics of off-vine ripened mango (Mangifera indica L.) Fruit (Dodo). *African Journal of Biotechnology* 6 (21): 2477 – 2483.

## Annex 2: Letters of commitment from participating partners

KENYA AGRICULTURAL RESEARCH INSTITUTE
HEADQUARTERS:
P.O. BOX 57811- 00200
NAIROBI

When replying please quote:
Our Ref: **KARI/1/104/Vol.XIII/58**

Date: **25th September, 2010**

**Programme Management Team**
**BioInnovate**
**P. O. Box 30709 - 00100**
**NAIROBI**
KENYA

Dear Sir,

**Re: Sida Funding on BioInnovate- Beans for Climate Change: Full Proposal**

This correspondence is a **Letter of Support** on the Full Proposal regarding the envisioned project on **Value Added Bean Technologies for enhancing Food Security, Nutrition and Income and Resilience to cope with Climate Change and Variability Challenges in Eastern Africa**, to be funded by Sida as a BioInnovate initiative.

The component on Beans Technologies, to address issues on food security and incomes in rural households of semi-arid areas of the region, is enclosed herewith for your perusal and necessary action. As I understand, the lead institution for the BioInnovate project will be the Kenya Agricultural Research Institute (KARI). Mr. David Karanja will be KARI's focal person.

I look forward to fruitful collaboration in pursuit of food ad nutritional security in Kenya in the face of Climate Change.

Yours sincerely,

Ephraim A. Mukisira (PhD, OGW)
**DIRECTOR - KARI.**

Telephone: 254-020-583301-20 / 254-020-583720. Fax: 254-020-583344 Email: director@kari.org

Trufoods Ltd.
*the friendly food people*

zesta Kenylon

P.O. BOX 41521 - 00100, JOGOO ROAD, NAIROBI - KENYA
TEL: 557700, 557814, 2385880/60 FAX: 254-020 554815/
652561/2385850
E-Mail: trufoods@accesskenya.co.ke

Date: 09th Jul 2010

Programme Management Team
C/o ILRI
P.O. Box 307099-00100
NAIROBI

**RE: CONCEPT NOTE-BEANS FOR CLIMATE CHANGE**

We are willing to participate in the concept note on adapting climate change in agriculture and the environment in Eastern Africa.

We look forward to working together in full proposal write-up and implementation if the concept note is successful.

Yours faithfully,
**For TRUFOODS LTD**

**HIMANSHU PANDEY**
**UNIT MANAGER**

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF AGRICULTURE, FOOD SECURITY AND COOPERATIVES

NORTHERN ZONE AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE

NZARDI

Tel: +255 73 6500538, 073 6500580

Fax: +255 73 6500538

E-mail: sari@habari.co.tz

Selian Agricultural Research Institute (SARI)

P.O. Box 6024
Arusha

22nd Sep, 2010

The Project Manager,
BioInnovate,
P.O. Box 30709 Nairobi,
**KENYA**
Tel: +254 20 422 3000
Fax: +254 20 422 3001

Dear Sir,

**RE: Bio-resources Innovations Network for Eastern Africa Development (BioInnovate)**

We are pleased to confirm that we will serve as the Partner Institution in the proposal "Value Added Bean Technologies for enhancing Food Security, Nutrition, Income and Resilience to cope with Climate Change and Variability Challenges in Eastern Africa." We fully authorise John W.J. Msaky and Sotenes O. Kweka who are the staff members at Selian Agricultural Research Institute (SARI) to participate in the project research team as collaborators.

SARI will be able to host the project activities in its various centres and we accept to be legally responsible for all official transactions with respect to BioInnovate project activities in Tanzania.

Yours faithfully

DR. LUCAS MUGENDI
**THE ZONAL RESEARCH DIRECTOR – NORTHERN ZONE**

ZONAL DIRECTOR
AGRIC. RESEARCH AND TRAINING
SELIAN AGRIC. RESEARCH INSTITUTE
P. O. Box 6024 ARUSHA

UNIVERSITY OF NAIROBI
COLLEGE OF AGRICULTURE AND VETERINARY SCIENCES
FACULTY OF AGRICULTURE

OFFICE OF THE DEAN
TELEFAX : 632121
TELEPHONE: 020-2181354 (DL)
deanagric@uonbi.ac.ke
TELEPHONE: 020-3592734/5/6/7/8/9 Ext. 27041

P O BOX 29053 00625
KANGEMI, NAIROBI
Email:

================================================================================

20th September 2010

Director,
Bioresources Innovation Network
For Eastern Africa Development,
BECA/ILRI Campus,
Nairobi
KENYA

Dear Sir/Madam,

RE: SUBMISSION OF FULL RESEARCH PROPOSAL TO BIOINNOVATE

I refer to the above-mentioned subject. This letter is to confirm that Prof. P.M. Kimani is employed by the University of Nairobi, Faculty of Agriculture in the Department of Plant Science and Crop Protection.

Prof. P.M. Kimani and the team from six institutions in Eastern Africa namely, University of Nairobi, KARI, ISABU (Burundi), Trufoods (K) Ltd, PABRA and EAIR (Ethiopia) have submitted a concept note titled "Value Added Bean Technologies for Enhancing Food Security, Nutrition, Income and Resilience to Cope with Climate Change and Variability Challenges in Eastern Africa" as a collaborative interest in participating on a full proposal to Bio-innovate

They have been adequately consulted and are fully participating in the design of this research proposal of this call. I also wish to confirm that they have the permission of the institution to participate in the delivery of research services should the research team win the grant.

Yours faithfully,

DEAN, FACULTY OF AGRICULTURE
UNIVERSITY OF NAIROBI
P. O. Box 29053 - 00625
NAIROBI
COLLEGE OF AGRIC. & VET. SCIENCES

PROF. L.S.M. AKUNDABWENI,
ACTING DEAN/ASSOCIATE DEAN,
FACULTY OF AGRICULTURE

LSMA/awm

SOKOINE UNIVERSITY OF AGRICULTURE
FACULTY OF AGRICULTURE
DEPARTMENT OF FOOD SCIENCE & TECHNOLOGY
P.O. Box 3006, MOROGORO – TANZANIA
TEL (023)2604402 OR 0232 - 603511- 4 EXT. 4419-22; FAX (023)2604649
Website: www.suanet.ac.tz, Email: fst@suanet.ac.tz,

**Our Ref.:** SUA/FST/C.1/9 **Date: 17th September 2010**

Coordinator
National Grain Legume
Kenya Agricultural Research Institute
P.O.Box 340 - 90100
Machakos - KENYA

Dear David Karanja,

**Re: LETTER OF COMMITMENT FOR PARTICIPATION IN BIOINNOVATE AFRICA PROJECT**

Please refer to the above captioned subject,

I have been made aware of the impending proposal writing exercise on the concept note: ***'Value Added Technologies for enhancing Food security, Nutrition and Income and resilience to cope with Climate Change and variability Challenges in East Africa'*** which is planned to take place at ILRI campus from Monday 20th September 2010.

I am writing to express the commitment by the Department of Food Science and Technology at Sokoine University of Agriculture to fully participate in this project proposal write up and eventual implementation, should the proposal be accepted for funding.

The Department is being represented by Dr. Peter Mamiro whose expertise in the theme of the proposal is unquestionable.

We hope to work with you in the future through this project and any other project that may be developed and implemented collaboratively by our institutions.

Yours Sincerely,

**Prof. Bernard Chove**
Head of Department

**QUOTATION OF REF NO. IS ESSENTIAL**

Bujumbura 20th September 2010

M.Nt./M.Nt.

Réf. N°: 863/2010/I.8.6.

To: Bioresources Innovations Network for
Eastern Africa Development (Bio-Innovate)
ILRI Campus, PO Box 30709, Nairobi 00100,
Kenya
e-mail: bioinnovate@cgiar.org

Dear Sir/Madam

**Submission of proposal on Value added bean technologies for enhancing food security, nutrition, income and resilience to cope with climate change and variability in eastern Africa**

I am writing in response to the above proposal that involves a collaborative project between the Institut des Sciences Agronomiques du Burundi (ISABU), Kenya Agricultural Research Institute (KARI), Ethiopian Institute of Agricultural Research (EIAR), the University of Nairobi, Kabazi canners and ECABREN/CIAT/PABRA.

I am pleased to confirm that ISABU will participate fully in the implementation of the above mentioned project could it be approved for funding. ISABU support shall entail staff salaries and emoluments, office and laboratory space and equipments, field space, water, electricity and germplasm.

Best regards

THE DIRECTOR GENERAL OF ISABU

Dr Ir Marie Goretti MIREREKANO

c.i.: DP
DAF
DEMSP
Programme Légumineuses

**Avenue de la Cathédrale – B.P. 795 BUJUMBURA – Tél. 257 22 227349-50-51 – Fax : 257 22 225798 – Télex : 5147BD**
**E-mail : dgisabu@cbinf.com Site Web : http://www.isabu-bdi.org**

የኢትዮጵያ የግብርና ምርምር ኢንስቲትዩት

Ethiopian Institute of Agricultural Research

Ref.No. 1486/2559/2010
22 September 2010

Biosciences Innovation Network for Eastern Africa (BioInnovate) Program
International Livestock Research Institute (ILRI)
P.O.Box 30709
Nairobi 00100,
Kenya

**Subject: Participation in proposal development and endorsement**

On behalf of the Ethiopian Institute of Agricultural Research (EIAR) I would like to extend my gratitude for accepting the concept note **(Value added bean technologies for enhancing food security, nutrition, income and resilience to cope with climate change and variability challenges in eastern Africa)** jointly developed by the National Bean Research Programs of Kenya, Ethiopia and Burundi in collaboration with CIAT and its affiliated regional networks, ECABREN and PABRA. Mr Kassaye Negash, a bean breeder from Melkassa Agricultural Research Center is delegated to participate in the proposal development planned to be held in Nairobi from 28 to 30 September, 2010. May I also take this opportunity to assure you the readiness of EIAR to give all the necessary support for the successful achievement of the project objectives.

Sincerely,

Adefris Teklewold (Ph.D)
Director, Crop
Research Process

The Federal Democratic Republic of Ethiopia
Ethiopian Institute of Agricultural Research

*FYI*
Director General, EIAR
Addis Abeba

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Addis Abeba, Ethiopia