Project Summary

Title	Improving biological nitrogen fixation (BNF) by groundnuts (Arachis hypogea L.) grown in acid soils through amendment with calcitic and dolomitic limestones.
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Purpose	To assess the biological nitrogen fixation (BNF) potential of groundnuts and increase their yields in the nutrient depleted soils of western Kenya and eastern Uganda.
Project Summary	The problem of food security in sub-Saharan Africa (SSA) is of global concern. Although concerted efforts are being made by governments, policy makers and international funding institutions to alleviate it, the problem persists. Arable land, the natural resource base on which Agriculture-the mainstay for most SSA countries- greatly depends, is increasingly becoming degraded through deforestation, soil fertility depletion, soil erosion and water scarcity. Soil fertility depletion is documented as the biggest constraint to sustained crop productivity across smallholder farms in this region (Sanchez et al., 1997; Woomer, et al., 1997). In Kenya, nitrogen (N) and phosphorus (P) nutrients are widely deficient with N deficiencies recorded in 48 % of the cropland soils (FURP, 1994). The depletion of soil nutrients is particularly high in the densely populated western and central Kenya. This has greatly affected per capita food production which has been reported to be low and continues to decline in many parts of the country. Use of fertilizer N to replenish soil is the most logical way to counterbalance the nutrient depletion in this region. However, due to the spiraling costs of fertilizers in the recent past, poor efficiency of utilization of N from N fertilizers (that is hardly

	greater than 50 %) and the increasing awareness of the environmental costs of N lost from fertilizers (Bohlool et al., 1992), this option presents a great challenge. The use of N fixing legumes, a process known as biological nitrogen fixation (BNF) to address the current soil nutrient depletion and increase crop yields, is a system that maximizes use of natural methods of maintaining soil fertility and therefore has capacity for stable and sustainable crop yields in the long term (Mugwe et al., 2007). BNF is a process where inert dinitrogen gas of the atmosphere (N2) is converted to nitrogen-containing organic compounds that become available to all forms of life through the nitrogen cycle (Brady and Weil, 2002). This process is catalyzed by nitrogenous enzymes which require a great deal of energy to break the nitrogen bonds between the nitrogen atoms. Association of the bacteria with the higher plants supplies the energy from photosynthesis (Brady and Weil 2002). Most BNF technologies have the potential to generate global environmental benefits by reducing greenhouse gas emissions and water pollution, protecting biodiversity and promoting more sustainable use of agricultural land. By contributing to better soil cover and the build-up of soil organic matter, some BNF systems also promote rainfall infiltration, protect soil from erosion and enhance carbon sequestration. Giller et al. (1997) established the effectiveness of legumes in improving soil fertility in many areas. In assessing the potential of BNF in legumes, it is essential to study their nodulation. Nodulation is an indicator of a legume's ability to fix N from the atmosphere. Nodulation of legumes is, however, affected by site characteristics such as nutrient deficiencies, soil acidity and presence of native rhizobia capable of nodulating the legumes (Dommergues, 1995). In acidic soils, nitrogen fixation is hindered as most rhizobia are not tolerant to acidity (Odee, 1996). Mugwe et al. (2007) attributed low nodulation to soil acidity, low soil P and lack of adequate indigenous rhizobia in Chuka, Eastern Kenya. Such conditions would not only lead to low yields of legumes but also deny the soil of adequate N that would otherwise have been derived from the system. In cases of low abundance of native rhizobia in a soil, inoculation with effective and persistent rhizobia strains can be explored. This has various advantages that would include non-repeated application of N fertilizers and higher pod yield due to increased nodulation (Sanginga et al., 1994). Giller (2001) reported N fixation rates of 1 to 2 kg N ha-1 day-1 in a growing season by most tropical legumes. Thus, by exploring BNF, not only does the system optimize economic returns to farmers but also minimizes the environmental concerns associated with high N use (Bundy and Andraski, 2005). A lot of work has been done on different legumes such as herbaceous leguminous trees, soybeans, common beans, cowpeas among others, in their contribution to BNF. Groundnut, however, has received little attention in the BNF technologies yet its high use in small scale farming as a source of dietary protein and income generation cannot be overlooked. In assessing and utilizing the BNF potential of groundnut, great achievement will be made in amending soil N deficiencies as well as increasing its yields in an agricultural system where it is already an important crop.

Country and Specific Location(s)	Bungoma East and Siaya districts in Kenya and Mbale and Bukedea districts in eastern Uganda.
Participating Institutions	Moi University, National Semi-Arid Resources Research Institute/NARO (Uganda), Tropical Soil Biology and Fertility (TSBF) in Nairobi, Kenya, Ministry of Agriculture (MoA) in both Uganda and Kenya
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