APPLICATION OF SOILDOC KIT TECHNOLOGY FOR TAILORING FERTILIZER AND INPUTS RECOMMENDATIONS IN COMMON BEAN (*Phaseolus vulgaris*) FARMERS FIELDS

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INTRODUCTION: For many years soil analysis has been used as an aid to assess soil fertility and plant nutrient management options (Huising et. al., 2013). In Africa, low soil fertility is the major constraints in bean production followed with diseases (CIAT, 2003). Some bean diseases caused by root rot pathogens in common beans interact with soil fertility, impeding acquisition of plant nutrients from soil, and thus are especially severe when soil fertility is limiting (Abawi and Widmer 2000). Low soil fertility (N & P) and drought (PABRA, 2009) are abiotic constraints that can result in severe losses in common bean production. Low potassium, aluminum and manganese toxicities are of intermediate importance; sodium toxicity is important in some localities (Wortmann and Allen, 1994). We have been using wet and dry chemistry analysis which must be conducted in the soil laboratories, but currently we got another technique named SoilDoc. This is a portable, on-farm soil testing kit which provide numerous results that include unlimited and available on-farm extension services and increased farm production. It is used to test for Soil pH, EC, nitrogen, phosphorus, sulfur, and potassium, as well as active organic matter and active carbon (SoilDoc kit manual, 2014 and Adeoye and Agboola, 1985). The application of this precise soil inputs reduces costs and limit soil nutrient losses to the environment. This study focuses on soil audits, involving additional analyses and recommendations based on different approaches to the interpretation of analytical data being offered to farmers using SoilDoc Kit which allow us to advance quickly in fine-tuning agronomic and fertilizer practices to increase crop yields and increase resource use efficiency nutrients and water (David 1994).

MATERIALS AND METHODS: This study targeted northern zone in five districts i.e. Same, Moshi, Hai, Siha and Arumeru. Representative sites for soil sampling were selected through collaboration of researchers from Selian Agricultural Research Institute and respective District Extension officers. Using Android, in-built GPS recorder which records Longitude, Latitude and Altitude were used for determining specific farmer's field for soil sampling. The area of fields which soil samples collected were from a range of 2023.43m^2 – 4046.86m^2 and soil sampling was done as per SoilDoc kit protocol (SoilDoc kit manual, 2014). Labels for each sample included: Famer's name, Crop grown, Date of soil sampling, Names of soil sample collectors, Barcode number, Region, District, Village, Altitude, Latitude and Longitude. Soil samples collected were air dried, grinded and sieved to get a representative soil samples to determine Soil chemical and physical test using the recommended SoilDoc protocol. After making an analysis for each sample, an android tablet data entry was done using installed android-ODK collect software program – Version 1.4.11(1062). This was followed uploading of data from the android tablet to the server and downloading analyzed soil results from the server. Compilation of individual soil analysis results was done for each farmer's field which were involved in the soil sampling. Through using GPS coordinates, the digital map indicating soil sample sites was prepared so that to show the coverage area.

RESULTS AND DISCUSSION: Total of 114 soil samples were collected and analyzed in Same (26), Moshi (21), Hai (19), Siha (21) and Arumeru (27). The pH values were classified as optimum (5.10-6.10) for 78% of total samples and 22% high but not limiting with pH value of 6.1-7.1. For nutritive values, Nitrogen was very low (<21mg/kg) to 60% of total samples and excessive for only 8% with >120mg/kg. Phosphorus was extremely low <0.05mg/kg for 42% of total samples and excessive with >2mg/kg for only 20%. Potassium was very high of >60mg/kg for 77% of total samples. Sulphur was classified very low, low, medium and high with proportional of 11%, 32%, 34% and 23% respectively. Organic matter showed to range from extremely low with <150mg/kg to very high with >700mg/kg of 10% and 39% of total samples respectively. The established critical thresholds were, N: 42mgNO_3 -N/kg soil, P: 0.30mg P/kg soil, K: 20mg K/kg soil, S: 10mg S/kg soil, Lime: pH $CaCl_2$ <5.10 (Huising, et al., 2013). From these samples, 75% indicated a need to apply N fertilizers; 54% P; 5% K; 43% S composed fertilizers and 22% organic matter. About 90% of soil samples analyzed had a pH ranging from 5.1 to 7.1 which was favorable to produce various crops including beans which have an optimum range of 5.5 to 6.5 (Sierra, 2014). Results for each parameter were analyzed, interpretation and recommendation based on each result were described for each site and shared with agricultural district officers so that they can advise on best management of their farm to increase production and apply costly fertilizers only where needed. Where levels of active carbon (AC) were very low, farmers were advised to incorporate into the soil any available crop residues, including straw, and organic wastes or use the recommended rate of farm Yard Manure (FYM) as one of remedial measure to increase carbon contents into the soil. Application of P fertilizer using of locally available fertilizes (TSP, DAP or Minjingu mazao) was also suggested especially in farms with low to extremely low levels of phosphorous.

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