Global Scientific JOURNALS

GSJ: Volume 9, Issue 3, March 2021, Online: ISSN 2320-9186

www.globalscientificjournal.com

Review on: Challenges to Soil Fertility in Ethiopia

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Abstract

Site specific and balanced fertilizer recommendations are used for not only sustainable soil fertility management and crop production, but used also as reduced environmental impacts and minimized farmers from unnecessary costs. Previous studies have shown that the country is only deficiency of nitrogen and phosphorus soil nutrients. However, there are currently deficiencies of macro and micronutrients in most Ethiopian soils. For instance, the studies K, S, Zn and Cu deficiency were prevalent in across parts of the country. Thus, the problems were associated with soil erosion, acidity and nutrient depletion, lack of soil fertility replenishment, nutrient mining and lack of balanced fertilization. As a result of the complex and dynamic nature of the soil, soil analysis alone cannot reflect what the plant was able to extract and store during the current season. Therefore, mapping of soil fertility, soil-test based data with crop responses is recommended for site-specific and balanced fertilizer recommendations.

Keywords: soil test, soil erosion, fertilizer

Introduction

Soil fertility is important, which determines the growth of plants. Soil fertility depends on the presence or absence of nutrients, such as macro and micro-nutrients. However, because they are used extensively by plants for growth and survival, these nutrients are often lacking in soil. According to (Lelago *et al.*, 2016; Fanuel *et al.*, 2016) reported soil fertility declining is the major problem in Ethiopia country due to intensive cropping system, degradation, crop residue removal, crop uptake, low soil OM, only N and P containing fertilizers used and poor management practices. Ethiopia also has abundant land resources, but agricultural productivity is

lower than production, mainly due to soil erosion, acidity and nutrient depletion, lack of soil fertility replenishment, nutrient mining and lack of balanced fertilization (Lelago *et al.,* 2016; Fanuel et al., 2016).

The appropriate rates of plant nutrients can be determined by knowledge about the nutrient requirement of the crop and supplying power of the soil (Tilahun, 2007). However, Ethiopian farmers used to apply only chemical fertilizers di-ammonium phosphate (DAP) and urea to increase crop yields for about five decades and this did not consider soil fertility status, agro-climates and crop requirement. As a result, little or no attention has been given to other macro and micronutrients, thus leading to unbalanced fertilization and poor nutrient management and crop quality (Wondwosen and Sheleme, 2011). Currently, however, various studies on soil fertility have been conducted in various agricultural ecologies in Ethiopia. Soil macro-nutrients status assessments were conducted (Lelago *et al.,* 2016) in the southern part of Ethiopia and found that about 98% of the farmland was deficient in Sulphur. Finding indicated that sulphur deficiency was observed in the northwestern Ethiopia (Habtamu, 2015). In the line with this, study was conducted at the Wolaita zone; southern Ethiopia revealed that, available potassium and available sulphur were deficiency (Wondwosen and Sheleme, 2011). A number of studies conducted so far showed that deficiency of Cu and Zn are widespread in many Ethiopian soils. For instance, the study in Central highlands of Ethiopia (Hillette *et al*., 2015) indicated that B, Zn, Mo were deficiency and the study in Bale Nitisols of western Ethiopia (Teklu *et al*., 2003)

Complete knowledge of soil fertility is essential as it is an important resource for the country. It should be maintained where it is high, improved where it is low and developed where it is lacking (Shan *et.al.,* 1985) as cited in (Hunduma *et al.,* 2016. Thus attention should be given to access to up-to-date data about status and spatial variation of soil fertility to ensure sustainable agricultural productivity. However, in Ethiopia information on soil fertility status at across country is scarce. Therefore, in this review, an attempt has been made to assess the status of soil fertility status in Ethiopia.

Overview of Soil Fertility in Ethiopia

Deteriorating soil fertility has become a major problem in Ethiopia to feed the country's growing population and bring about improved and sustainable productivity. As the demographic pressure increases, crop yields have not increased significantly, so it is not sufficient to meet the needs of

the population. This is mainly due to the significant reduction in soil nutrients (Wakene and Helluff, 2004). Factors contributing to low agricultural productivity in the country may include agricultural dependence on rainfall, the use or shortage of modern technology by farmers, improper land use practices, pests and diseases, and, most importantly, low soil fertility, and Lack of accurate data on soil fertility practices for sound handling practices without external input (IFPRI, 2010).

Ethiopia faces many challenges regarding declining soil fertility across the country; it requires re-examining the fertility of the soil and advising the appropriate chemical fertilizers at the appropriate rate and type (s) and land management practices. The essential nutrients will help us to improve food security and increase the country's export demand. To understand this; In order to reverse the current poor soil fertility, many stakeholders need to deliberately do homework on integrated soil nutrient management practices, especially in the application of balanced fertilizers (Gete et al., 2010).

In the highlands of Ethiopia, soil acidity has also been a major challenge for crop development, and it is mainly produced by reducing nutrient and water intake by destroying plant root growth. Moreover, low pH or soil acidity converts available soil nutrients in to unavailable form and acidic soils are poor in their basic cations such as Ca, K, Mg and some micronutrients which are as essential to crop growth and development. Mostly at lower pH, many nutrients become very soluble and are readily leached from the soil. Study indicated that soil acidity is expanding both in scope and magnitude in Ethiopia that severely limiting crop production (Wakene and Hiluf, 2006). In light of this fact, the Federal Government of Ethiopia has recently identified soil acidity as a key agricultural problem, and a large-scale campaign has been launched to reactivate soil acidity in many crops and farmers and encouraging results were obtained (Wasse and Shiferaw, 2011).

Soil degradation is widespread in Ethiopia's highlands and is a major challenge to sustainable agricultural production. Unfortunately, balanced fertilizer application and other soil conservation and soil health issues are not well understood by the farming community and are currently poorly managed. In connection with this, the average annual soil loss in the country is estimated at 137 tons / ha per year and could increase even in mountainous terrain and in areas with low vegetation coverage (IFPRI, 2010). Due to soil fertility problems, the increase in production may

not be as radical as it should be. This makes the issue of balanced fertilizer application and other integrated soil fertility practices more important to achieve sustainable agricultural development programs (Gete et al., 2010).

Soil Fertility Interventions in Ethiopia

Fertilizers DAP and urea has been using only two of these chemical fertilizers since the introduction of FAO in Ethiopia in the late 1960s. However, the increase in production could not be achieved due to the application of blankets. In addition, those two types of fertilizers do not provide all the essential nutrients that plants need. Although improved agronomic practices and various soil fertility interventions have been implemented by the government, efforts have not been able to increase crop yields as needed (Shahidur et al., 2012).

Following the 1991 reforms, new economic policies were introduced to address issues related to landownership, liberalization of input and output markets, conservation of natural resources and other incentives to make the farming community responsive to economic reform. However, the interventions and impacts seem to have different forms and scales in different regions of the country. With a transition towards a market-based economy, many households might be engaging in practices that could restore or maintain soil fertility. Soil conservation measures were planting trees, construction of stone terraces, crop rotation, soil bunds, and applying organic and inorganic fertilizers are some of the support measures, which are visible around the farming communities. Farmers switch to different economic activities responding and adjusting to market operation and policy incentives were pave the way for radical increase in crop production (Tekalign and Gezahegn, 2003).

In Ethiopia, there is lack of up-to-date, comprehensive and accessible soil data. Almost all soil related national-level recommendations base from the FAO studies from the date 1980s and are not regionally tailored to fit need of cropping systems and plants. Much of the existing data is only for N and P nutrients but very little information is available about other soil nutrients especially micronutrients (IFPRI, 2010). At the same time, the main soil fertility interventions are limited to blanket application and organic nutrient sources, mainly compost application without its well defined dose (Eyasu, 2002).

In order to address the lack of nation-wide soil fertility information, the ATA in partnership with MoA and other stack holders, introduced new fertilizers in compound and blended forms. They were demonstrated across several areas in more than 40,000 farmers' plots and farmers; training centers (FTCs). Encouraging results were obtained. Farmers' positive evaluation of the new fertilizers is another asset to adapt and use new fertilizers efficiently.

Soil Fertility Status in Ethiopia

Different researchers surveyed different soil nutrients, mostly at watershed level. Major surveys of macronutrients across the soils of the country were conducted in the 1950s-60s, first at the Alemaya College of Agriculture and then through the Institute of Agricultural Research at Holetta, Werer and Bako research centers (Gete *et al.,* 2010). Nevertheless, these studies were limited only to macronutrients that did not give attention to soil micronutrients and it also only certain area coverage study which cannot give full spatial information about Ethiopia's soil nutrients status (Gete *et al.,* 2010).

Developing rough soil maps alone does not give guarantee to enhance crop production and productivity without complete soil fertility assessment and mapping (Gete *et al.,* 2010). The lack of periodic soil fertility assessment in Ethiopia becomes one of the main problems that limit optimum crop production. Mainly, periodic soil fertility assessment and mapping gives core information about soil health and related issues to take appropriate soil fertility remedial measures based on the fertility status of the given soil.

According to various researches conducted on soil fertility status in different agro-ecologies of Ethiopia. For instance, (Lelago *et al,* 2016) reported that S, P, TN, OM were to be deficient in the south part of Ethiopia, he proposed deficiency is due to intensive cropping system, degradation, crop residue removal, crop uptake, low soil OM, only N and P containing fertilizers used and poor management practices. Many soils in Ethiopia are poor in available plant nutrients and organic matter content (Abebe *et al.*, 2013; Alemu *et al*., 2016). Recently, the results of national soil fertility mapping initiative has also indicated that other nutrients including K, S, Fe, Zn and B are also found to be deficient in Ethiopian soils (EthioSIS, 2015). The soil nutrient status of cassava farms was conducted by Fanuel (2016) in Southern part of Ethiopia, who found that N, P, S, K, B, Cu S, exchangeable Ca and Mg induced K deficiency were observed to be deficient on cassava farms. Also, study in the Central Rift Valley of Ethiopia; results indicated that micronutrient levels in study area (Fe, Zn and Mn) were found to be deficient in all salt

affected soil class (Worku *et* al, 2016). The deficiencies of Mo, Cu, and Zn are mainly reported on Ethiopian Nitisols (Teklu *et al.,* 2003).

Conclusion and Recommendations

According to this review, the deficiency of macro and micronutrients other than N and P has been identified as a major problem in crop productivity. K, S, Zn, Cu and B deficiency were prevalent in across parts of the country. Irrespective of knowing status of soil nutrients, applications of fertilizers to crops are not significant changes. Therefore, it is important to give serious attention to periodic soil fertility assessment and mapping of soil resource since soil is dynamic in nature due to changes in land use and other environmental factors. Further studies based on soil test and crop response calibration should be conducted for fertilizer recommendation in the country.

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