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Impact of Agroforestry Fertility Improvement: A Case Study of Larkana Sindh-Pakistan

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Abstract:

The current research investigates Impact of agroforestry Fertility improvement: A case study of Larkana Sindh-Pakistan. The lease holding farmers used the synthetic and biological fertilizers as input to cover the nutrient deficiencies in the soil for maximum crop yields. It was revealed by the farmers of these lands that the fertility of these soils was significantly improved as it caused more productions in comparison with other adjacent lands in the area. This fertility improvement is attributed to Agroforestry Practices. The trees grown on the soil improved the microbial activities as the acacia trees are leguminous plants and nodules in the tree roots are the abode of microorganisms convert atmospheric nitrogen into nitrate. The nitrate is available form of nitrogen to the plant for the better growth and vitality. Further more the tree grown on the land improved the structure of soil giving the way to roots of the plants for maximum uptake of nutrients. In addition tree biomass production and decomposition improved the soil fertility, ultimately increased the output yield of tree and Agriculture crop yields. Livelihood improvement.

Key Words: Impact, agroforestry, Fertility improvement, Sindh

Introduction:

Now, Agroforestry has been universally acknowledged as the best mean to mitigate climate change and mean to improve the fertility of the soils. The use of diverse tree species and other practices employed in agroforestry systems can represent alternative forms of increasing soil fertility and maintaining agricultural production, with important practical applications for the sustainability of tropical agriculture. (Rachel C Pinho et al 2012)

Growing trees in association with the short rotational Agriculture crop gives monetary returns in a shorter time to meet the demands of livelihood. Where as trees are considered as carbon sink with it's biological ability to convert emitted Carbon from other industrial emissions in the biomass of tree's trunk. Various physiological processes and biochemical reactions given the way to sequester Carbon by the nature. In addition to sequester Carbon trees belonging to the leguminous crops has a specialty feature to improve the fertility status of the the soil by converting atmospheric Nitrogen into the available nitrate form. This study is focussed around the areas where Agriculture crops were cultivated in association with Tree crops. The area of study was the reserved forest lands in Hyderabad Division. These combination of tree and Agriculture was the backdrop of Agroforestry Lease policy implementec by the government of Sindh. This study is meant to understand the effects of Agroforestry practices in terms of fertility improvement It will focus to

observe the increase in crop yield by addition of trees and their role to improve the nutrient and its efficient reactions by microbial activities in soil.

Based on these findings, it is recommended that, farmers should practice agroforestry systems especially the agrosilvopastoral and agrisilvicultural systems, for they have huge potentials to enhance soil fertility, thereby improving crop productivity and food security (Azembouh et al 2021)

Literature Review

The use of diverse tree species and other practices employed in agroforestry systems can represent alternative forms of increasing soil fertility and maintaining agricultural production, with important practical applications for the sustainability of tropical agriculture.

Rachel C Pinho et al 2012

Agroforestry, defined as the growing of perennials (trees, shrubs, bamboos, and palms) with annual crops and/or livestock on the same piece of land, is believed to reverse land degradation, restore carbon and nutrient stocks, and improve soil fertility.

(Arun Jyoti Nath et al 2020) The review provided substantial evidence for the amelioration of land degradation and the creation of a more closed nutrient cycling via deep nutrient capture, increased supply via N fixation, litter production, and decomposition, and increased soil biological activity in agroforestry than in annual cropping systems.

Arun Jyoti Nath et al 2020. Deep capture of nutrients by tree roots can also recycle nutrients leached from inorganic fertilizers applied to crops, thus improving nutrient use efficiency and potentially reducing negative environmental consequences.

(Arun Jyoti Nath et al 2020) Agroforestry has recently been rediscovered by modern scientists and agronomists as an excellent tool for maintaining the long-term biological balance of agricultural and livestock production systems, especially, but not only, in the arid and semi-arid zones. (HN Le Houérou et al 1980). Agroforestry practices had an important effect on soil fertility, significantly increasing the content and cycling of Ca and P in the soils.

(Rodrigo Santana Macedo et al 2023). Agroforestry systems represent a sustainable practice for soil fertility improvement and SOC sink in the highlands of the Brazilian Northeast. (Rodrigo Santana Macedo et al 2023) The results show significant differences in soil pH, aluminum content, base saturation, electric conductivity, organic matter, nitrogen content, and cation exchange capacity between AF and CS soils, indicating a higher Niels Schwab et al 2015

Results and Discussions

It was revealed by the farmers of these lands that the fertility of these soils was improved as it caused more productions in comparison with other adjacent lands in the area. This fertility improvement is attributed to Agroforestry Practices. The trees grown on the soil improved the microbial activities as the acacia trees are leguminous plants and nodules in the tree roots are the abode of microorganisms convert atmospheric nitrogen into nitrate. The nitrate is available form of nitrogen to the plant for the better growth and vitality. In addition, the deep roots of the trees grown in association with Agriculture crops improve the structure of the soil which increases the availability of nutrients available in deep layers of the soil. The review provided substantial evidence for amelioration of land degradation and creating a more closed nutrient cycling via deep nutrient capture, increased supply via N fixation, litter production and decomposition and increased soil biological activity in agroforestry than in annual cropping systems. (Arun Jyoti Nath et al 2020) In the same sequenc, the microbial activities by the rhizobium and other microlife present in the root nodules of the leguminous trees reacts with the unavailable phosphatic chemicals to make them available to the roots of Agriculture crops. The literature reviewed provides evidence that inoculating tree seedlings with

appropriate N-fixing bacteria and mycorrhizal fungi, and application of phosphorus fertilizer ensures better tree establishment. Therefore, we strongly recommend the routine application of these inputs during tree planting in drylands to maximize nutrient cycling. (Arun Jyoti Nath et al 2020). In addition, tree biomass production and seasonal shedding of leaves on soil develops a compost layer on the soil. The presence of compost in the soil improved the soil fertility, as it increases the organic matter content of soil. The compost also ameliorates the roots of plants more efficiently and effectively. Resultantly, the improved soil structure duly enriched with the biological actions of microbial life the output yield of tree and Agriculture crop increased in terms of financial and economic returns. It was revealed by some farmers that these tree plantations are grazing ground of our livestock. These grazing goats, cows and buffaloes add organic matter by their digested faecal matter. These dungs are rich in nutrients and it improve fertility status of the soil.

References

The Agroforestry practices were reviewed in terms of Fertility Improvement from different research publications which are available in different scientific journals. The references are given as under:

Conclusion

It was concluded by the people who adopted Agroforestry Practices that tree association with Agriculture improved the fertility of the soil, ultimately increasing the productivity of the soil in terms of financial and economic returns. It has been reviewed from the different scientific studies that the trees belonging to the Leguminacea family improve the nitrogen content by biological means. In addition, the microbial activities induced by the soil microbial life improve the structure to ameliorate the roots for maximum uptake and availability of nutrients.

References

Sarwar et al 2010 Contents of mineral nutrients of the soil also increased by the addition of green compost. Resultantly, an improvement in soils chemical properties was noticed.

Sarwar et al 2010. compost improvement to soil fertility has a positive impact on soil stabilisation by plant roots.

Suzanne Donn et al 2014 The final results of a 6-year pot experiment on the organic fertilization of sunflower crops using compost prepared from vegetable and animal wastes are reported.

It is concluded that the use of compost can lead to improved soil fertility, even after several years, which in turn results in a quantitative improvement in crop yield and product quality.

Allievi et al 1993 The present work aimed to study the effect of compost and arbuscular mycorrhizal fungi (AMF) on soil physicochemical parameters on garlic (*Allium sativum* L.) growth, physiology, biochemical traits, and yield under environmental conditions.

- 1) The application of AMF or compost increased both carbonic and mineral contents in soil.
- 2) Indeed, available phosphorus and total nitrogen were increased by 139% and 52% in case of compost+AMF compared to the control. Mycorrhizal frequency was significantly higher in AMF than in compost+AMF plants, while compost application did not significantly affect the mycorrhizal intensity in garlic roots.
- 3) The positive impact of the tested biofertilizers and the interest in adoption of innovative practices improving growth, physiology, biochemical traits, and soil fertility as well as biological agriculture of garlic yield.

Abderrahim et al 2021 Application of organic waste compost (Cp) and Jatropha seed cake (JSC) represents new possibilities to improve soil organic matter (SOM) and thus reduce the risk of soil degradation

2) JSC has higher influence on soil properties (microbial activity and plant production) in the short term. Conversely, Cp affects soil properties in the long term. These properties are due to their chemical composition.

Jakub Elbl et al 2016. Coffee husk supplemented with cow manure, and fertilizers (phosphorus and urea) were studied. The fertility of soil, mineral nutrients in the coffee leaf and the growth of the coffee were improved in comparison with plots that no using the compost.

Nguyen et al 2013 A field trial was established to analyze the effects of a single application of three organic residues on barley yield and nutrient uptake and selected soil properties after two consecutive harvests. Municipal solid waste compost (MSWC), sewage sludge compost (SSC) and farmyard manure (FYM) were tested at rates of 0, 20, 40 and 60 t ha⁻¹.

Houda Oueriemmi et al 2021 Adding all three organic amendments increased organic matter, cation exchange capacity and available P, Ca, Mg and K in the soil, the grain yield (up to 51%), and the barley plants' nutrient contents. After the second harvest, a positive residual effect of the amendment was observed in plant yield (up to 77%) and nutrient contents.