# Groundwater and soil analysis with impacts of fertilizers for future hazards using remote sensing techniques: a case study of district Larkana

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Pakistan has an arid and semi-arid climate so various plants grow in different seasons. Soil contains mixture of micro (Boron, Chlorine, Copper, Iron, Manganese, Zinc, Nickle, etc.), macro (Nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur,) and non-mineral (from air and water are Carbon, Hydrogen, oxygen) elements which are essential for plant growth. Due to excessive use of nitrogen groundwater used for drinking gets contaminated by nitrate leaching which causes toxic effects to the urinary and digestive tract and cause inflammation. Heavy non-organic metals absorbed by vegetables cause health hazards. In soil nitrification by microorganisms occurs with access use of fertilizers around 50% of nitrogen is used by the plant, 20% is lost by evaporation, 20% reacts to organic compounds present in the clay, and 10% interferes with ground and surface water due to negative charge of nitrate it can leach to groundwater easily. Eutrophication is also a negative effect of fertilizers it causes algae which degrade water quality and its life. Fertilizers increase pH levels in the soil. Soil health is important because the soil does not support plant and provide life gas oxygen and also participate in the economy of the country. Soil health is relying on three parameters chemical (pH, Soil Salinity, organic matter), mechanical (texture of soil), and biological (microbial activity). Plants require 16 essential elements for their normal growth, yield and production. 13 are provided by soil including primary nutrients. and others provided them by fertilizers. According to the Soil survey of Pakistan Report parent material of Larkana's soil is alluvial deposits of piedmont and river plains. Average ranges pH 7.95, EC 0.4 $ds/m^1$, organic matter 0.88, phosphorous 4.74 ppm, and average extractable potassium 156 ppm. Larkana soils are low in organic matter. Larkana has 4 Talukas but Ratodero Taluka is highly vulnerable to salinity specially Ratodero taluka where rice is major crop. Soils of Ratodero were found calcareous due to calcium carbonate content. Larkana is irrigated by Dadu and rice canal mostly flows by river Indus which is reduced in size due to cementation. A huge amount of irrigation water is lost due to seepage and unmanaged pattern which causes Salinity and water logging in different areas which affects agricultural production and makes land unproductive. Most peoples of Larkana use groundwater for drinking purposes but overall 27.9% of areas use unsuitable groundwater for consumption 13.95% of areas use bitter taste and are contaminated. Groundwater, soil, and fertilizers were categorized with the problem, evaluation, and mitigation analysis in the Analytical hierarchy process (AHP).

Research comprises ArcGIS techniques to provide impacts of climate in RAI, NDWI, LST, SPI, impacts of soil texture in NDVI, NDMI, and water analyses with NDWI techniques. Primary data was conducted through surveys and questionnaires. Secondary research articles and agricultural census. 50 people were interviewed, and 70 online questionnaires were accumulated which results Larkana is vulnerable to climate change, water shortage, and the quality of water is not good. Fertilizers impact on health and food quality said 90% of surveyors.

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