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Soil Quality Assessment of Vacant Land Reconverted to Agricultural Land

David Licapa[1], Doris Esenarro[2],Ciro Rodriguez[3], Vicenta Irene Tafur[4], Cesar Minga[5]
[1,4]University National Federico Villarreal. Lima, Perú
[2,3,5]Specialized Institute Ecosystems and Natural Resources Research (INERN)
[1]david_agor@hotmail.com, [2]desenarro@unfv.edu.pe, [3]crodriguez@unfv.edu.pe, [4]itafuranzualdo@yahoo.con, [5]cminga@unfv.edu.pe

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Abstract

Solid and hazardous waste cannot be solved simply by burying them in the ground. Confining hazardous waste, far from being a solution, is a way of postponing the problem. The waste minimization, which reduces the amount and pollution load of waste, generates by-products. The objective of this study was to evaluate the quality of the soil of a converted agricultural land from vacant land, located in the Villa El Salvador district in Metropolitan Lima. The benefits of reducing the environmental impact on food security and climate change, the result obtain the content of organic matter in the study soil of 1.31%, its equivalent in organic carbon is obtained by dividing by the factor 1.724, resulting in 0.76%.

Keywords; *Soil quality, vacant land, reconverted, agricultural land, solid waste*.

I. INTRODUCTION

In recent decades, the management of industrial, hazardous and municipal waste has become a problem that has caused great concern worldwide, due to the severe risks to the environment and the health of the population resulting from inadequate management of such waste[1]. Although the fight to protect the situation has been going on for a long time, especially in the highly industrialized countries, it can be said that in the developing countries, this issue is in its initial stages, and the results obtained are often far from what is intended. The problem of the increase in the generation of industrial and hazardous waste is particularly severe the industrial sector is increasing to improve economic conditions. However, this growth does not necessarily go hand in hand with the measures that must be taken to avoid or reduce the risks to the environment and health inherent in such development.

The problems of solid and hazardous waste cannot be solved simply by burying them in the ground. Confining hazardous waste, far from being a solution, is a way of postponing the problem. It is necessary to emphasize waste minimization, which reduces the amount and pollution load of waste, generates by-products that are sold as raw material, and saves on the purchase of inputs and the payment of public services for waste management[2].

Likewise, ecological agriculture is a good alternative for the adequate use of soil areas destined for waste accumulation, in which better quality food is produced concerning crops based on the intensive use of agrochemicals. In this regard, the present work is oriented to evaluate the quality of an agricultural soil reconverted from a wasteland in an urban zone located in the district of Villa el Salvador as show fig.1, in Metropolitan Lima; to establish ecological agriculture as a representative module, in such a way that economic and environmental benefits are generated.

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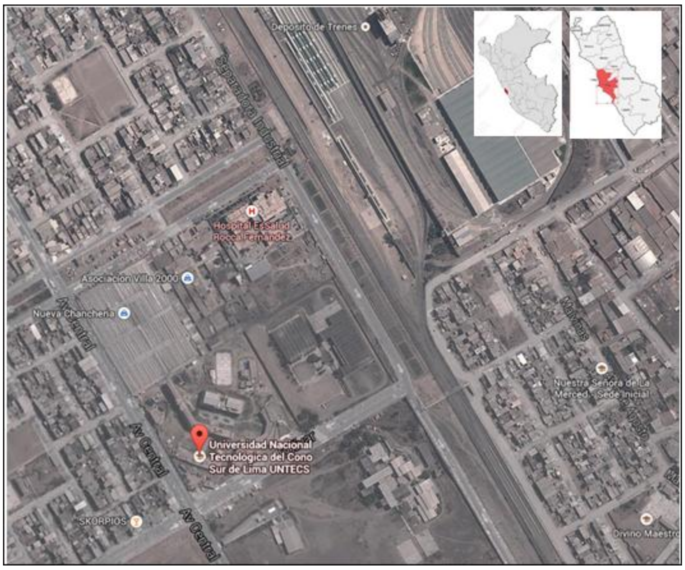

Figure 1.Location map of the study area. The oval show The area where it was made is a soil analysis study

II. METHOD

2.1. Soil sampling for physicochemical and microbiological analysis

Soil samples are obtained to obtain information and then interpret the physical-chemical and microbial conditions of the soil before and after it is reconverted to be sent to the Soil, Plant, Water, and Fertilizer Analysis Laboratories; and the other for the Biotechnology and Microbial Ecology Laboratory.

2.2. Instruments

An interview was held with those responsible for the agreement project, who provided information on economic and financial aspects and trends and prospects.

2.2.1. Instruments for determining soil quality

Field phase

It involves exploring, describing, and collecting information on the current condition of the property in terms of management programs for the agricultural center. It also includes taking soil samples for laboratory analysis, which determines the environmental viability of agro-ecological management that is related to the soil's capacity for recovery.

Sampling: 2 soil samples of one kilogram each are obtained from a total of 20 samples for each example, by the Zig-Zag Method, over the entire area of the land. One to be sent to the Water, Soil and Fertilizer Laboratory, and the other to the Biotechnology and Microbial Ecology Laboratory.

Laboratory phase

Considering that in the evaluation field, there were superficial and subterranean accumulations of garbage, it is to be expected the existence of contaminants inside the soil. For reasons of generating validity to the investigation, it is justified to carry out analyses of physicochemical and microbiological characterization of the land. [3]

2.2.2. Data analysis

Soil quality analysis

Considering the initial state of the land in order to validate the research in terms of its generalization, it is justified to carry out physicochemical and microbiological characterization analyses before and after the agricultural soil, as to data show in the table 1.

Table 1: Physical-chemical soil analysis

pH (1:1)	C.E. (1:1) dS/m	$CaCO_3$ %	M.O %	P ppm	K ppm	Mechanical Analysis			Class Textural	CIC	Changeable Cations					Suma de Cationes	Suma de bases	% Sat. de Bases
						Arena	Limo	Arcilla			Ca^{+2}	Mg^{+2}	K^{+}	Na^{+}	Al^{+3} + H^{+}			
						%	%	%		Meq/100g								

The physicochemical analysis includes 1) General characterization (physicochemical parameters, mechanical breakdown and changeable cations); nutritional quality (nutritional richness of macro and micronutrients)

Table 2: Microbiological soil analysis

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Microbiological Analysis	Magnitude
Counting of viable mesophilic aerobes	(CFU/g)
Thermophilic aerobic count	(CFU/g)
Mould and yeast counts	(CFU/g)
Actinomycetes count	(CFU/g)
Microbial activity	$(mgCO_2\,g^{-1},h^{-1})$

It is based on microbial populations that indicate the viability of soil for agricultural purposes. [4], as the show the table 2 indicate the microbiological data

Project Cost Data Analysis

The costs of the project acquired from reports were calculated by simple addition, of which a comparison was made with standards for other municipal solid waste management work. [5]

(mgCO2.g-1,h-1)

III. RESULTS

3.1. Soil characterization results

3.1.1. Physicochemical analyses

The interpretation of the results of analyses of characterization of the soil under study is observed that the case of the pH is of alkaline reaction, which is suitable for most of the crops that require a PH close to neutral. This parameter implies the availability of nutrients since, according to Cook and Hulbert (1957), the nutrients are available in a range of pH of 5.1-8.4, reason why an increase in phosphorus and nitrogen is observed, by the organic amendments in the soil, as the show the result table 3.

Table 3. Physical and chemical characteristics of the soil used.

Characteristic	Unit	Value	Interpretation
Sand	%	66	
Limo	%	24	Sandy Loam
Clay	%	10	
pH (1:1)	--	8,05	Moderately alkaline
$EC_{(1:1)}$	$dS\ m^{-1}$	0,62	Very slightly saline
$CaCO_3$	%	1,20	Medium
Organic matter	%	1,31	Under
Phosphorus available	$mg\ kg^{-1}$	62,4	High
Potassium available	$mg\ kg^{-1}$	217	Medium
CIC	$cmol_c\ kg^{-1}$	11,52	Under
Ca^{2+}	$cmol_c\ kg^{-1}$	9,32	High
Mg^{2+}	$cmol_c\ kg^{-1}$	1,62	Medium
K^+	$cmol_c\ kg^{-1}$	0,39	High
Na^+	$cmol_c\ kg^{-1}$	0,19	Under
$Al^{3+} + H^+$	$cmol_c\ kg^{-1}$	0,00	--
PSB	%	100,0	High

It is a sandy loam textured soil with a low level of organic matter, typical of the coast, with a moderately alkaline pH and an EC of 0.62 dS/m, a value that qualifies it as very slightly saline (EC > 2).

The phosphorus and potassium contents are high and medium, respectively, while the carbonate level is medium. The cation exchange capacity (CEC) is low, denoting low potential soil fertility. The exchange cations (Ca and Mg) saturate the exchange complex by 90 %.

According to the analysis of cation ratios, the soil under study is diagnosed as hypopotassium, where the deficient cation is potassium.

For the content of organic matter in the study soil of 1.31%, its equivalent in organic carbon is obtained by dividing by the factor 1.724, resulting in 0.76%, which is lower than the minimum established value. [7] However, this condition could be improved with more intensive use of organic material sources.

As regards base saturation, the value reached by the sum of the percentages of the exchangeable bases is 100%, which is suitable for establishing crops that will be able to have Ca+2, Mg+2, K+, and Na+. Likewise, the soil under study lacks H+ and Al+3, which determine a high degree of acidity, being, in this case, an alkaline soil. [8]

The phosphorus content was high, which is an essential element for the plants, and whose

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deficiency limits the correct growth and development of the plants.

The potassium content is medium; however, this element is not necessarily required in high concentrations, since its main activity is enzymatic, being needed in limited quantities.

Table 3: Microbial population and Survey and interview data analysis Microbial activity

Difference	Vacant land	Reconverted land
Viable Mesophilic Aerobic Count (UFC/g)	**13 x 10**	**^{5}41 x 10^5 3.2**
Thermophilic Aerobic Count (UFC/g)	**14 x 10^3**	**11 x 10^5 78.6**
Yeast and mold counts (UFC/g)	**39 x 10^2**	**14 x 10^3 3.6**
Actinomycete count (UFC/g)	**69 x 10^3**	**13 x 10^5 18.8**
Microbial activity ($mgCO_2 g^{-1},h^{-1}$)	**0.0070**	**0.0168 2.4**

The estimation of soil respiration gives an idea of the dynamics of its biota and, therefore, of the metabolic processes that take place in it; such methods vary according to biophysical and climatic factors of the soil and land use, so its measurement is an indicator of the microbial biomass present. The microbial activity develops as a function of factors intrinsic and extrinsic to the soil system, which is why it is an indicator of the dynamics of the soil and the health of the resource since good microbial activity can be the reflection of optimal physical and chemical conditions that allow the development of the metabolic processes of bacteria, fungi, algae and actinomycetes and their action on organic substrates.

Microbial biomass is expressed in terms of kg. Carbon per hectare (kg.C/ha), the same as the organic matter in the soil. The values vary widely depending on the type of soil, management practices, and fertilization, the plant component that supports it, climate variations, rainfall, temperatures, drought, etc.

IV. DISCUSSION OF RESULTS

4.1. Soil quality assessment

When talking about soil quality, the soil scientific community developed the concept of soil quality after the following functions were recognized: promote the system's productivity without losing its physical, chemical, and biological properties (sustainable biological productivity); attenuate environmental contaminants and pathogens (environmental quality); and favor the health of microorganisms, plants, animals, and humans. Soil quality is the capacity of this resource to function in a natural or humane ecosystem to sustain or improve the productivity of plants and animals and to control water and air pollution.

Soil quality is an attribute that depends on the integration of different physicochemical and biological properties, management effects, and cultivation systems, together with climatic conditions.

The concept of soil quality comprises two components: Inherent quality and dynamic quality. [9]

4.1.1. Inherent quality

Inherent quality is that which results from the natural properties of the soil, determined by the factors that guide its formation (climate, topography, biota, and parent material). It is frequently used in the comparison of soils and to evaluate their suitability for different uses.

4.1.2. Dynamic quality

The dynamic quality of lands is that which is derived from changes in the health or conditions of soil properties, influenced by agricultural use and agricultural management policies.

4.1.3. Soil biological quality

The biological quality of the land is the result of the interaction of the micro and macro organisms present in it, which perform different functions, determining their natural properties.

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4.1.4. Soil microbial communities and their distribution

Soil is generally a favorable habitat for the proliferation of microorganisms, and microcolonies develop in the particles that form it. Micro-organisms isolated from the ground include viruses, bacteria, fungi, algae, and protozoa. Heterotrophic micro-organisms can use sugars, alcohols, and amino acids as an energy source. Some are capable of using polysaccharides, such as starch and cellulose, by having the ability to hydrolyze these compounds to simple sugars

Bacteria populations are generally higher in prairie soils and more nutrient-rich root development. Waste production in metropolitan Lima amounts to 0.8 kg per day per inhabitant, and due to lack of space and inadequate waste management, vacant lots may be established to house these wastes.

There are various proposals for the rational management of solid waste generated in large cities, among which is composting, mainly for those wastes based on organic matter, which are the most abundant among household wastes. Composting is a type of aerobic treatment that transforms natural products into solid bio-fertilizers with adequate properties for agricultural soils, as well as for gardening. [10]

V. CONCLUSIONS

The soil of the current agricultural center presents adequate physical-chemical and microbiological characteristics due to the agro-ecological management handled since the beginning of its installation, where organic agriculture is established, mainly destined to the production of vegetables, which are the ones that better adapted.

The urban population's perception of the social impact, through surveys, approves of the fact that the conversion of wasteland to productive land is good.

Soil fertility in organic production through the use of biofertilizers (production of biol, biogas, and liquid bioproducts), improves soil quality.

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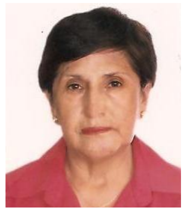
AUTHORS

David Licapa, an agricultural engineer, graduated from the Daniel AlcidesCarrión - Pasco National University, works at the National Technological University of Lima Sur, as Head of the University Social Service Center.

DorisEsenarro Vargas
Professor at the Faculty of Environmental Engineering and Graduate School of the National University Federico Villarreal, with studies in System Engineering, Architecture, and Environmental Engineering.

Ciro Rodriguez,
Professor at the School of Software Engineering at the National University Mayor de San Marcos, and also at the Computer Science School and Graduate School of the National University Federico Villarreal, with science studies at the Abdus Salam International Center for Theoretical Physics (ICTP) and the United States Particle Accelerator School (USPAS).



Vicenta Irene Tafur
Professor at the Graduate School of the National University Federico Villarreal, with studies in Economic

Cesar Minga,
Professor at the Faculty of Environmental Engineering and Graduate School of the National University Federico Villarreal, with studies Engineering, Environmental Engineering.

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