Instituto de Medio Ambiente y Comunidades Humanas

Universidad de Guadalajara

Arturo Curiel
University of Guadalajara, Mexico
arturoc@redudg.udg.mx

"Health is the capacity of the land for self-renewal"
(Aldo Leopold, 1949).

Background

- For the early inhabitants of Mesoamerica, soil represented the underworld which, upon contact with the sky, gave origin to all things on earth. Soil is the maternal womb. The crisis in soil health is the biggest chronic disaster of humanity.
- Soil health refers to the continuous ability of soil to sustain biologic productivity, air and water quality and contribute to human, plant and animal health. Then, loss of the ability to produce food, water, plants, and animals, is related to the soil degradation process and the reduction in soil quality, which is the result of factors arising from the technologies used on such soil.
- Soil formation is a supporting service which has ensured the availability of provisioning services through a secure and certain production of food, wood fiber, fuel and cultural development. It has also allowed regulating services such as flood regulation and water purification and cultural services, such as the spiritual value we assign to soil, when the bodies of loved ones are buried in the soil in varied funeral ceremonies, returning to the origin.
- Humans have put undue pressure on the soil, through a technology that has halted the evolution of the soil, either by using agricultural machinery to mix soil horizons thus disrupting the soil order, modifying chemical cycles with the input of chemical fertilizers, disrupting the dynamics of the exchange of air and water in the soil, and waterproofing the urban infrastructure which results in the loss of soil regulation services, thus increasing the cases of the three types of disasters that have caused the greatest loss of human life in the last century: Drought: (1.7 million deaths per decade), Epidemics: (955,000 deaths per decade) and Floods: (336,000 deaths per decade).

Objectives

- Determine the processes leading to soil health loss in the state of Jalisco, Mexico, and their consequences.

Methods

- Health Soil is a concept based on the scientific-interpretative paradigm, and one approach used in the study of health soil is the use of environmental health indicators: Driving force--Pressure--State—Exposure-Effects--Action (DPSEEA), where the State-Effects relation can be used for assessment based on the Ecosystem Services- Well-Being approach.
- Forty-six samples were taken, both of soil and of corn yield, and evaluation on eight runoff-soil loss plots and infiltrometer. Correlation analysis and regression analysis were used.

Results

Driving force

- The predominant technology for food production in Jalisco uses agricultural machinery that is 75% obsolete, which represents both a risk to the operator and to the soil, and the weight of such heavy machinery creates impermeable layers called "plow pan"; another technology used for soil preparation is the burning of crop remains which mineralizes organic matter, but the ability to store humus is lost and thus there is a reduction in fertility and structure. Habitat loss ensues, along with increased soil erosion and emissions of pollutants and greenhouse gases into the atmosphere. During cultivation, up to four times more than the necessary amount is applied for corn crops, using acid-reacting nitrogenous chemical fertilizers, a practice which has been used continuously for the past 60 years.

Pressure

- Soil is under pressure from technology and, under natural conditions, would not have received such pressure. Due to tractors, soil must bear a weight that no living being could bear, over three tons, which causes soil compaction. Due to burning biomass, increased temperatures over 200°C, another non-natural condition, causes the loss of nutrients in the soil, and the sudden increase of nitrogen added to the soil through chemical fertilizers such as ammonium sulfate brings about the presence of acute acidity in the soil resulting in the loss of chemical stability and release of exchangeable aluminum.

State

- The effect of the technology used for many years, without any assessment of the loss of soil health, has led to problems of soil degradation such as Compaction, Loss of Organic Matter and Soil Acidification. Most degradation is caused by acidification, followed by compaction and finally, by loss of organic matter. This is in relation to crop production; however, the loss of organic matter has caused the greatest vulnerability with respect to soil, as the loss of the cation exchange capacity is the most widespread problem in the study area, occurring in 51% of such area, in addition to the fact that the increase in soil erodibility (or vulnerability to erosion) is determined at 34% by organic matter content.

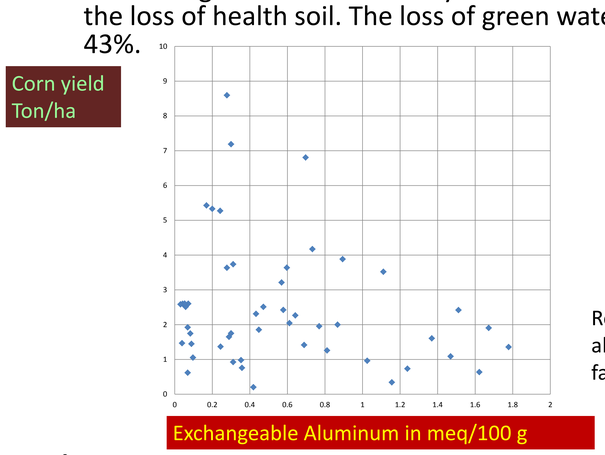
Soil Vulnerability	r
Fine sands	0.73
Clays	-0.56
Organic matter	-.58
Aggregates	-.50

Exposure

- In the case of the loss of soil health and soil erosion, those subject to exposure are the inhabitants, who would be more vulnerable to floods, drought and loss of access to food.

Effects

- Reduction in corn yield and green water.
- Of all types of degradation, exchangeable aluminum resulting from the soil's chemical degradation was the one that showed a correlation (-0.25) with corn yield.
- Corn yield is affected starting at 1.0 meq. of aluminum/100g. which is equivalent to a pH value of 4.7; thus, we can consider that the presence of this metal as of such values is an indicator of the loss of health soil.
- The average reduction in corn yield was 1.3 tons due to this effect associated to the loss of health soil. The loss of green water by compaction, was between 12-43%.

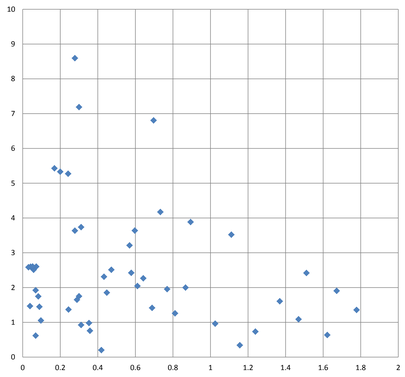


Relationship between exchangeable aluminum and corn yield in soils of the farming valley of Zapopan. r= -0.25

Discussion

- It is important to analyze the subject of food production and water availability linked to human welfare as a service of the ecosystem, and that food supply depends on a healthy soil. Soils have suffered degradation due to the technologies being used and the lack of proper management to preserve health soil, a factor which threatens the stability of food supplies as well as human health.

Corn yield Ton/ha



Exchangeable Aluminum in meq/100 g

Relationship between exchangeable aluminum and corn yield in soils of the farming valley of Zapopan. r= -0.25