International Journal of Applied and
Natural Sciences (IJANS)
ISSN (P): 2319–4014; ISSN (E): 2319–4022
Vol. 9, Issue 5, Jul–Dec 2020; 19–28

International Academy of Science,
Engineering and Technology
Connecting Researchers; Nurturing Innovations

EFFECT OF ORGANIC MATTER ON CARBON DIOXIDE CONCENTRATION IN SOIL - AIR SYSTEM AND THE EFFECTS OF CLIMATE CHANGES IN KUWAIT

Monther I. Almatouq

Research Scholar, The Public Authority for Applied Education and Training, High Institute of Energy-Shuwaikh, Kuwait

ABSTRACT

Larger amount of carbon and carbon dioxide are introduced on the land more than that in living plants. Additionally natural issues in soil have more carbon put away in soils than that in plants, all creatures, and the climate joined. Soil natural issue contains an expected four fold the amount of carbon as living plants. The truth to be told, carbon put away in all the world's wastes is more than multiple times the sum in the climate. As soil natural issue is drained, it turns into a wellspring of carbon dioxide for the climate. In the event that natural issue diminishes from 3% to 2%, the measure of carbon dioxide in the environment could be multiplied. This paper aims to examine the presence of the CO_2 in soil-air framework which is created from the natural materials in soil and condition and the effects of temperatures and global warming on CO2 flux and environmental effects of CO_2 on rainfall and increase in temperature in Kuwait. Many of articles, reports and studies were performed to show the assessments of the analysts who had concentrated on such issue. Data were gathered from such assets about the impacts of the natural issues on CO2 creation and age. As a result of human exercises which incorporates, petroleum products ignition, utilizing more vitality assets, and unseemly horticultural practices, the outflows of CO2 have been expanding and this is consider as a principle asset of an unnatural weather change, which can be decreased by following a few methodologies including, reforestation and carbon sequestration. The rates of CO2 in various kinds of soils will be concentrated in this paper and the interest of CO2 in atmosphere changes and worldwide worming are explored additionally and the other way around. An extraordinary report for CO2 emanations and assets in Kuwait and the consequences for and by environmental change and worldwide worming are introduced here. Environmental change in Kuwait is examined and dissected here and the CO2 nearness in Kuwaiti air is determined, it is discovered that both temperature and carbon – profundity have an extensive impacts CO2 mass motion.

KEYWORDS: *Organic Matter Decomposition, Global Warming, Climate Change, Carbon Sequestration, Reforestation*

Article History

Received: *13 Aug 2020* | ***Revised:*** *21 Aug 2020* | ***Accepted:*** *28 Aug 2020*

INTRODUCTION

Soil-organic matter (SOM) is a complex set of segments including soil fauna and vegetation at various phases of deterioration (Berg et al., 1982). Its concentration in soils can change from 0.5% in mineral soils to practically 100% in peat soil (Brady, 1974). Soil organic matter content relies upon the harmony between natural buildup expansion and the pace of decay. Deterioration speed of soil natural issue depend on SOM (Soil Organic Matter) structure, soil surface, waste, and carbon: nitrogen proportions for natural issue, atmosphere changes and yield rehearses. Soil organic matter for the most part increases where biomass creation is higher and where natural matter added substances happen. Plant buildups

with low C/N (high nitrogen) deteriorate more rapidly than those with high C/N and don't expand the degrees of soil natural issue at a similar speed (USDA-NRCS, 2007). Exorbitant culturing wrecks soil sums, expanding the pace of debasement of soil natural issue. Settled soil totals increment the dynamic natural issue and shield the steady natural issue from fast microbial corruption. Measures that increase soil dampness, soil temperature, and ideal ventilation quicken the decay of SOM (USDA-NRCS, 2007). Carbon dioxide (CO2) is substantially more inexhaustible in soil gas (soil air) than in the climate. This is alluded to reality of that foundations of plants decay and produce carbon dioxide, and the oxidative deterioration of natural issue produces carbon dioxide. Soil breath is the aftereffect of microbial breath and the arrival of CO2 through plant roots, which may represent 20 – half of all CO2 discharged from the dirt (Michal et al., 2016). Soil breath is the biggest earthly wellspring of CO2 to the climate and at present speaks to a yearly motion and extent more than that delivered from anthropogenic petroleum derivative ignition (Raich et al., 2002).

To determine exchange between CO2 and the environment of the plant, start with photosynthesis continues, CO2 atoms are continually extricated from air encompassing plants are integrated in photosynthesis items. During the plant photosynthesis goes about as sink for CO2 and the air as a source, while breath, the circumstance is turned around. In like manner, the inclination focus creates and the conversion scale (stream) of carbon dioxide along this slope is the capacity of pneumatic vehicles that are described by transport coefficient. (James and Edgar, 1997). Soil Carbon collection and turnover are significant worldwide procedures: soils contain about 1.5×1018 gram of Carbon, which is 2-3 times greater than the aggregate sum of C in vegetation (Allen et al., 1997). The impacts of high carbon dioxide are abridged as expanded photosynthesis of plant, variable waste quality (C/N proportion), and changes in soil dampness (Cheng et al., 1998). Be that as it may, the effect of high CO2 fixation on the disintegration of local SOM across plant roots is infrequently researched which can associate expanded carbon dioxide focus with soil sequestration misfortune and soil supplement cycle. Estimations of CO2 fixations have been utilized as operator for root and microbial movement in soil (Michal et al., 2016). Carbon sequestration can be characterized as the procedure by which carbon dioxide is expended in the environment by trees, grasses and different plants through photosynthesis and put away as carbon in biomass (its trunks, branches, leaves and roots) and soil. Carbon retention in backwoods and wood items helps counterbalance wellsprings of carbon dioxide in the environment, for example, deforestation, timberland flames, and non-renewable energy source emanations (USDA-NRCS) . A few examinations have revealed positive relationships to expanded CO2 discharges with an expansion in Temperature and soil dampness. CO2 from enzymatic exercises created by microorganisms and growths during hydrolysis which influences the heterogeneous breath of Soil may change as indicated by temperature, soil dampness and accessibility of natural issue. The affectability of the deterioration of natural issue in temperature increments with the sub-atomic unpredictability of the substrate, proposing that the nature of the trash can be of incredible organic physiological hugeness (Eline et al., 2018)

Benefits of Organic Matter

Organic soil material is a significant piece of the arrangement of sound soils. It is a result of the corruption of various kinds of natural issue. Substances that experience the procedure of debasement to shape natural issue in the dirt include: crop deposits and plants, tree squander, creature squander, domesticated animals, different sorts of soil life forms, their sub-items, and to a lesser degree human waste. Carbon in natural issue is the fundamental wellspring of vitality for soil microorganisms that are significant too the way to making nourishment accessible for plants. Here are only a portion of the constructive outcomes of elevated levels of natural substances or solid soil (NDSU, 2009): Cover harvests to give soil spread to lessen vanishing, disintegration and spillover. Perennial grasses to include over the-ground just as beneath the-

ground biomass - .Legumes for green excrement purposes .Planting crops plants that produce more prominent biomass, Incorporation of straw/crop buildups - .Reduced culturing to limit soil carbon misfortunes and to hinder natural issue – decay forms. Application of manures on spread harvests and vegetables to deliver more biomass. Application of fertilizer, plant material or other carbon-rich waste .Using rummage by brushing as opposed to gathering and Provides carbon and vitality hotspot for soil organisms.

Global Carbon Cycle

Plants take carbon dioxide through photosynthesis, and this carbon dioxide is later allocated above ground and underground, Plants take carbon dioxide through photosynthesis, and this carbon dioxide is later apportioned over the ground and underground, adding to the worldwide plant stock. All inclusive, woodlands represent 92 percent of all the Earth's biomass, putting away around 400 metric tons, however not consistently appropriated all through the Earth. Timberland biological system types store various measures of carbon, and a lot of this change is connected to atmosphere in a specific piece of the world (fig. 1). Tropical woods represent 66% of all earthly biomass (262 Gt C), while calm timberlands (47 Gt C) and northern (54 Gt C) contain around 20 percent of the measure of carbon in tropical backwoods. The carbon put away over the ground in leaves, branches and stems comparative with the sum put away underground in soil sums and plant roots relies upon the provincial atmosphere. The examples in carbon dispersion can without much of a stretch be seen on a worldwide scale. In the tropics contain a lot higher measures of carbon put away over the surface than in the Earth. Interestingly, the cool zones of the northern backwoods have huge underground carbon stores. Mild zone (cool, dry and clammy biological systems) is progressively mind boggling, as both temperature and water accessibility limit carbon contribution through photosynthesis and yield through disintegration. The objective of carbon the board is to deal with the land so carbon stays in the woodland as opposed to discharged as ozone harming substances, for example, carbon dioxide or methane (CH_4) (USDA, 2017).

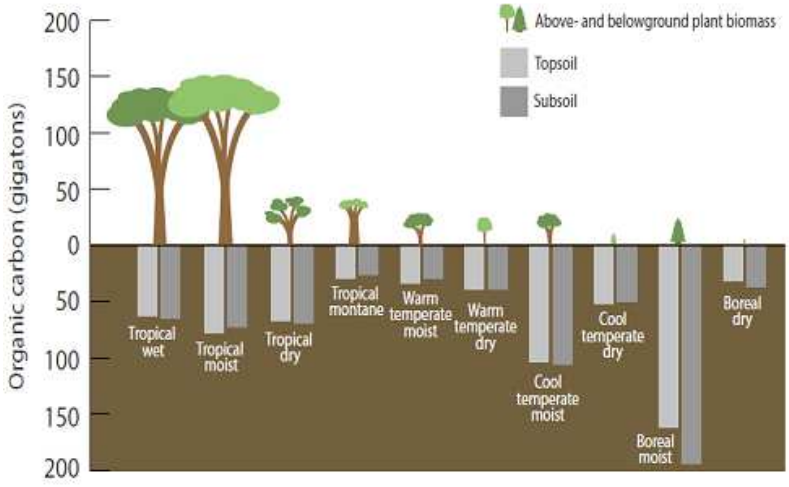

Figure 1: Organic carbon and its relation with plants (USDA, 2017)

Figure 1: Organic Carbon and Its Relation with Plants (USDA, 2017).

The Relation between Organic Matter and Carbon Dioxide

The soil has dead life forms and natural issue, disintegrating into dark humus. In field (Prairie), the dim shade of the layers with which it brings supplements and high ripeness. Somewhere down in the dirt, the natural shade covers the dirt surfaces, making it darker than the shading inside. Humus shading diminishes with profundity and iron colors become clearer. In

forested territories, natural issue (leaves, needles, pine cones and dead creatures) aggregate at the highest point of the dirt. Water-solvent carbon goes down through the dirt and disperses portions of humus and iron that development underneath it in soggy dark groups on scoured iron bars. Frequently, a white layer, for the most part quartz, happens between the natural issues on a superficial level where the shades have been expelled. (USDA, 2000).

Carbon Sequestration

The average surface temperature of the Earth has expanded by 1.3 degrees Fahrenheit over the previous century, and the Intergovernmental Panel on Climate Change (IPCC) is required to increment by an extra 3.2 to 7.2 degrees through the span of the 21st century. These apparently minor changes in temperature can effects ranchers and farmers. As indicated by the EPA (Environmental Protection Agency), the normal temperature can build: the developing season in the areas with the spring and pre-winter seasons can be generally cold. Contrarily influence crops in regions where summer heat limits creation; expanded soil vanishing rates; and expanded odds of serious dry spell (Schahczenski and HillP, 2009). Natural frameworks of creation increment the degrees of natural issue in the dirt using fertilizer compost and yield inclusion. Natural cultivating frameworks likewise dispense with emanations from the creation and transport of manufactured composts. Natural cultivating parts can be actualized with other manageable horticultural frameworks, for example, protection culturing, to improve the probability of relieving the impacts of environmental change. Instances of practices that lessen CO2 emanations, increment soil carbon direct seeding, field wind breaks, rotational nibbling, perpetual feed crops, low summer squander and legitimate straw administration. The utilization of high return harvests or assortments and augmenting yield potential can likewise expand soil carbon (Schahczenski and HillP, 2009). Figure 2 beneath shows the worldwide CO2 barometrical focuses for the years 1959 to 2019.

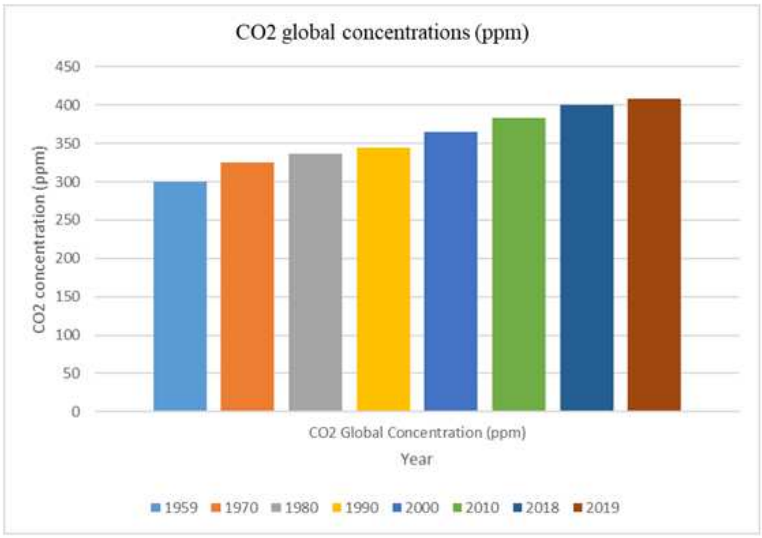

Figure 2: CO2 Concentrations in (ppm) for Different Years. Source: Noaaesrl (2019).

Figure 3 shows the CO2 emissions distribution by sector.

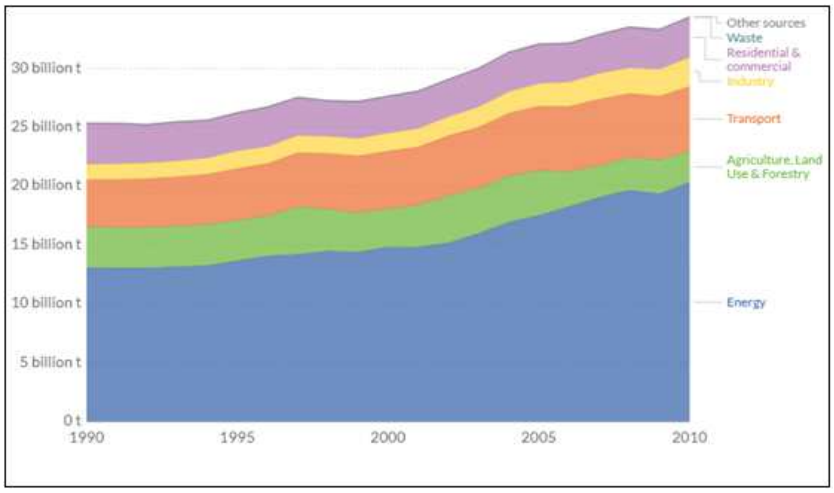

Figure 3: Carbon Dioxide Emission by Sector in the World (tonnes/year) (Source: Food and Agriculture Organization of the United Nations (Source: FAO, 2017).

CO2 Concentrations in Kuwait

On a CO_2 basis, most of discharges from horticulture are related with methane radiated during the residential domesticated animals' enteric maturation process, about 2.5 Gigagram (Gg), or 80% of farming emanations. Remaining outflows are related with nitrous oxide discharges from soils, about 0.03 Gg, or 14% of farming emanations. This modest quantity is because of manure contributions (about 60%) and the funds to be paid to aberrant nitrous oxide outflows related with filtering and spillover. Figure 4 shows the CO_2 emanations in Kuwait in 1994 by parts and movement.

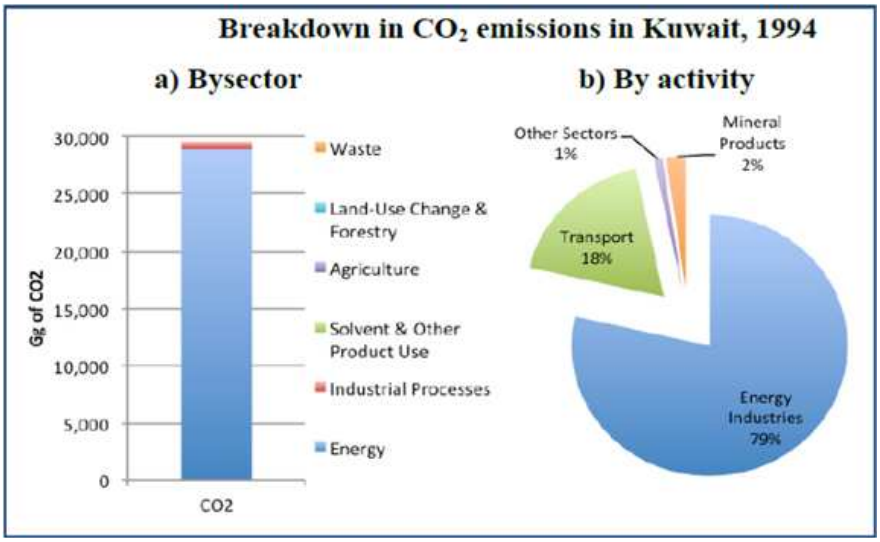

Figure 4: Carbon Dioxide in Kuwait in 1994.

Table 1 shows the growth of CO2 and other emissions in percentage /year in Kuwait by sectors.

Table 1: Growth of CO2 and Other Emissions in Percentage /Year in Kuwait by Sectors

Parameter		Units	Natural gas	Liquid fuels	Gasoline	LPG	Diesel	Kerosene	Lubricants	Electricity
Growth, 1994-2020		%/year	7.8%	2.6%	4.1%	3.8%	9.9%	5.3%	2.5%	7.0%
GHG emission factor	CO_2	tonne/TJ	55.78	76.5	68.56	17.2	73.28	70.736	36.275	NA
	CH_4	kg/GJ	0.1 - 6	0.9	0.012	0.001	0.004	0.002	2	NA
	N_2O	kg/GJ	<0.001	0.3	0.003	0.003	0.002	0	0.6	NA
Pollutant emission factor	NO_x	kg/GJ	190-250	73.9	0.222	0.148	0.677	0.29	200	NA
	CO	kg/GJ	18-46	15	4.833	0.326	0.319	0.12	10	NA
	NMVOC	kg/GJ	0	0	0.932	0.410	0.107	0.018	5	NA
	SO2	kg/GJ	<0.001	512.8	0.0	0.0	0.0	0.0	0.0	NA

The flux of CO2 diffused from the soil can be calculated by modified Fick's first law of diffusion:

$$F = -\rho D_0 \xi \left(\frac{T}{T_0}\right)^{1.75} \left(\frac{P}{P_0}\right) \frac{dC}{dz} \quad (1)$$

Where F is the mass flux (kg/m.s) of CO_2, ρ is the density of air ($kg.m^{-3}$), and (dC/dz) is the relative CO_2 concentration (dimensionless) at depth z (m) in the soil (the slope or gradient), D_a (m^2/s) is the CO2 diffusion coefficient in free air and ξ (m^3/m^3): is the tortuosity factor. While Where T is the air temperature (K), P is the air pressure in (Pa), D0: is the reference value of CO2 diffusion at T_0=293.15 K and P_0 of 1 bar ($1.013x10^5$). The value of D_0 is equal to $1.47x10^{-5}$ m^2/s (Jones, 1992 and Roland et al., 2015).

The air density in Kuwait and other regional areas at gulf and Middle East was changed because of global warming and climate change which is originally related to the increase of CO_2 emissions increase and D_s is the diffusion coefficient. Figure 5 shows the effects of climate change in increasing average annual atmospheric temperature in Kuwait for different years.

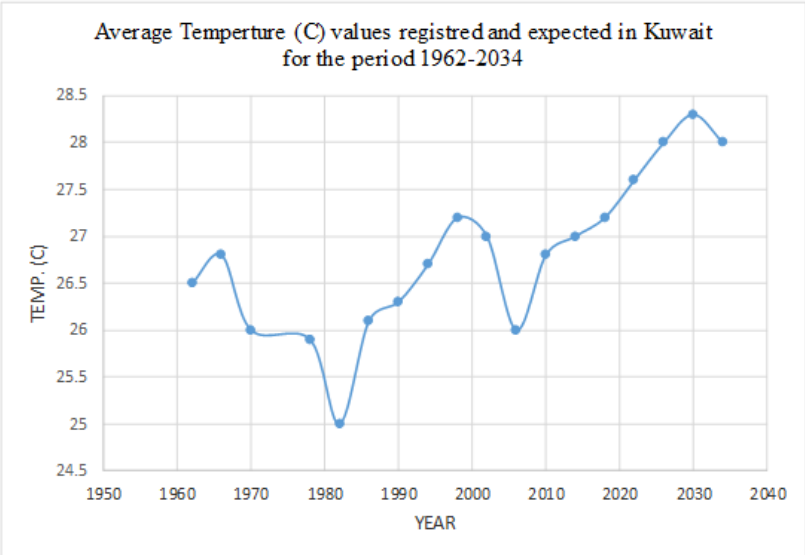

Figure 5: The Projected Average Annual Temperature Variation for the Years 1962-2035.

Also the global warming and climate changes effect on the rainfall in Kuwait, figure 6 shows such effects.

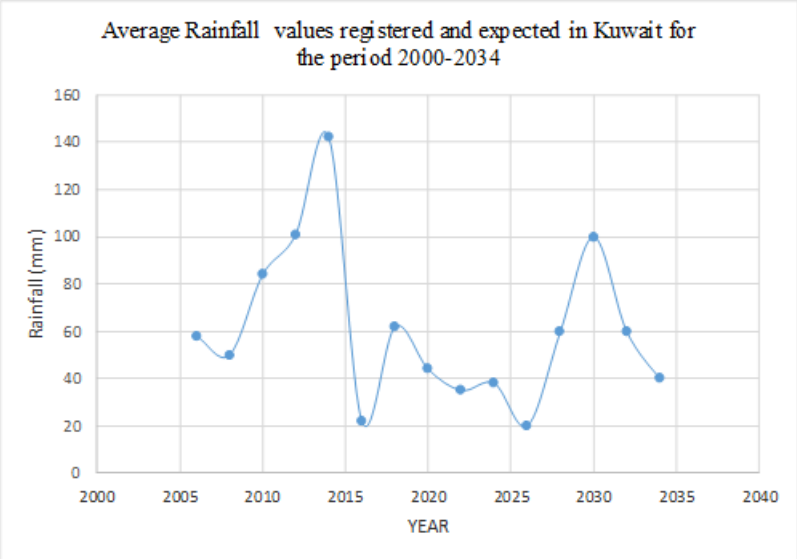

Figure 6: Rainfall Variation in Kuwait Caused by Climate Change and CO2 Emissions.

RESULTS AND DISCUSSION

The effects of temperature variation caused by climate change in Kuwaiti environment effects on the CO2 mass flux from organic soil system to air, figure 7 show the effects of temperature increase on the CO2 emissions in Kuwait.

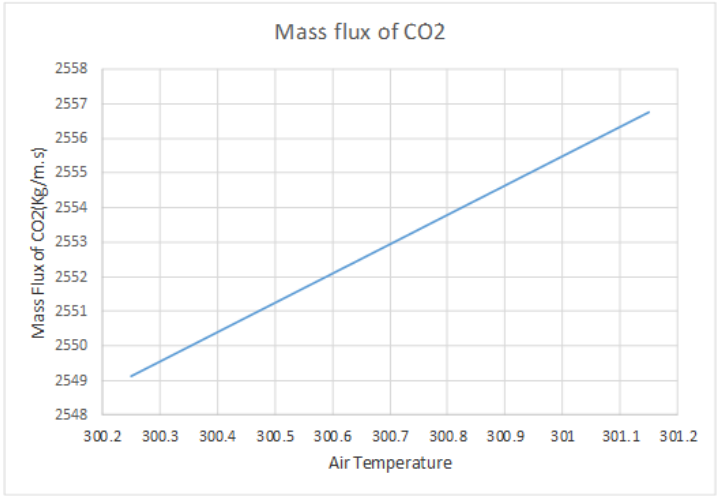

Figure 7: Effects of Increase in Temperature in Kuwait because of Climate Changes on CO2 Flux.

Figure 8 shows the effects of Carbon –depth of soil gradient of soil organic materials on CO2 flux.

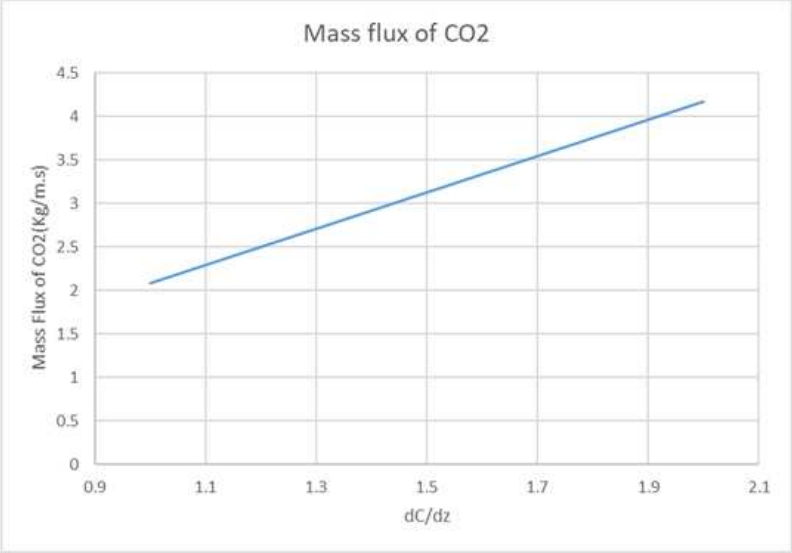

Figure 8: Mass Flux of CO2 vs. Carbon-Depth Slope.

CONCLUSION

This paper focused on examination of the variables influencing on expanding the natural substances thus the grouping of CO2 in both climate and soil-air frameworks, there are numerous elements doing so like: Cover yields to give soil spread to lessen vanishing, disintegration and spillover, lasting grasses to include over the-ground just as beneath the-ground biomass, vegetables for green compost purposes. Planting crops plants that produce more noteworthy biomass. Consolidation of straw yield buildups. Decreased culturing to limit soil carbon misfortunes and to hinder natural issue - disintegration forms. Use of composts on spread yields and vegetables to create more biomass. Use of compost, plant material or other carbon-rich waste. Using search by touching as opposed to collecting. Gives carbon and vitality source to soil microorganisms. Preservation, natural creation, spread development and yield revolution can essentially build the measure of carbon put away in the dirt. Sending a source or sink of CO2 will rely upon the connection between land use, time, temperature, Soil dampness, the board and substance and physical properties of soil. A few examinations have announced positive relationships to expanded CO2 outflows with an expansion in temperature and soil dampness. CO2 delivered from enzymatic exercises of microscopic organisms and parasites during hydrolysis which influences the heterogeneous breath of Soil which may differ as indicated by temperature, soil dampness and accessibility of natural issue. It is discovered that expanding CO2 emanations have a significant commitment in worldwide worming marvel.

REFERENCES

1. *Allman M., Jankovský M., Messingerová V., Allmanová Z. (2016). Changes of carbon dioxide concentration in soils caused by forestry machine traffic. Forestry Journal (62) (1).pp:23-28.*
2. *Berg B, Hannus K, Popoff T, Theander. (1982). Changes in organic-chemical components during litter decomposition. Long-term decomposition in a Scats pine forest. I. Can J Bot 60:1310-1319.*
3. *Brady N. (1974). The nature and properties of soils. 8th Ed. MacMillan Publishing Co. Inc., New York*
4. *Cheng W., and Johnson D. (1998). Elevated CO2, Rhizosphere processes, and soil organic matter decomposition. Plant and Soil 202: pp:167–174.*

5. *Costa E., Souza M., Marrocos P., Dan Lobão D., and Silva D. (2018). Soil organic matter and CO2 fluxes in small tropical watersheds under forest and cacao agroforestry). PLoS ONE 13(7).*
6. *NDSU. 2009. Soil Organic Matter and its Benefits. By: Dave Franzen and Ann-Marie Fortuna.*
7. *Raich J.W, Potter C.S, Bhagawati D. (2002). Inter-annual variability in global soil respiration 1980-94. Global Change Biology 8: 800–812.*
8. *Schahczenski J. and HillP H. (2009). Agriculture, Climate Change and Carbon Sequestration. NCAT.*
9. *St. Joseph, Michigan. (1970). The Exchange of Carbon Dioxide between the Atmosphere and the Plant James L. ASAE (Vol. 13, No. 2, pp. 238 and 239, 1970) Published by the American Society of Agricultural Engineers.*
10. *Theresa B. (1994). Carbon Storage and Carbon-To-Organic Matter Relationships Of Three Forested Ecosystems Of The Rocky Mountains. Master thesis, College of Graduate Studies, University of Idaho.*
11. *Torbert H., Rogers H. Prior S., Schlesinger W., and Runion G. (1997). Effects of elevated atmospheric CO2 in agro-ecosystems on soil carbon storage Global Change Biology (1997) 3, 513–521.*
12. *USDA. (2000). the color of soil Adapted by: Lynn, W.C. and Pearson, M.J.*
13. *USDA. (2011). Carbon to Nitrogen Ratios in Cropping Systems.*
14. *USDA. (2017). Considering Forest and Grassland Carbon in Land Management.*
15. *USDA-NRCS soil organic matter.*
16. *Marilyn Roland, Sara Vicca, Michael Bahn, Thomas Ladreiter-Knauss, Michael Schmitt, and Ivan A. Janssens (2015). Importance of non-diffusive transport for soil CO2 efflux in a temperate mountain grassland. Journal of Geophysical Research: Biogeosciences, 120, 502–512.*